

DEVELOPMENT OF A SCIENCE E-MODULE BASED ON GAME-BASED LEARNING ASSISTED BY WORDWALLS ON THE MATERIAL OF CLASSIFICATION OF LIVING THINGS

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ABSTRACT

This study aims to develop a Game-Based Learning (GBL)-based science learning e-module using the Wordwall platform for the classification of living things in junior high schools and to assess its validity and practicality. This study uses the Research and Development (R&D) method with the ADDIE model, which in this article is limited to the analysis, design, and development stages. The analysis stage is carried out through student and teacher needs analysis, curriculum analysis, and material analysis. The design stage includes the preparation of the e-module structure, display design, and integration of Wordwall game activities. The development stage includes expert validation, one-on-one trials, and practicality tests. The e-module validation was carried out by material experts, pedagogical experts, and media experts. The validation results showed an increase in product quality with a final validation score of 3.71 in the material aspect, 3.64 in the media aspect, and 3.76 in the pedagogical aspect, all of which are in the valid category. The results of the teacher practicality test obtained an average score of 3.72 with a very practical category while the results of the student practicality test obtained an average score of 3.84 with a very practical category. Based on these results, it can be concluded that the Science E-Module based on Game-Based Learning assisted by Wordwall is valid and very practical so it is suitable for use as an innovative learning resource in junior high school science learning.

Keywords: e-module; GBL; Wordwall; Science Learning

INTRODUCTION

Education is an inseparable part of human life and lasts throughout life (Makuro *et al.*, 2025). Consciously or unconsciously, education serves as a means of adapting to the environment and developing individual potential. Through education, students are expected to be able to control their attitudes, personality, intelligence, and morals (Sa & Wardono, 2025). In today's learning context, educational demands are increasingly complex due to the rapid development of digital technology. Technology serves not only as a tool but also as a strategic tool for creating innovative, effective, and relevant

learning that meets the needs of the 21st century (Fitri Mulyani, 2021)

In Natural Sciences (IPA), technology plays a crucial role because it emphasizes the scientific exploration of natural phenomena. Science learning is not simply the delivery of facts, concepts, and principles, but also the process of developing scientific thinking, scientific attitudes, and the ability to apply concepts in real life (Barman & Mahavidyalaya, 2022; Winarni *et al.*, 2020). To achieve these goals, media and learning models play a major role in helping students understand abstract concepts. The contextual learning model, based on constructivism, emphasizes that students must construct their own knowledge through meaningful learning experiences, while the teacher acts

as a facilitator (Mauke *et al.*, 2013). However, in reality, understanding of science concepts in schools is still low (Thahir *et al.*, 2020; Soeharto, 2021). Many students experience misconceptions even in basic material (Fortuna *et al.*, 2025). This is exacerbated by learning that still emphasizes memorization rather than deep understanding of concepts (Mulyono *et al.*, 2018). In fact, understanding concepts is an important foundation in science where students must be able to construct the meaning of learning both verbally, graphically, and through other representations (Hurrell, 2021). Furthermore, student motivation, one of the most important internal factors in the science learning process, remains low. Students tend to find science lessons boring and difficult, leading them to be less active in participating in learning activities (Shirazi, 2017). Low motivation has a direct impact on weak understanding of concepts (Rubiana, 2020).

The needs analysis also showed that 62.2% of students were unmotivated to solve science problems, and 76.2% of students gave up quickly during the lesson. This condition occurred, among other things, in the classification of living things material, which was full of Latin terms, abstract concepts, and many categories (kingdom, phylum, species), making it difficult for students to understand and memorize them. Academic data at SMPN 3 Tambusai Utara also showed low daily test scores for students, reinforcing the need for immediate intervention in conceptual understanding and learning motivation. To solve this problem, teachers need to use learning models and media that are engaging, interactive, and able to activate students' roles. One alternative that has proven effective is Game-Based Learning

(GBL). The GBL model provides a fun, challenging learning experience and involves active student participation, thereby increasing motivation and conceptual understanding (Arrinna Nur Aini, 2023). The Wordwall platform, as a web-based GBL media, provides various educational games such as matching, spinning wheels, and puzzles which are proven to increase student engagement and attention (Lovandri *et al.*, 2024).

