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Development of Android-based Bimanji e-media for Innovation Learning Resources on Ecosystem Material

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Abstract

Background: *The rapid development of technology in the Industrial Revolution 4.0 era significantly affects various sectors, especially education. This research aimed to develop an innovative Android-based educational game, Bimanji (Biology Jumanji), as an interactive learning medium for ecosystem material in junior high school.* **Methodology:** *The study employed the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. The product was tested at Junior High School of Muhammadiyah 1 Surabaya. Data was collected through observations, interviews, documentation, and validation questionnaires by media, material, language, IT experts, and student and teacher responses. Bimanji integrates the concept of the popular Jumanji board game with interactive, contextual learning content, including 2D animation and multiplayer features.* **Findings:** *The content covers biotic-abiotic interactions, trophic levels, food chains, food webs, and ecological awareness. Validation results showed that Bimanji achieved a 92 % average validity score, indicating a high feasibility level without requiring significant revisions. Practicality tests with 16 students and teacher also resulted in high scores (93 % and 88 %, respectively), confirming its usability and effectiveness. The game enhances students' understanding of ecosystem concepts and motivation through fun and collaborative digital learning.* **Contribution:** *This research concludes that Bimanji is a highly valid, practical, and accessible educational medium suitable for classroom and independent learning. Limitations involve limited field trials and require broader implementation. Future development may integrate augmented reality to enrich the user experience further*

Keywords: *Android-based learning media; Bimanji; Ecosystem; Educational Game; Interactive Learning*

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INTRODUCTION

The development of rapid technology in the era of revolution industry 4.0, has significantly influenced various fields of life, especially in education

(Hasrul et al., 2020). Therefore, integration technology becomes essential in activity learning (Salim, 2022). Students now have wide access to various sources of information. Thus, transformation technology also triggers a shift in the method of thinking and social interaction, ultimately making participants more individualistic (Arvianto, 2023).

Learning Biology on matter ecosystem demands the ability of participants to understand concepts that are naturally abstract and cannot always be observed in a way directly, such as the interaction between creature life as well as channeled energy in chain food. The limitations method, which tends to the nature of textual and memorization, causes difficulty hooking phenomena with microscopic and symbolic representation (Andarini et al., 2013). Therefore, innovation is needed in the provision of source learning that is capable of facilitating understanding holistically. Development of learning media based on digital technologies, such as game educative Android, becomes an alternative strategy Because it can serve material visually, interactively, and contextually, contributing to the improved understanding of conceptual and motivational Study participants (Miftah, 2022).

Ecosystem material at the junior high school level includes understanding various levels of complex tropics, such as chain food, web food, and pyramid food. Still, it is often difficult for students because of its abstract nature (Taufiqa, 2017). Based on observations at Junior High School of Muhammadiyah 1 Surabaya, many students still do not understand the material optimally and show low learning motivation. This condition is worsened by the limited use of learning media by teachers, despite the availability of digital devices. Furthermore, previous science learning outcomes show that only 60% of students meet the minimum learning achievement targets in science subjects.The learning media used is Still dominated by student worksheet, so students are more interested in using gadgets for entertainment than learning. Tendita (2024); Meier (2012) suggest that media-based innovation of digital technology, such as Android educational games, is required to present material in an interesting way through animation and simulation, while also providing opportunities for easily accessible media development suited to the characteristics of modern learners.

Various studies previously supported learning media development based on technology, especially in education. Research Chemanji Malihah et al., (2021) has proven effective in increasing mastery of the material. Research Rianingtias (2019) shows that Android games can effectively visualize the draft ecosystem, while Lestari (2024) developing the Jumanji Board for the ecosystem, although limited Because only one unit is available. Limitations push the need for Android-based media that can accessed by Lots of students at once. Therefore, E-Media Bimanji was developed as an innovation that combines a draft Jumanji game with digital technology to increase understanding and motivation. Study students visually, interactively, and with fun.

