

Development and Feasibility of BIOSTACKO, a Game-Based Biology Learning Media Integrating Religious Values for Biodiversity in Senior High School

Early Deswita Uzla^a, and Achmad Ali Fikri^b

^{a,b}Department of Biology Education, Faculty of Tarbiya, UIN Sunan Kudus

ABSTRACT

This study aimed to develop BIOSTACKO, a game-based biology learning media integrating religious values for biodiversity material in senior high school, and to determine its feasibility and practicality. The study employed a Research and Development (R&D) approach using the 4D model, which includes define, design, develop, and limited disseminate stages. The product was validated by a material expert, a media expert, and a religious expert, and its practicality was assessed through responses from one biology teacher and students in a limited classroom trial. The validation results showed that BIOSTACKO obtained scores of 97% from the material expert, 88% from the media expert, and 95% from the religious expert, indicating that the product was highly feasible. The practicality test showed scores of 98% from the teacher and 92% from students, indicating that the media was highly practical for classroom use. These findings suggest that BIOSTACKO is a feasible and practical alternative learning media for biodiversity material that may support student engagement, conceptual understanding, and the integration of religious values in biology learning.

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Introduction

Biodiversity is one of the important topics in biology learning because it requires students to distinguish levels of diversity, relate concepts to real examples, and develop observational understanding in real contexts. In practice, however, learning biodiversity is not always carried out effectively. Based on interviews with a biology teacher at SMA Negeri 2 Bae Kudus, grade X students still experienced difficulty distinguishing genetic, species, and ecosystem diversity. During observation-based learning, some students were also less focused, tended to follow their peers, and had not yet shown optimal individual responsibility in completing observation tasks. These conditions indicate that biodiversity learning still requires more structured, interactive, and student-centered support.

One factor contributing to this condition is the limited use of varied and interactive learning media. Learning media have an important role in helping teachers deliver messages, making abstract concepts easier to understand, and increasing student attention and participation during the learning process (Mukarromah & Andriana, 2022). However, classroom practice in this study context showed that the media used were still dominated by PowerPoint and one-way videos, which tended to position students as passive recipients of information. As a result, direct observation activities were not always supported by media that could guide students toward systematic conceptual understanding. This is relevant to broader concerns that monotonous teaching approaches can reduce student motivation and engagement in learning (Reni et al., 2024).

Game-based learning offers a potential alternative to address this problem because it creates a more active, participatory, and enjoyable learning environment (Whitton, 2012; Greipl et al., 2020). Previous studies have shown that game-based learning can support student engagement and improve learning experiences in science learning (Safitri et al., 2025). In biology learning, game-based approaches have also been reported to support student creativity and learning participation (Jayantika & Putri, 2023; Putri & Jayantika, 2022). In addition, educational games can increase students' interest and enthusiasm because they are directly involved in meaningful activities during the learning process (Sholeh, 2024). These findings indicate that game-based learning media have considerable potential to support biology learning, especially for topics that require active conceptual understanding such as biodiversity.

Studies on stacko-based learning media have also shown promising results. Uno Stacko media in physics learning was reported to have good validity, while bioedutainment-based Uno Stacko Biology media was also developed to support problem-solving in biodiversity learning (Kumala et al., 2020; Sifa et al., 2024). Nevertheless, previous studies have not

clearly combined several important aspects in one product, namely biodiversity concept learning, guided observation support, integration of religious values, and alignment with more meaningful student-centered learning. Therefore, the contribution of BIOSTACKO lies not only in the use of a stacko game format, but also in the integration of question cards, challenge cards, observation support, and religious-value reinforcement in one biology learning medium.

BIOSTACKO (Biology Stacko) was developed as a game-based biology learning media for biodiversity material in senior high school. The media consists of game blocks, question cards, challenge cards, QR code-based instructions, and supporting components designed to encourage conceptual understanding and active student participation. The integration of religious values is intended to strengthen not only cognitive understanding but also student character and reflection in relation to environmental conservation. In this way, BIOSTACKO is expected to function as an engaging and practical learning medium for biodiversity learning.

Based on this background, this study aimed to develop BIOSTACKO as a game-based biology learning media integrating religious values for biodiversity material in senior high school and to determine its feasibility and practicality for classroom use.