Previous research also supports the effectiveness of Wordwalls in science learning. Nadia Nur Kholifah, (2025) noted an increase in student learning activities when using Wordwall which had an impact on increasing motivation and learning outcomes. Lutfiana & Widiyatmoko, (2024) showed a significant increase in learning motivation and understanding of science concepts. Although Wordwall has been widely used as a Game-Based Learning medium to enhance motivation and learning outcomes, previous studies tend to view Wordwall as a supplementary activity, rather than as part of a structured, open-ended learning design. Consequently, the integration of learning objectives, conceptual understanding indicators, and game activities has not been comprehensively examined. Furthermore, most studies emphasize effectiveness testing, while development research that systematically documents the validation process and product practicality is still limited. This study specifically fills this gap by developing a GBL-based science e-module that integrates Wordwall into a single digital learning unit.

METHOD

This research is a Research and Development (R&D) study that aims to develop a Game-Based Learning (GBL)-

based science learning e-module with the help of a Wordwall platform on the classification of living things material in junior high schools. The development model used is ADDIE which includes the stages of analysis, design, development, implementation, and evaluation. The ADDIE model was chosen because it has a systematic, flexible flow and is widely used in the development of technology-based learning media. However, in this article the research is limited to the analysis, design, and development stages while the implementation and further evaluation stages will be reported in subsequent studies. A descriptive research approach is used to describe the process and results of product development based on the data obtained.

Analysis Stage

The analysis phase aims to identify the need for developing a GBL-based e-module and ensure its suitability to student characteristics and curriculum demands. The analysis was conducted through needs analysis, student characteristics analysis, curriculum analysis, and materials analysis. The needs analysis was conducted by distributing questionnaires to science teachers and students and conducting interviews with science teachers to obtain information related to learning problems and the availability of teaching materials. Student characteristics analysis was conducted by examining students' cognitive development backgrounds through daily test scores and student needs questionnaires. Curriculum analysis was conducted by aligning the learning objectives of the classification of living things material with the learning outcomes of the independent curriculum. Furthermore, material analysis was

conducted by compiling a concept map of the classification of living things to ensure the sequence and integration of the concepts to be presented in the e-module.

Design Stage

The design stage is carried out based on the analysis results by compiling the structure and format of the E-Module. The E-Module format refers to the Ministry of National Education standards which consist of an introduction, content, and conclusion. The introduction contains instructions for use, learning objectives, and a concept map. The content section contains learning activities designed according to Game-Based Learning syntax that integrates play activities using Wordwall to train students' conceptual understanding and learning motivation. The conclusion section contains a summary, feedback, bibliography, and glossary. At this stage, the learning flow, mapping of concept understanding indicators, and the preparation of the initial draft (Draft I) of the GBL-based E-Module are also designed.

Development Stage

The development phase is the stage where the Game-Based Learning (GBL)-based science learning e-module design, supported by the Wordwall platform, is realized into a complete and usable learning media product. This stage is the most crucial in research and development because it is at this stage that the product quality is determined through the validation and trial process. After the GBL-based science learning e-module is completed, several further steps are carried out, namely validity testing, one-on-one trials, and practicality testing.

1. The validity test of the E-Module was conducted by a validator team consisting of material experts, pedagogical experts, and learning media experts. The validators assessed the E-Module using an instrument in the form of a validation questionnaire with four response options, namely (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree. The validation process aims to assess the appropriateness of the

material content, pedagogical suitability, as well as the quality of the display and use of the Wordwall media integrated in the E-Module. The results of the validator assessment are used as a basis for making revisions until the E-Module is declared valid and suitable for use in science learning. The validity test criteria can be seen in the following table.

Table 1. Validation Criteria for GBL-based Science E-Modules

Number	Average Score Interval	Criteria
1	$3,00 < \bar{X} \leq 4,00$	Valid
2	$1,00 \leq \bar{X} \leq 3,00$	Invalid

Source: Sugiyono, (2019)

2. A one-on-one trial involving three students with low, medium, and high academic ability levels was conducted. This trial aimed to assess the readability, clarity of content, presentation structure, language, and ease of use of the GBL-based e-module with the aid of a Wordwall. Furthermore, the one-on-one trial served as a means of obtaining direct feedback from students for product improvement.