METHOD

Study This is study development (Research and Development), which uses the ADDIE model, which consists of five stages: Analysis, Design, Development,

Implementation, and Evaluation. This model was chosen Because it is systematic, flexible, and developing learning media based on interactive technology. The product developed Sugiyono (2018) is Bimanji e-media, namely game media educative Android based designed to support learning material ecosystem for student class VII. This media is equipped with 2D animation and multiplayer features. The research was conducted from October 2024 to April 2025 at SMP Muhammadiyah 1 Surabaya. Research data is obtained from qualitative data derived from results observation, interviews, and documentation, while quantitative data covering results evaluation questionnaire validation given to expert validators in media, material, language, and IT, as well as questionnaire teacher and student responses that are aimed at for evaluating media appeal. The procedure study development of ADDIE is as follows:

Analysis

The analysis stage in a study aims to identify school problems before continuing to stage development. Analysis was done through observation and interviews with biology teachers for dig need, which will be e-media Bimanji Android-based. The results show that teachers and students need interactive learning media to support learning. Furthermore, it carried out an analysis of the characteristics of participant education, including aspects of understanding, background, and cognitive development. Data obtained show that Junior High School of SMP Muhammadiyah 1 Surabaya has applied an Independent Curriculum in first grade of class VII, student worksheet, and methods lectures Still dominate learning, and students tend to enjoy learning based on games and usage gadgets. This shows that motivation to Study biology students is Still low, and the available learning media is not varied enough. Based on the results, is done analysis media development is to produce valid, practical, and effective products, so that need developed game media Bimanji Android-based as an alternative innovative in support of learning biology.

Design

The design stage in the study aims to design an e-media Bimanji Android based compatible with need learning and support achievement objective learning. The design process started with analyzing the material ecosystem class VII, compiling objective knowledge by an Independent Curriculum, determining limitation materials, and developing draft games that include channel story, mechanics, and educational elements. The design consists of a flowchart, storyboard, interface creation, Attractive and friendly user (UI) users, and element-appropriate graphics with the theme ecosystemIn addition, instrument evaluations—such as validation sheets for expert validators and practicality questionnaires for teachers and students—are also compiled and validated, covering aspects such as clarity of language, relevance to learning objectives, ease of use, and suitability to student characteristics.This stage ensures that the media developed can bridge the gap in student's knowledge and skills through interactive and fun learning.

Development

After the stage design, the development process of Bimanji e-media Android is done by preparing the required materials and tools and compiling content games that

include questions, challenges, and scenarios related to the material ecosystem, which is equipped with supporting multimedia elements. Media development is done using the Unity Visual Studio platform, followed by functional tests and internal trials to ensure technical eligibility. Next, experts carry out a validation process. The validation involves material experts, media experts, language experts, and IT experts to evaluate aspects such as content, appearance, language, and technical media. A total of four validators are involved, each selected based on their academic qualifications, professional experience in education or instructional media, and relevance to the instrument being validated. Validation results give input in the form of comments, criticisms, and suggestions, which are used as base revision products. Validation ensures that e-media is developed to fulfill valid, practical, and feasible criteria before continuing to the limited and trial field trial phase.

Implementation

Implementation was done after the e-media Bimanji Android was declared valid and revised through trials limited to 16 students in class VII Junior High School of Muhammadiyah 1 Surabaya. The prosecution will observe students' interaction with media, identify technical constraints and complex understanding, and evaluate the instruments' clarity. The observation results and feedback received during the trial become the basis for media improvement to ensure content, language, and technical application can be understood and used optimally in learning.

Evaluation

Evaluation is the end goal for evaluating Bimanji e-media quality Android-based comprehensive, covering stages of analysis, design, development, and implementation. This stage is done by testing the validity of empirical to instrument assessment used during the trial limited. Items stated invalid based on empirical test results revised for increased quality instruments so that e-media is developed to become better and used correctly in context learning.