Methods

This study employed a Research and Development (R&D) method to develop BIOSTACKO, a game-based biology learning media integrating religious values for biodiversity material in senior high school. R&D was selected because this study was intended not only to design a learning product, but also to examine its feasibility and practicality before classroom use. The development procedure adopted the 4D model, which consists of four stages: define, design, develop, and disseminate (Nursyamsi, 2025).

The study was conducted at SMA Negeri 2 Bae Kudus. The initial needs analysis involved a biology teacher who provided information about classroom learning conditions, especially the difficulties experienced by grade X students in learning biodiversity. The product validation stage involved three validators, namely a material expert, a media expert, and a religious expert. After expert validation and revision, the practicality of the product was examined through limited trials involving one biology teacher and students of class X-E1. These respondents were selected because the product was intended for use in grade X biodiversity learning.

Define Stage

The define stage aimed to identify learning problems and determine the basis for product development. At this stage, unstructured interviews were conducted with the biology teacher to explore the classroom situation more freely while still referring to the main issues relevant to biodiversity learning. The findings showed that learning was still dominated by teacher-centered practices, the media used were not sufficiently varied, and students still had difficulty distinguishing genetic, species, and ecosystem diversity. In addition, during observation-based activities, some students were less focused and had not yet shown optimal individual responsibility. These findings became the basis for determining the need for a more interactive and structured learning medium.

Design Stage

The design stage focused on preparing the initial product draft. This stage included the preparation of validation instruments for material experts, media experts, and religious experts; the development of teacher and student response questionnaires; and the design of BIOSTACKO components. The product components consisted of game blocks, question cards, challenge cards, a guide for use, QR code-based supporting materials, and media packaging. The initial draft was then discussed with the supervising lecturer before being revised into a development-ready product.

Tabel 1. The Biostacko media prototype consists of several components:



Game blocks, consisting of several colors with images of flora and fauna.



Question cards, containing conceptual questions about levels of biodiversity.

Challenge cards, containing simple case studies, analyses, and reflections on religious values related to environmental conservation.



Wooden media packaging (media box) containing the game's identity.

Instructions for use, containing gameplay, learning objectives, and learning outcomes in QR code format, including a summary of the material and the developer's profile. Each component was designed with curriculum suitability, student characteristics, and effective learning design principles in mind.

Develop Stage

The develop stage aimed to produce a more concrete and reviewable product. At this stage, BIOSTACKO was validated by the three expert validators to assess the appropriateness of content, media design, and the integration of religious values. The suggestions and comments from validators were used as the basis for product revision before the media was tried out on a limited scale. After revision, the practicality of the media was assessed through teacher and student responses in classroom use. The validation and practicality results were then converted into percentage scores to determine the category of the product.

Disseminate Stage

The disseminate stage in this study was carried out on a limited basis. After the product was declared valid and practical, BIOSTACKO was introduced to the biology teacher and implemented in class X-E1 as a limited trial. This stage was intended to obtain an initial picture of the product's usability in an actual learning setting rather than broad-scale dissemination.

Instruments and Data Collection

Two main data collection techniques were used in this study, namely interviews and questionnaires. Interviews were conducted at the define stage to support the analysis of classroom needs and learning problems. Questionnaires were used in the validation and practicality stages. The expert validation sheets were used to assess the feasibility of the product

from the perspectives of content, media design, and religious-value integration. The teacher and student response questionnaires were used to assess the practicality of BIOSTACKO in classroom use.

The data were collected using a Likert scale with four response categories: 4 = Strongly Agree, 3 = Agree, 2 = Disagree, and 1 = Strongly Disagree (Sudjana, 2005). The obtained scores were then converted into percentages using the following formula:

$$\text{Percentage} = (\text{obtained score} / \text{maximum score}) \times 100\%$$

The percentage results were interpreted based on the product eligibility criteria proposed by Sudjana (2005): 81%–100% = Very Eligible, 61%–80% = Eligible, 41%–60% = Fairly Eligible, 21%–40% = Ineligible, and <21% = Very Ineligible. These criteria were used to determine the feasibility and practicality categories of the BIOSTACKO media.