3. The practicality test involving students aims to determine the level of ease of use, attractiveness, and usefulness of the

e-module in learning. The practicality assessment was conducted using a rating scale of 1 to 4, with the highest score indicating an excellent level of practicality. The practicality test data from students and teachers were used to ensure that the e-module for science learning based on Game-Based Learning with Wordwall assistance is practical, flexible, and can be implemented effectively in the learning process. The criteria for assessing the practicality test can be seen in the following table.

Table 2. Practicality Criteria for GBL-based Science E-Modules

Number	Average Score Interval	Criteria
1	$3,25 < P \leq 4,00$	Very practical
2	$2,5 < P \leq 3,25$	Practical
3	$1,75 < P \leq 2,5$	Less practical
4	$1 \leq P \leq 1,75$	Not practical

Source: (Arikunto, 2021)

RESULTS AND DISCUSSION

Analysis Stage

Based on the results of the analysis of student needs, various fundamental

problems were found in science learning, particularly in the material on the classification of living things. The data shows that students' conceptual

understanding is still low, especially in the ability to interpret information, classify concepts, and relate science material to the context of everyday life. As many as 46.9% of students experienced difficulty in converting text information into visual forms, such as diagrams or classification charts, while 80.5% of students were unable to provide relevant examples of the science concepts being studied. In addition, 63.3% of students stated that it was difficult to group concepts into the right categories, and 62.3% were unable to compare two or more science concepts. These findings indicate that students' conceptual understanding abilities, particularly in the aspects of interpretation, classification, and comparison, are still relatively low. This condition is in line with the findings of Astuti *et al.* (2024) who stated that science learning that does not involve exploratory activities and visual representations results in low student conceptual understanding.

In addition to conceptual issues, students' learning motivation also shows suboptimal conditions. The results of the questionnaire revealed that 57.1% of students were not diligent in completing science assignments and easily felt bored during the learning process. This low learning motivation is closely related to the learning process which is still dominated by a teacher-centered approach and the minimal use of interactive learning media. Science learning that only relies on textbooks and static presentations has not been able to provide an interesting and meaningful learning experience for students. According to Luh *et al.*, (2025) the use of digital game-based media can significantly increase student motivation and engagement compared to conventional methods. Therefore, the development of a game-based learning science e-module

supported by the Wordwall platform is a relevant solution to overcome these problems.

The results of the teacher needs analysis reinforce the findings from the student perspective. Most science teachers still rely on printed textbooks and PowerPoint presentations as their primary learning resources, while the use of game-based learning models remains very limited. As many as 85.8% of teachers rarely use game-based learning models, and 85.7% of teachers have not optimally trained students' skills in transforming information into various representations, such as tables or charts. As a result, learning tends to be monotonous and lacks active student engagement, especially in the abstract material on the classification of living things. This condition aligns with the findings of Hidayati *et al.*, (2025) who stated that science learning without media innovation tends to decrease student motivation and participation. Nevertheless, teachers showed a positive response to learning innovations. The questionnaire results showed that 85.7% of teachers stated that they needed interactive learning media that could increase student motivation and conceptual understanding. Teachers also assessed that utilizing the Wordwall platform has the potential to help students understand concepts through educational games that provide immediate feedback and repeated reinforcement of concepts. These findings indicate strong teacher support for the development of game-based learning-assisted science e-modules with Wordwall as an alternative, innovative learning media that suits class needs.

Design Stage

In the design stage, the Game-Based Learning-based Science E-Module was

designed based on the results of the analysis of teacher and student needs. The E-Module structure is arranged referring to the digital module development standards which consist of three main parts: introduction, content, and conclusion. The introduction contains instructions for use, learning outcomes and objectives, and a concept map to help students understand the learning flow. The content section is designed in the form of learning activities that integrate game-based learning syntax with educational game activities assisted by the Wordwall platform such as Maze Chase, Airplane, and Balloon Pop. These activities are designed to train the ability to classify, compare, and identify living things interactively. According to Rifdah Radhita Zahrah, (2025) the presentation of interactive multimedia-based material can increase student engagement and help strengthen conceptual understanding. The E-Module design also pays attention to visual aspects, readability, and ease of navigation to suit the characteristics of junior high school students. Indicators of conceptual understanding and learning motivation are systematically integrated

into each learning activity. The presentation of interesting and systematic material is expected to increase the cognitive and affective involvement of students as stated by Wong & Hughes, (2023) that interesting digital media design plays an important role in increasing student participation in learning.