Instrument and Data Analysis

Data collection was carried out during compilation instruments and implementation assessment in class, including an interview open with the science teacher at Junior High School of Muhammadiyah 1 Surabaya, for analysis needs, as well as the feasibility and practicality test of Bimanji e-media Android based via questionnaire validation by experts materials, media, language, and IT, as well as response tests by teachers and students. Data analysis techniques include analysis validity and practicality using non-test instruments with a Likert scale assessment. Criteria validity and practicality refer to the category evaluation from Astuti et al., (2020), used to determine level eligibility and revision products to become a reference in e-media refinement before being used more carry-on in learning.

Table 1. Product Development Validity Criteria (Source: Astuti et al., 2020)

Validity Value Range (%)	Criteria and Conclusion
8 1.00% - 100 .00%	Very valid; the product can be used without revision
6 1.00% - 8 0.99%	Valid: The product can be used with minor revisions
4 1.00% - 6 0.99%	Less valid, the product can be used with many revisions
2 1.00% - 40.99%	Not valid; the product still needs intensive consultation
00.00% - 20.99%	Invalid, no can be used

Table 2. Practicality Criteria for Product Development (Source: Astuti et al., 2020)

Validity Value Range (%)	Criteria and Conclusion
82-100	Very valid; the product can be used without revision
63-81	Valid: The product can be used with minor revisions
44-62	Less valid, the product can be used with many revisions
25-42	Invalid: The product still needs intensive consultation

RESULT AND DISCUSSION

In research, this use method of R&D with the expected ADDIE model gets innovative and effective learning media products used in activity learning. Educational, challenging, and fun games can make students active in understanding material learning to increase motivation. In line with study of Nahampun et al., (2024). So it is necessary to use instructional Media in the form of e-media Bimanji Android-based to help convey the draft ecosystem in a way that is interactive, fun, and easily accessible, as well as supports learning. This media can also visualize the connection between component ecosystems like interaction organisms through engaging 2D animation.

Bimanji E-Media Display Design Android Based

At the stage of design, I designed channel games and visualizations beginning from Bimanji e-media Android-based, which aims to make it easier for students to understand the draft ecosystem. Design this covers the preparation of a flowchart that describes the channel logic game, starting from login and selection of characters to the interaction process in a game, like answering questions and steps on the board virtual games. In addition, storyboards are created to describe the appearance of the interface game in a comprehensive way, including menu display layout, colors, icons, animations, and interaction with the player with visual elements in the game. This media adapts a draft from the popular Jumanji game in the 1995 Jumanji

Febrianti (2021) adventure film but developed digitally and customized with content science learning on the material ecosystem.

The name of Bimanji is an abbreviation for Jumanji Biology, with challenges and questions arranged based on the topic of ecosystem. Unlike the version board, the whole component game Bimanji, like a board, dice, pawns, questions, and systems scores, is integrated directly into the Android application so that several players can simultaneously access it through each device. This makes the learning experience more flexible, collaborative, and fun for students (Haniko et al., 2023). The appearance prototype from the product board game Bimanji developed can seen in Figure 1. An all-over element game is integrated into digital applications without a physical component. It has four features, the main one resembling function cards on the game board: a card ask, a symbiosis card, and a resume card.

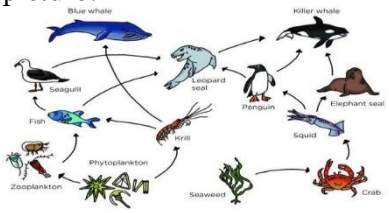
Figure 1. Bimanji Plot Line

Question Card

The card ask consists of 10 questions in the form of question descriptions, with a cognitive level range that varies from C1 (remembering) to C2 (understanding), C3 (applying), and C4 (analyzing), refer to the cognitive levels as outlined by Bloom's Taxonomy. The creation of these questions is aligned with the learning objectives to ensure that their development is consistent with the established standards. The indicator questions on the card are more religious than those on card symbiosis and resume cards: they mention components that are biotic and abiotic, analyze the impact of lost consumers, and identify differences and levels in chain food, net food, and pyramid food. Several indicator questions and questions on the card can seen in Table 3.

