



Augmented Reality-Based Lactic Acid Bacteria Diversity Flash Card Traditional *Pakati'ng Rape'* Food

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Abstrak

Dampak revolusi industri 4.0 terhadap pendidikan adalah memposisikan pendidikan untuk pembelajaran modern. Pembelajaran modern tentunya harus melibatkan media pembelajaran yang dapat mengoptimalkan proses pembelajaran. Penelitian ini bertujuan mengembangkan media flash card keanekaragaman bakteri asam laktat makanan tradisional *Pakati'ng Rape'* berbasis augmented reality. Penelitian ini menggunakan metode *research and development* (R&D) dengan model pengembangan Alessi dan Trollip serta melibatkan 9 orang validator untuk memvalidasi media pembelajaran flash card. Instrumen penelitian ini menggunakan lembar validasi yang terdiri dari lembar validasi bahasa, lembar validasi media dan lembar validasi materi dengan teknik analisis kuantitatif. Untuk uji kepraktisan terdapat instrumen angket respon siswa. Hasil dari penelitian ini adalah pengembangan media flash card keragaman bakteri asam laktat makanan tradisional *pakati'ng rape'* berbasis augmented reality sudah dinyatakan layak dengan rata-rata 90,39% (sangat praktis). Berdasarkan hasil respon siswa, rata-rata wa 79% (praktis) pada tes skala kecil dan 80% (praktis) pada tes skala besar. Media flash card keragaman bakteri asam laktat makanan tradisional *pakati'ng rape'* berbasis augmented reality agar valid dan praktis sehingga dapat digunakan dalam pembelajaran.

Kata Kunci: Kartu Flash, Augmented Reality, Mikrobiologi, Makanan Fermentasi Lokal, Bakteri Asam Laktat

Abstract

The impact of the Industrial Revolution 4.0 on education is to position education for modern learning. Modern learning must certainly involve learning media that can optimize the learning process. This study aims develop flash card media of lactic acid bacteria diversity of traditional food *Pakati'ng Rape'* based on augmented reality. This research uses a research and development (R&D) method with the Alessi and Trollip development model and involves 9 validators to validate flash card learning media. This research instrument uses validation sheets consisting of language validation sheets, media validation sheets and material validation sheets with quantitative analysis techniques. For the practicality test, there is a student response questionnaire instrument. The results of this study are the development of flash card media diversity of lactic acid bacteria traditional food *Pakati'ng Rape'* based augmented reality has been declared feasible with an average of 90.39% (is very practical). Based on the result of student responses, the average wa 79% (practical) in the small-scale test and 80% (practical) in the large-scale test. Flash card media diversity of lactic acid bacteria tradisional food *Pakati'ng Rape'* based on augmented reality to be valid and practical so that it can be used in learning.

Keywords: Flash Cards, Augmented Reality, Microbiology, Locally Fermented Foods, Lactic Acid Bacteria

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1. INTRODUCTION

The development of the 21st century is characterized by the rapid development of science and technology. One of the goals of education in the 21st century is to encourage students to have the skills to be responsive to rapid changes and in line with the times (Andriani et al., 2021; Bosica et al., 2021). The impact of the Industrial Revolution 4.0 on education is to position education for modern learning. Modern learning must certainly involve learning media that can optimize the learning process (Fatmawati et al., 2021; Shahroom & Hussin, 2018).

The situation that occurs in the field, based on the results of observations made at SMA Muhammadiyah 1 Pontianak, is that the learning process has used modern and varied media such as PPT (Power Point), LKPD (Learner Worksheet), package books, the use of the

internet to find information, and e-modules. However, the school has never done augmented reality-based learning. Augmented reality is a simulation that is a combination of the virtual world and the real world created by computers (Ibáñez & Delgado-Kloos, 2018; Utami, 2021). Previous research has shown that the use of augmented reality can optimize the learning process (Fakhrudin & Kuswidyanaro, 2020). This can be seen from the results of the pre-test and post-test, which reached a value of around 95%, which indicates that augmented reality-based learning is favored by students (Aprilinda et al., 2020). To help support the use of augmented reality in learning, it needs to be combined with minimalist print media such as flash cards. Flash cards are one of the print media resulting from technology that contain images or text related to concepts. There are advantages to flash card media, including being practical and concrete in nature so that it is easy to remember, overcoming space and time limitations in conveying material, clarifying problems, and being easy to carry everywhere (Febiola & Yulsyofriend, 2020; Utami, 2021).