Development Stage

E-Module Validation

The development stage of the Game-Based Learning (GBL) science learning e-module with the help of the Wordwall platform was carried out after going through the analysis and design stages. At this stage, researchers realized the e-module design into a complete digital learning product by integrating science materials, Wordwall educational game activities, and interactive visual displays. The material is presented in the form of text, images, exercises, and games designed to encourage active student involvement in understanding science concepts, especially in the material on the classification of living things. The following are the results of the E-module validity test.

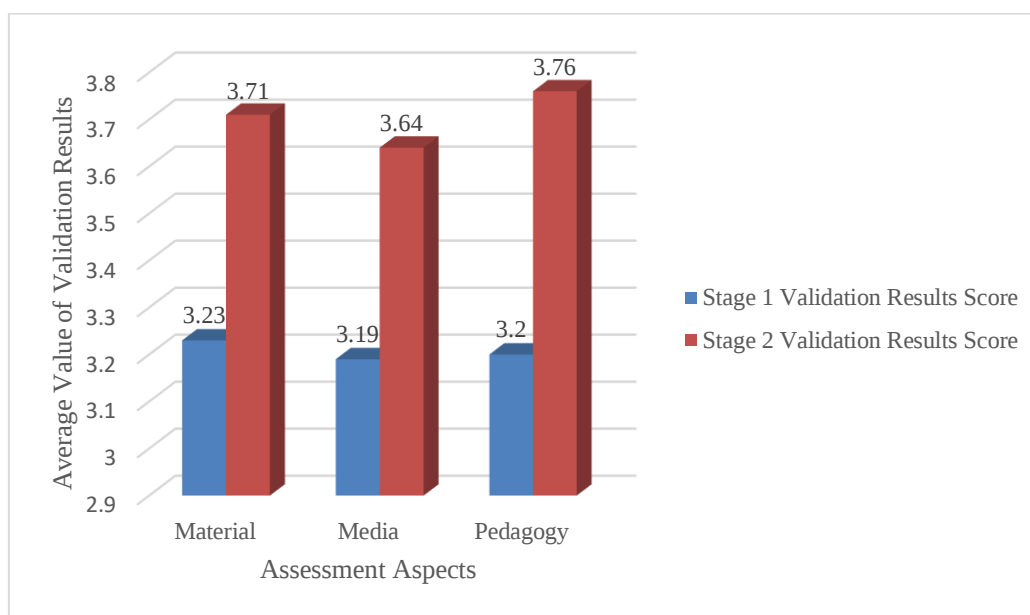


Figure 1. Validation results of the game-based learning E-Module by the Validator

The validation results of the Game-Based Learning (GBL) Science E-Module assisted by the Wordwall platform show an increase in product quality from the first validation stage to the second validation stage in all assessment aspects, namely material, media, and pedagogy. In the material aspect, the validation score increased from 3.23 to 3.71, indicating that after the revision, the E-Module content is in accordance with the learning objectives, scientifically accurate, and relevant to the characteristics of students. The integration of material with Wordwall game activities helps facilitate the understanding of abstract concepts through a more concrete and contextual presentation. This is in line with the opinion of Nurhairunnisah, (2018) that digital teaching materials that are arranged systematically and interactively can improve the quality of students' conceptual understanding. In the media aspect, the validation score increased from 3.19 to 3.64. This improvement indicates that improvements in visual appearance, navigation, and the integration of the Wordwall game have made the E-Module more attractive and user-friendly. Learning media with good visual design and interactive are known to increase students' attention and interest in learning (Khoirunnisa *et al.*, 2025). Meanwhile, the pedagogical aspect obtained the highest score in the second stage, namely 3.76, which indicates that the learning approach in the E-Module is in accordance with the principles of student-centered learning and game-based learning syntax. According to Raharjo *et al.*, (2024) application of game-based learning can encourage active student involvement and create more meaningful learning. Overall, these validation results confirm that the developed E-Module has met the valid criteria and is suitable for use

as a science teaching material in junior high schools.