Figure 2. Question Card (in Indonesian Language)

Table 3. Question Indicators and Questions on Question Cards

No.	Question Indicator	Question
1.	Students can identify component abiotic factors that affect biotic.	Mention component abiotic factors that affect component biotic in an ecosystem!
2.	Students can analyze the impact of the disappearance of primary consumers.	What happens if primary consumers (e.g., grasshoppers) disappear from chain food? Explain the impact of chain food. 
3.	Students can identify the consumer level First in the picture.	What is the consumer level first in the picture? 

Card Symbiosis

Card symbiosis consists of 10 pieces of card symbiosis that contain questions based on draft connections between creatures. Card this functioning for stimulating thinking, the participant is educated through a short-shaped choice double, with cognitive level C3 (applying). When one player gets card symbiosis, questions will be displayed on the screen and read aloud to take turns. Other players are invited to discuss and answer based on knowledge and experience. In condition, this, games not only push understanding concepts but also train the ability to think critically and solve problems. The ongoing discussion process allows participants to educate each other, exchange ideas, develop arguments, and study from a corner view of friends and peers (Mardliyah et al., 2023). Activity

collaboration like this also supports social development skills, such as the ability to convey opinions, accept viewpoints, and maintain healthy participation in an atmosphere (Septiana & Fadhilah, 2024).

By involving element games in groups, participants are given opportunities to become peer tutors, which cannot directly strengthen their mastery of the material and improve their trust in themselves (Mukhlis, 2016). Using card symbiosis enriches the game's content and becomes a fun evaluative medium for measuring mastery material and forming character work equal and healthy competition. In preparation, questions must involve students' ability to study problems and link them to the concept that has been owned (Rohim, 2019). For the indicators questions and questions on the symbiosis card, see Table 4.

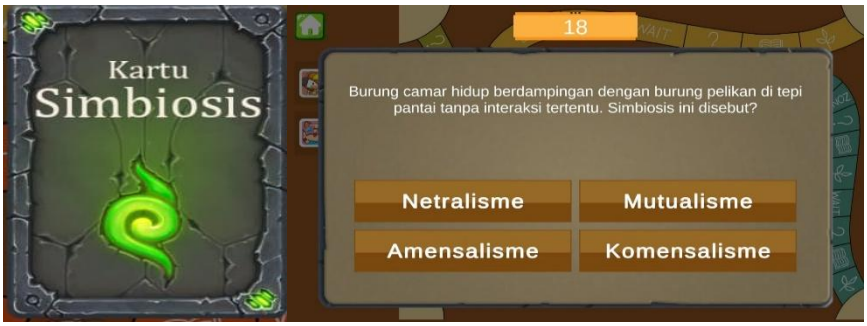


Figure 3. Card Symbiosis (in Indonesian Language)

Table 4. Question Indicators and Questions on Cards Symbiosis

No.	Question Indicator	Question
1.	Students can identify type symbiosis from example cases.	a. **Question**: A parasite living in a tree is its host, absorbing nutrition from the tree and harming the tree host. This is called symbiosis. b. **Options :** a. Mutualism b. Parasitism c. Commensalism d. Amensalism **Answer:** Parasitism c. **Question:** Bird storks live in the rice fields with sparrows without each other's influence. This is called symbiosis. d. **Options :** a. Mutualism b. Parasitism c. Commensalism d. Neutralism **Answer:** Neutralism

Resume Card

Resume tiles play a role as point pause reflective, allowing participants to read information about issues in the actual environment. When the player stops at the

square, they will obtain a resume card containing a summary of the Topic ecosystem in the form of an article short, infographic, or narrative descriptive. The material in the card not only covers the draft base ecosystem but also loads of examples like damaged reef coral, the release of wild orangutans, threats of invasive species, campaign subtraction of plastic, and diversity of Indonesian life. The resume plot invites participants to hook material lessons with the conditioning environment. The moment this expands the corner view, and from the beginning, the abstract becomes more contextual and meaningful. This feature also supports the formation of awareness of ecology and, at the same time, increases the ability to literacy information and skills to think critically through presentation text informative factual. Not only do resume cards function as a refresher in the middle competitive game, but they also provide an educational addition to the mark.