One of the materials in class X Biology that can be applied to augmented reality-based flash card media is biodiversity. This is based on the results of previous interviews, which show that the material has been delivered but is limited to the utilization of local potential. Thus, the previous teaching materials can be developed into an introduction to the characteristics of lactic acid bacteria in fermented local fruits. The fermented local fruit is *Pakatik'ng Rape*, commonly called Kelampai fruit (*Elateriospermum tapos*).

Augmented reality-based flash card media in the context of biodiversity refers to using technology that superimposes digital content (such as images, videos, or 3D models) onto real-world environments to create interactive flashcards that enhance learning about biodiversity (Halili, 2019; Suh & Prophet, 2018). Biodiversity is the variety and variability of life on Earth, encompassing all living organisms and their interactions within ecosystems. Augmented reality (AR) can be a powerful tool to engage learners and improve their understanding of complex concepts like biodiversity (Aprilinda et al., 2020; Fakhrudin & Kuswidyanaro, 2020). Augmented reality flashcards can turn static images of plants, animals, and ecosystems into interactive 3D models or animations. Students can explore the virtual models from different angles, observe intricate details, and interact with the elements, making the learning experience more engaging and memorable.

Based on the description researchers are interested in making new innovations by developing learning media. Flash Card: Diversity of Lactic Acid Bacteria in Traditional Food *Pakatik'ng Rape'* Based on Augmented Reality Class X SMA Muhammadiyah 1 Pontianak This study aims to develop media-based Flash Card Diversity of Lactic Acid Bacteria in Traditional Foods *Pakatik'ng Rape'* based augmented reality.

2. METHODS

This research uses a research and development (R&D) method with the Alessi and Trollip development model. This model consists of three stages: planning, design, and development. The quality of multimedia is measured by conducting validity and practicality tests (Jaiz et al., 2022). This research involved nine validators. The research instrument used a questionnaire in the form of statements related to material content, media presentation, and language. The validation assessment uses a Likert scale with criteria 1–5, with categories 1) not good, 2) less good, 3) good enough, 4) good, and 5) good. The data to be used is quantitative descriptive analysis to determine the feasibility of the media developed after being validated by experts and practitioners. Learning media is categorized as feasible to use if the percentage of validation test results by validators is more than 62% (Renita et al., 2020). The categories of learning media feasibility criteria are described in Table 1.

Table 1. Criteria for Feasibility of Learning Media

Percentage (%)	Criteria
81 – 100	Very Valid
62 – 81	Valid
43 – 62	Quite Valid
33 – 43	Less Valid
0 - 33	Very less Valid

The next step after validation is the practicality test with a student response questionnaire. Student response is a student response to the media developed (Megananda et al., 2018; Simanjuntak & Imelda, 2018). The percentage of student responses can be interpreted in Table 2.

Table 2. Criteria for Interpretation of Student Response Scores

Percentage (%)	Criteria
81 – 100	Very Practical
61 - 80	Practical
41 - 60	Quite Practical
21 – 40	Less Practical
0 - 20	Very less Practical

3. RESULTS AND DISCUSSION

Result

Researchers first determine the purpose of making media and prepare various elements that will be used to develop learning media. The front-end analysis is carried out by interviewing the teacher of the field of study (biology). This phase aims to identify fundamental problems in biology learning. Based on observations made at SMA Muhammadiyah 1 Pontianak, the learning process has used modern and varied media such as PPT (Power Point), LKPD (Learner Worksheet), package books, the internet to find information, and e-modules. However, the school has never done augmented reality-based learning. So that the use of media that will be developed will be a new innovation for class X students of SMA Muhammadiyah 1 Pontianak, especially in biodiversity material. After analyzing the front end, proceed with concept analysis.

Concept analysis is used to analyze the teaching materials to be used. One of the materials in class X Biology that can be applied to augmented reality-based flash card media is biodiversity. This is based on the results of previous interviews, which show that the material has been delivered but is limited to the utilization of local potential. Thus, the previous teaching materials can be developed into an introduction to the characteristics of lactic acid bacteria in fermented local fruits. The fermented local fruit is *Pakatik'ng Rape*, commonly called kelampai fruit (*Elateriospermum tapos*).

The design stage are including all of the ideas, content development, and material decisions that come out of the planning stage. The steps taken at this stage are isolation and characterization. Isolation aims to obtain a pure culture. The media used are selective media. Selective media are used to grow and maintain certain bacteria so as to select LAB with special properties. For the characterization of lactic acid bacteria in general, several tests are carried out, consisting of gram staining, endospore staining, catalase, and motility testing.