Data Analysis

The collected data were analyzed descriptively and quantitatively in percentage form. Interview data were described narratively to explain the classroom problems underlying the product development. Validation and practicality data were tabulated, converted into percentages, and then interpreted according to the eligibility criteria. The analysis focused on determining whether BIOSTACKO met the standards of feasibility and practicality as a biology learning medium for biodiversity material. Because this study was a development and limited trial study, the analysis was restricted to product validity and practicality rather than effectiveness testing on learning outcomes. This limitation is important to maintain consistency between the data collected and the claims made in the manuscript.

Results and Discussion

Expert Validation Results

BIOSTACKO was developed and then evaluated through expert validation to determine its feasibility as a biology learning media for biodiversity material. The validation involved three experts, namely a material expert, a media expert, and a religious expert. The results showed that the product obtained a score of 97% from the material expert, 88% from the media expert, and 95% from the religious expert. Based on the eligibility criteria adapted from Sudjana (2005), these percentages fall into the very eligible category. These findings indicate that BIOSTACKO was considered appropriate in terms of content, media design, and the integration of religious values.

The high material validation score suggests that the media content was considered relevant to biodiversity learning objectives and suitable for grade X students. This is important because biodiversity material requires students to distinguish several levels of diversity and relate them to real examples. The high media validation score also indicates that the product design, layout, and usability were judged to be highly appropriate for classroom learning. In addition, the strong religious expert validation confirms that the integration of religious values was considered suitable and meaningful within the structure of the media. This result is important because religious-value integration is one of the distinguishing features of BIOSTACKO compared with earlier stacko-based learning media.

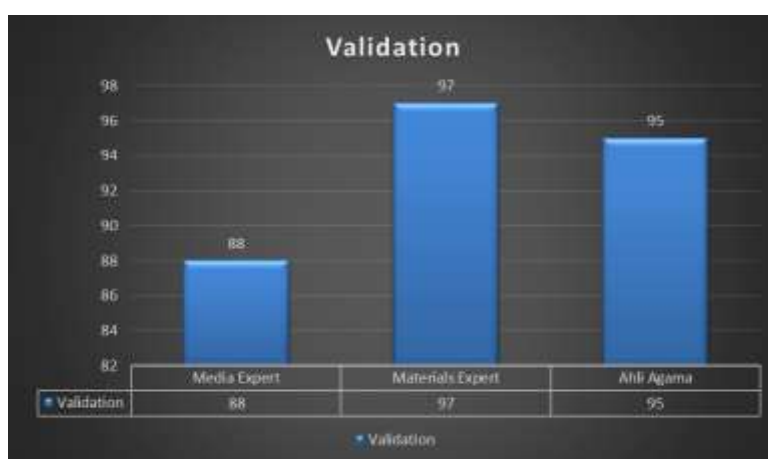


Figure 1. Expert Validation Results

Practicality of BIOSTACKO in Limited Classroom Trial

After revision based on expert input, BIOSTACKO was implemented in a limited classroom trial to examine its practicality. The practicality test showed that the teacher response reached 98%, while the student response reached 92%. According to the criteria used in this study, both scores are included in the **very practical** category. These results indicate that BIOSTACKO was easy to use in classroom learning and was positively received by both teacher and students.

The teacher's high practicality score suggests that the media was considered manageable and supportive for classroom implementation. From the student perspective, the high response score indicates that the media was engaging and

accessible during the learning process. These findings support the idea that learning media should not only be valid in expert judgment, but also practical in actual classroom use. In this study, the practicality of BIOSTACKO may be related to its game-based structure, which combines challenge, interaction, and instructional support in one medium. Game-based learning has been reported to increase learning participation and improve the learning experience when students are actively involved in classroom activities (Safitri et al., 2025; Sholeh, 2024).