Figure 4. Resume Card (in Indonesian Language)

One of the feature supporters of Bimanji e-media Android is the main menu games, which consist of several parts, including information Bimanji, instructions, competence basic, material divided ecosystem become three sub-chapters, method play, games, and profile developer. This guide explains the maximum number of players (up to 4 people), how to start the game and plot games, and applicable provisions when players answer questions correctly or incorrectly. The game starts from the point each player begins, and the system controls the movement of virtual pawns. Dice automatically in the application. Every player will browse the track digital board up to the reach point center game, where wins can achieved if the challenge ends successfully.

The whole game process walks automatically in the system, so there is no need to manually role referee. Instead, answers and feedback come back directly displayed by the system based on the key database of the answer that has been integrated into the application. With this method, the game can progress in an independent, fair, and consistent way in evaluating all players. On the board game Bimanji, which is based on Android, a path must be passed through the typewriter player from square start to square finish. As for the type, the squares on the board game Bimanji Android-based can be seen on the table 5.

Table 5. Bimanji Plot

No.	Grid Image	Information
1	Start Plot	Players who occupy the plot are given 50 points.
2	 Question Box	Players who occupy the plot must answer correctly in the column description. If they are accurate, they get 20 coins. If they are wrong, they get minus five coins.
3	 Symbiosis Plot	Players who occupy the plot must answer the questions with multiple choice within 20 seconds. When successful, they get 10 coins; if they fail, they get minus five coins.
4	 Resume Plot	The player who occupies the plot must read information with a stern voice and get five coins minus three coins if it fails.
5	 Wait 4 or 6 plot	Players who occupy this plot can play until other players get number 4 or 6 to shake the dice.
6	 Blank Plot	Players who occupy the plot must return to start.
7	 Resonance Plot	Players who occupy the plot can choose a card or anything and get 20 coins.
8	 Finish Plot	The player who occupies the plot gets 100 coins.

Bimanji E-Media Validation Results Android Based on Ecosystem Material

Validation tests are done to evaluate conformity instruments used , analyze conformity products with the material ecosystem, media design, language, and technical aspects, and measure excess products produced. Fuada (2015) E-learning media Bimanji Android-based has been developed and validated by four validators: expert material, media expert, expert language, and IT experts. Validation uses a questionnaire assessment based on indicator eligibility content, appearance interface, language, and technical functionality. Based on the questionnaire given, the results are evaluated using the total average taken. Products declared valid by experts are then revised by input to ensure media eligibility before being used in trial limited and field. Bimanji e-media validation results are shown in Table 6.

Table 6. Recapitulation of Bimanji E-Media Validation Results Android-Based

Validator Category	Presentation Validation	Category
Media Expert	92%	Very valid, without revision
Subject Matter Expert	85%	Valid, with revision small
Linguist	90%	Very valid, without revision
IT Expert	100%	Very valid, without revision
Total Average	**92%**	Very valid, without revision

Bimanji E-Media can made into an alternative learning ecosystem. In addition, Bimanji e-media uses the Jumanji game, which is a social game because it creates interaction between players and improves soul competition (Wijayanto et al., 2024). Research conducted Prayoga, (2019) discusses the Jumanji game on the material ecosystem that can increase motivation among study students. In addition, games can also be used in a way that is independent outside activity learning. Research Malihah et al., (2021) also proves that Chemanji media based on board Jumanji games on material chemistry can increase students' understanding of the material. The game board presents an experience of interesting and fun learning in breakdown problems. According to research, Rianingtias (2019), game education is effective in Android based on a visualized draft ecosystem. Research conducted by Lestari (2024) explains that the Jumanji Board game media for a material ecosystem can increase the understanding of material students.