The results of macroscopic observation of bacterial morphology on NA media of bacterial colonies show that the bacteria are circular or round, have varying elevations,

namely flat and convex, the edges are smooth and regular lenticular-shaped, and have a beige and white color. These isolates are Lactic Acid Bacteria isolates because they have the special characteristics of a smooth surface and a round shape with flat edges is show on [Figure 1](#).



Figure 1. Lactic Acid Bacteria

Gram staining results showed that all lactic acid bacteria isolates have purple cells with a coccus cell shape. The purple color indicates that bacterial cells have a thick peptidoglycan layer that can help maintain the color of crystal violet during the decolorization process. Gram-positive characters are a common feature of lactic acid bacteria. The results of endospore staining using malachite green showed that the isolates were non-endospores because the cells were only colored red. Gram staining results and endospore staining is show in [Figure 2](#).



Figure 2. Gram Staining Results and Endospore Staining

Negative catalase test results are indicated by the absence of gel when the isolate is tested with H₂O₂. This indicates that lactic acid bacteria do not have catalase enzymes. Motility test results show that lactic acid bacteria isolates are non-motile. As seen from [Figure 3](#) the distribution of lactic acid bacteria colonies grown on semi-solid MRS media does not spread because the colonies do not have flagella. The non-motile nature is also a common characteristic of lactic acid bacteria.



Figure 3. Catalase Test Results and Motility Test Results

The contents of the media that have been made include the cover, instructions for use, learning objectives and indicators, SK and KD, biodiversity material, lactic acid bacteria material, a bibliography, and evaluation questions. While the application that will be used for its use in learning is the Assemblr Edu application: Learning Using Augmented Reality,

Augmented reality will display images of the material and research results and will display a barcode when scanned. Flash card format of lactic acid bacteria diversity in augmented reality-based *pakatink'ng rape* traditional food is show in Table 3.

Table 3. Flash Card Format of Lactic Acid Bacteria Diversity in Augmented Reality-Based *Pakatink'ng Rape* Traditional Food

Front Side	Back Side	Front Side	Back Side	Front Side	Back Side
1th card		2th card		3th card	
Front Side	Back Side	Front Side	Back Side	Front Side	Back Side
4th card		5th card		6th card	

The development stage of the Flash Card Media Feasibility Assessment is an activity to evaluate whether the developed module is feasible to implement. The feasibility of flash card media Diversity of Lactic Acid Bacteria in Traditional Foods: *Pakatink'ng Rape* Based Augmented Reality was assessed by nine experts who have expertise in biology and learning. There are three aspects that are validated, namely: media, material, and language aspects; each aspect is validated by three experts.

The results obtained from media validation are 94%, 79% for material experts, and 97% for linguists. This shows that the media Flash Card Diversity of Lactic Acid Bacteria Traditional Foods *Pakatink'ng Rape* Based Augmented Reality is worth using. Learning media is said to be feasible to use if the percentage of validation test results by validators gets a value of more than 62%. The results of the percentage acquisition are implemented using Figure 4.

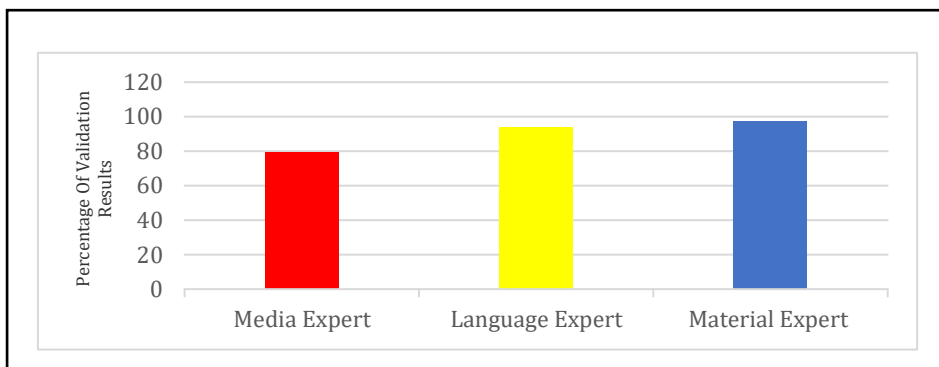


Figure 4. Media Validation Results Flash Card: Diversity of Lactic Acid Bacteria in Traditional Food *Pakatink'ng Rape*-Based Augmented Reality

The results of the data analysis of the large-scale student response questionnaire conducted on 31 students in class X, IPA 3, were 80.50%, meaning that the student response to the flash card media developed gave a positive response. The results of the percentage acquisition are implemented using Table 4.