One-on-One Trial

A one-on-one trial was conducted to obtain initial information regarding the readability, ease of use, and clarity of the e-Module content from the students' perspective. This trial involved three students with varying academic ability levels. The following are the results of one-on-one trials.

Table 3. Results of one-on-one trials

Aspects	Key Findings
Ease of Use	Most students found the e-Module easy to use because it included clear guidance, structured learning steps, and a simple interface. The language used was easy to understand, helping students follow the lesson.
Interest	All students stated that they enjoyed learning using the e-Module because it was attractive and interactive. The integration of wordwall games such as Maze Chase and Plane Game increased student interest and engagement.
Learning Benefits	The e-Module was deemed beneficial in increasing learning motivation and understanding of the concept of classifying living things. High-ability students felt challenged, while medium- and low-ability students became more active because learning was presented in the form of educational games.
Difficulties Encountered	Low-ability students still require teacher guidance to understand the game mechanics and relate them to the material concepts.

Time Efficiency	Technical challenges, such as internet connection, were also encountered when accessing the Wordwall online.
	Once students became accustomed to using the E-Modules, learning became more efficient due to the concise learning activities and immediate feedback. However, additional time was required to explain the instructions in the initial stages.

The results of the one-on-one trials showed that the Game-Based Learning-based Science E-Module with Wordwall support was easy to use, engaging, and beneficial for students. Clear guidance and a simple interface made it easy for students to follow the learning, while the integration of games such as Maze Chase and Plane

Game increased interest and engagement. Although lower-ability students still needed initial guidance and faced internet connection issues, the E-Module was overall deemed efficient and supported meaningful learning.

Teacher Practicality Test

Practicality testing is a crucial stage in the development of teaching materials, including the development of learning modules. This stage is conducted after the module has been developed and declared valid. It aims to determine the extent to which the module can be used easily, efficiently, and effectively by users. Practicality testing involves teachers and students as primary users to assess the module's ease of use, attractiveness, and usefulness in supporting the learning process. The following are the results of the teacher practicality testing.

Table 4. Results of teacher practicality test

Number	Assessment Aspects	Validation Result Score	
		Average %	Criteria
1.	Interest	3,67	Very Practical
2.	Game-Based Learning E-Module Material	3,70	Very Practical
3.	Language	3,78	Very Practical
Average Validation Score		3,72	Sangat Praktis

The results of the teacher practicality test showed that the E-Module was in the very practical category with an average score of 3.72 out of a maximum scale of 4.00. Specifically, the interest aspect scored 3.67, the material aspect scored 3.70, and the language aspect scored 3.78. All scores were in the interval $3.72 \leq 4.00$, which is included in the very practical category. This is in line with the opinion of Tika *et al.*, (2021) who stated that a development product is said to be practical if it is easy for

teachers to operate and is in accordance with the learning characteristics of junior high school students. In addition, the use of the GBL-based E-Module helps teachers reduce the dominance of lecture methods and encourages more student-centered learning. In addition to the practicality test on teachers, a practicality test was also conducted on students. The following are the results of the student practicality test.

Table 5. Results of Student Practicality Test

Number	Assessment Aspects	Practicality Results Score	
		Average %	Criteria
1.	Attractiveness	3,80	Very Practical
2.	Ease of Use	3,86	Very Practical
3.	Benefit	3,85	Very Practical
Average Practicality Score		3,84	Very Practical

The results of the student practicality test also showed that the Game-Based Learning-based Science E-Module was in the very practical category with an average score of 3.84. The ease of use aspect obtained the highest score, which indicates that the E-Module was designed with a simple interface, clear instructions, and a learning flow that is easy for students to understand. This is very important because the ease of use of digital learning media directly influences student engagement and comfort during the learning process. In addition, the attractiveness and benefits aspects also obtained very high scores, which indicates that the visual display, integration of the Wordwall game, and interactive presentation of the material were able to increase students' learning interest and help them understand the concept of classification of living things more effectively.