An average of 92% was obtained from the validation test results. Shows that e-media learning Bimanji is Android-based and very valid. According to Astuti et al., (2020) if the score mark validity ranges from 81% - to 100%, then the product is very valid and can used without existing revision. Based on the research results, the e-media Bimanji Android is worth using as a learning medium interactive on the material ecosystem, both within the class and as independent teaching materials. This media has gone through stage validation and gotten constructive input from experts, who later made it into the base of the revision process to increase the quality of the products.

Bimanji E-Media Practicality Test Results Android Based on Ecosystem Material

Implementation stage in study development: This includes a small-scale trial group, which was carried out on 16 participants educated in class VII Junior High School of Muhammadiyah 1 Surabaya. This stage aims to evaluate the practicality of Bimanji media in the learning process material ecosystem. In addition, the stage evaluation is formative in every development phase to perfect media-based input from users and experts.

Data collection techniques were carried out through questionnaire practicality spread to participant students and teachers. The questionnaire is designed based on indicator practicality Nieveen (1999), which includes convenience usage, clarity of instructions, understanding of materials, and efficiency in supporting learning. The questionnaire for participants focuses on aspects of attraction media display, clarity navigation, flow games, and understanding material obtained after using media. That questionnaire for teachers includes aspects of convenience in the implementation of

media in class, suitability with curriculum, media potential in the increasing involvement of students, and efficiency of time and resources power.

Table 7. Recapitulation of Response Results Students in Small Group Trial

Respondents	Amount	Percentage (%)	Category
1	47	94	Very valid
2	46	92	Very valid
3	48	96	Very valid
4	47	94	Very valid
5	43	86	Very valid
6	50	100	Very valid
7	46	92	Very valid
8	46	92	Very valid
9	43	86	Very valid
10	47	94	Very valid
11	44	88	Very valid
12	49	98	Very valid
13	48	96	Very valid
14	44	88	Very valid
15	49	98	Very valid
16	45	90	Very valid
Total	**742**	**93**	**Very valid**

Table 8. Recapitulation of Teacher Response Results

Aspect	Percentage (%)	Category
Convenience in media implementation	90	Very practical
Media suitability with curriculum	90	Very practical
The potential of media to increase the involvement of student	80	Very practical
Efficiency time and resources Power	90	Very practical
Total	**88**	Very practical

Based on the results of data analysis, an average practicality score of 93% of participants indicates that the e-media Bimanji was rated as very interesting and easy to use. It supports a practical understanding of the material ecosystem. As for the results, the questionnaire practicality from the teacher, with 1 teacher involved as a respondent, shows a score of 88%, which also includes the category of being convenient. This indicates that e-media Bimanji is not only in accordance for used by students in a way independent but is also effectively applied in context classroom learning.

According to Astuti et al., (2021), a learning medium is efficient if a score percentage ≥ 81% is obtained, indicating that the media is easy to use, efficient, and appropriate for the learning needed. The test results show that the e-media Bimanji

Android-based meets the practicality criteria and is good from the perspective of participants and teachers.

Furthermore, participants' height score attraction shows that this media is capable of creating interactive and fun learning. This aligns with the opinion of Anggreini et al., (2024) that media-based games can increase participants' involvement, build interaction between players, and raise motivation and the spirit of constructive competition in learning. Therefore, e-media Bimanji is worthy of scaling more areas at the trial stage for field use to obtain media effectiveness data.

CONCLUSION

Based on the research results, the e-media Bimanji Android stated very valid and practical as a learning medium interactive on the material ecosystem. With a score average validation of 92 % and practicality of 93 % of students and 88 % of teachers, Bimanji proved capable of increasing the understanding and motivation of study students in a significant way. The advantages of this media lie in the visualization draft ecosystem through 2D animation, multiplayer features, and an engaging and contextual educational game approach. Although this, the limitations study is in the trial scope, which is still limited. Therefore, it is recommended that testing be done on a larger scale and that the development of augmented reality features for an immersive experience be considered. Studying students becomes more deep and enjoyable.

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