Table 4. Percentage Results of the Small Scale Test and the Large Scale Test

No.	Indicator	Percentage (%)	
		Small	Large
1	Responses to the media flashcards of lactic acid bacteria diversity in traditional food <i>Pakatink'ng Rape</i> based on augmented reality	76.67	77.41
2	Responses to the material in the flashcard media of lactic acid bacteria diversity of traditional food <i>Pakatink'ng Rape</i> based on augmented reality	81.66	9.03
3	Responses to the cover flashcard of lactic acid bacteria diversity in traditional food <i>Pakatink'ng Rape</i> based on augmented reality	83.33	83.22
4	Responses to the display in the media flashcard: diversity of lactic acid bacteria in traditional food <i>Pakatink'ng Rape</i> based on augmented reality	80	82.89
5	Responses used in the Flash Card of Lactic Acid Bacteria Diversity of Traditional Food <i>Pakatink'ng Rape</i> Based on Augmented Reality	75	80.14
6	Responses to images, characters, writing, and colors on media flashcards of lactic acid bacteria diversity of traditional food <i>Pakatink'ng Rape</i> based on augmented reality	80	80.32

Discussions

The development product produced in this study is the Augmented Reality-based Flash Card of Lactic Acid Bacteria Diversity in Pakatik'ng Rape's Traditional Foods. The advantages of augmented reality-based flash card media include being able to optimize the learning process (Detha et al., 2019; Fakhrudin & Kuswidyanaro, 2020; Putri & Kusdiyantini, 2018), being practical and concrete in nature so that it is easy to remember, overcoming the limitations of space and time in delivering material, being able to clarify the problem, and being easy to carry everywhere (Rizanti et al., 2023; Utami, 2021). This development research procedure uses the Alessi & Trollip model by going through several stages, namely planning, design, and development (Jaiz et al., 2022; Latifah et al., 2020; Yolanda & Wahyuni, 2020).

According to previous study a positive response is obtained if the response questionnaire category shows more than 61%, so the media is said to be practical (Anisa & Mitarlis, 2020). After media validation is carried out, the second category is the practicality test. The practicality test was analyzed based on student responses using student response questionnaires. Student responses are students' responses to the media they developed (Ayuti et al., 2023; Rahayu & Setiadi, 2023; Siregar et al., 2014). According to previous study a positive response is obtained if the response questionnaire category shows a value of more than 61%, so the media is said to be practical if used in learning (Anisa & Mitarlis, 2020).

According to other study the analysis of student response questionnaires was carried out in small-scale trials and large-scale trials (Ibrahim, 2019). The results of the data analysis of the small-scale student response questionnaire were conducted on six students in classes X

IPA 1, X IPA 2, and IPA 3, which had previously been selected. The selection is based on the cognitive abilities of students at high, medium, and low levels. The small-scale test has three levels in its determination according to the cognitive abilities of students (Fallo et al., 2021; Susanti et al., 2018; Yusmarini et al., 2017).

The results of the student response presentation in the small-scale test amounted to 79.44%, meaning that the student response to the flash card media developed gave a positive response. The feasibility of flash cards is determined by a large-scale field trial, which is the final stage of learning media development. This is in line with previous research showing that one of the characteristics of lactic acid bacteria is the absence of endospores (Anindita et al., 2021; Fahmi et al., 2022; Yanti & Dali, 2013).

The implication of this research can help increase education and understanding of the microbial diversity involved in the manufacture of traditional foods. Using augmented reality flash cards can help students understand scientific concepts more visually and interactively. This research can be an example of how technology such as augmented reality can be integrated into the learning process. This can inspire educators and other educational institutions to adopt innovative technology in delivering subject matter. However, the results from this study may not be directly applicable to other contexts or to different traditional foods. The microbial diversity of traditional foods may vary from one culture or region to another.

4. CONCLUSION

The results of research on the development of media flash cards of the lactic acid bacteria diversity of traditional food *Pakatink'ng Rape* based on augmented reality have been declared feasible to use. Based on the results of student responses, the average score in the small-scale test and in the large-scale test can be said to be practical and feasible to use in learning.

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