The high level of usefulness indicates that the GBL-based e-module is not only

visually appealing but also provides a tangible contribution to students' learning process. Through educational game activities such as Maze Chase and Plane Game, students can learn while playing, receive immediate feedback, and review the material without feeling bored. This condition supports the theory of game-based learning, which emphasizes that game elements can increase student motivation, engagement, and conceptual understanding (Hermawan, 2024). Thus, the game-based learning science e-module with the help of Wordwall has proven practical for teachers and students and has great potential to be implemented in science learning in junior high schools as an innovative and effective learning medium. The following presents several displays of the science learning modules that have been developed after going through a validation and revision process as a form of product refinement before being used in learning.



Figure 2. E-Module Cover

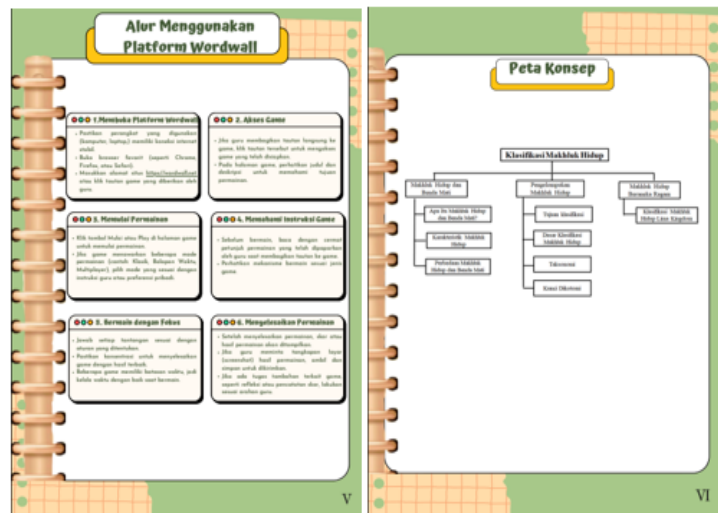


Figure 3. Flow using Wordwall and Concept Map



Figure 4. Content

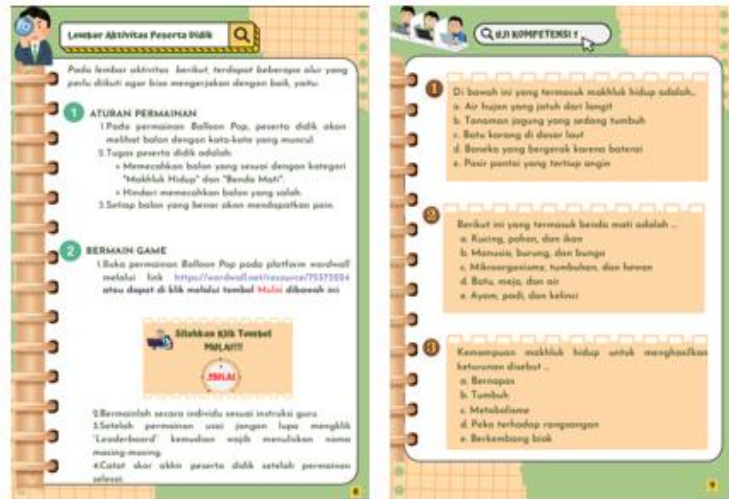


Figure 5. Student Worksheet and Competency Test



Figure 6. Summary and Glossary

CONCLUSION

This research produced a Game-Based Learning (GBL)-based science e-module with the aid of a word wall on the classification of living things through the analysis, design, and development stages of the ADDIE model. Expert validation results indicated that the e-module was valid to very valid, with an average validation score of 3.71 for the material expert, 3.64 for the media expert, and 3.76 for the pedagogical aspect out of a maximum scale of 4.00, thus meeting the validity criteria.

The practicality test by teachers showed an average score of 3.72, categorized as very practical, while the practicality test by students yielded an average score of 3.84, also categorized as very practical. These findings indicate that the e-module is easy to use, engaging, and beneficial in supporting science learning.

However, this research was limited to product quality assessment and did not include a comprehensive learning effectiveness test. Therefore, conclusions are limited to validity and practicality aspects. Future research is recommended to conduct implementation tests using a controlled experimental design and long-term impact measurement..

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