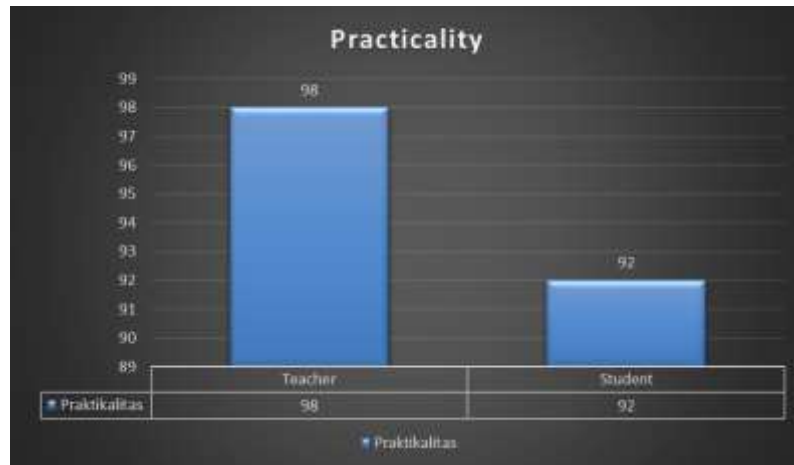


Figure 2. Practicality Test Results

Interpretation of Product Strengths and Novelty

The validation and practicality findings indicate that BIOSTACKO has several strengths as a biology learning medium. First, the product combines game elements with conceptual guidance, allowing biodiversity material to be presented in a more structured and engaging way. Second, BIOSTACKO was designed not only to support conceptual understanding, but also to support guided observation through question and challenge cards. Third, religious values were explicitly integrated into the product, especially through challenge and reflection components related to environmental responsibility. This aspect positions BIOSTACKO differently from previous stacko-based media, which mainly emphasized gameplay and content delivery without clearly integrating religious-value reinforcement (Kumala et al., 2020; Sifa et al., 2024).

The high validation scores may therefore be explained not only by the visual attractiveness of the media, but also by the coherence between content, activity design, and value integration. In other words, BIOSTACKO was judged positively because it was developed as more than a game. It functioned as a structured biology learning medium with conceptual, interactive, and character-related dimensions. Previous studies have also suggested that game-based learning can make science learning more meaningful and contextual when students are actively involved in the learning tasks (Jayantika & Putri, 2023; Putri & Jayantika, 2022; Safitri et al., 2025).

Product Revision Summary

In addition to the validation scores, expert review also functioned as the basis for revising the product before limited implementation. Revisions were directed toward improving the clarity of content, strengthening the visual presentation, and ensuring that the integration of religious values was appropriate and relevant to biodiversity learning. This revision process was important because it ensured that the product was not directly implemented in its initial draft form, but had first been improved based on expert judgment. Thus, the final BIOSTACKO product used in the limited trial represented a revised and more feasible version of the media.

Table 1. Summary of Validation Results and Main Revisions

Validator	Score	Category	Main revision focus
Material expert	97%	Very eligible	Improvement of concept clarity and content suitability
Media expert	88%	Very eligible	Improvement of visual layout, organization, and usability
Religious expert	95%	Very eligible	Strengthening the appropriateness of religious-value integration

Limitations of the Present Study

Although the results indicate that BIOSTACKO is highly feasible and practical, the findings should be interpreted within the scope of a development study with limited trials. This study did not directly test the effectiveness of BIOSTACKO in improving learning outcomes, higher-order thinking skills, or scientific literacy. Therefore, the findings only support conclusions related to product feasibility and practicality, not instructional effectiveness. This distinction is important because earlier statements in the manuscript tended to overstate what the current data could support. Reviewer comments also emphasized the need to restrict claims to the evidence actually collected in the study.

Another limitation is that the product was tested only in a limited classroom context involving one teacher and one class. As a result, the findings cannot yet be generalized to wider educational settings. Future studies should therefore examine the effectiveness of BIOSTACKO in broader implementation contexts and evaluate its impact on measurable student learning outcomes.

Conclusions

This study developed interactive web-based learning media for the periodic table of elements by integrating Carrd as the main content-delivery platform and Educandy as the interactive exercise feature. The development process, which followed the ADDIE model up to the development stage, produced a learning medium that was systematically designed based on curriculum-aligned learning objectives, structured content organization, and interactive activities adapted to the intended indicators. The expert validation results showed an average score of 0.85, which indicates that the developed media had a very high level of validity. In addition, the limited feasibility test involving 15 Grade X students produced an average percentage of 89.13%, which categorized the media as feasible for limited use. These findings indicate that the developed Carrd-Educandy-based learning media is valid and feasible as a learning support medium for periodic table material at the development stage.

However, this study was limited to the development stage and did not include broader implementation or effectiveness testing. Therefore, future studies are recommended to continue to the implementation and evaluation stages in order to examine the effect of the media on learning outcomes, conceptual understanding, and student engagement in chemistry learning.

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