**JURNAL EDUKASI BIOLOGI**
**Volume 12 No 1, March 2026, 1-9**
**ISSN: 2986-5484 E-ISSN: 2986-4828**
**DOI: 10.21831/edubio.v12i1.27535**


# Preliminary evaluation of an e-module with problem-based learning for improving junior high school students' understanding of the digestive system

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**Abstract.** This study aims to conduct a preliminary analysis of the need for developing Problem-Based Learning (PBL)-based e-modules on the digestive system for grade VIII junior high school students. The lack of interactive learning media and the dominance of conventional methods lead to a low understanding of students' concepts in abstract materials. This type of research is descriptive, using both quantitative and qualitative approaches. The data collection instruments included a needs questionnaire distributed to 12 students of grade VIII.7 at SMPN 25 Pekanbaru and structured interviews with two science teachers. The results of the questionnaire analysis showed that the need for digital teaching materials was in the category of quite good (56.25%), but the indicators of the use of the PBL model (15.90%), the attractiveness of the display (13%), and the interactive features (10.10%) were in the very poor category. The results of the interviews revealed that students had difficulty visualizing the mechanisms of digestive organs and enzymes through printed books. The teacher emphasized the need for digital media that integrates contextual issues to stimulate critical thinking. The results of this study suggest that developing Problem-Based Learning (PBL)-based e-modules on materials related to the digestive system should be considered an alternative learning medium to improve learning quality and students' understanding of concepts.
***Keywords: Concept understanding, Digestive system, E-module, Problem-based learning***

***Received: 21 January 2026 Revised: 26 January 2026 Accepted: 31 January 2026 Published: 30 March 2026***

## INTRODUCTION

Science (IPA) learning at the junior high school level aims to develop students' conceptual understanding and scientific thinking skills in solving everyday problems. However, reality shows that science learning is still largely conducted through lectures and relies solely on textbooks. This approach makes students less active, as they simply receive information without engaging in in-depth thought. As a result, students' conceptual understanding tends to be low (Siregar & Nara, 2020; Zubaidah et al., 2018), especially in material that requires reasoning and associations with real-world phenomena, such as the human digestive system. The concepts in this material require the ability to connect the digestive process to everyday life and to visualize the mechanisms of organ function and enzyme action. Unfortunately, many students lack the ability to understand organ function, the roles of enzymes, or various digestive system disorders, resulting in suboptimal learning outcomes (Hafizah et al., 2024; Anggrella & Sudrajat, 2024).

Technological advancements in education provide opportunities to provide more interactive and easily accessible digital teaching materials. One widely used format is the e-module, an electronic module that can contain various components such as text, animation, video, illustrations, and interactive exercises in a single unit. E-modules are considered to increase motivation to learn, encourage independent learning, and help visualize abstract material (Mayer, 2020; Susilana & Riyana, 2020). However, the availability of e-modules specifically designed to improve conceptual understanding through active learning remains very limited. The Problem-Based Learning (PBL) model provides students with opportunities to develop problem-solving skills through active engagement with real-world problems

(Hidayati et al., 2022a). Problem-based learning provides students with opportunities to develop critical thinking skills through active engagement in meaningful problem-solving processes. Previous research has shown that integrating PBL with digital visual media can also strengthen students' conceptual understanding and higher-order thinking skills (Hidayati et al., 2022b).

E-modules are electronic teaching materials systematically designed to support independent and guided learning using digital devices. E-modules are equipped with learning objectives, materials, activities, exercises, and evaluations, and can integrate interactive media such as videos and animations to enhance students' conceptual understanding (Atiqoh & Suhandoyo, 2022). In PBL-based learning, e-modules serve as teaching materials that facilitate contextual problem-solving (Cahyani & Pertiwi, 2024).

In the digestive system, PBL is highly relevant because it can highlight authentic problem examples, such as unhealthy eating patterns, digestive disorders, and nutritional health issues. Through the process of investigating these problems, students not only build conceptual understanding but also apply the concepts to real-life situations (Arends, 2021; Hmelo-Silver et al., 2021). However, implementing PBL in the classroom often faces obstacles. Many teachers lack teaching materials that systematically support PBL steps, such as providing problem scenarios, supporting data, and investigative activities. Therefore, developing PBL-based e-modules is a relevant solution to address these needs (Trianto, 2021; Yustina et al., 2022). Unfortunately, there are currently not many PBL-based e-modules specifically designed for eighth-grade junior high school students, particularly those focused on the digestive system.

Given these challenges, a preliminary study is needed to identify teachers' and students' needs, analyze learning constraints, and assess the feasibility of developing PBL-based e-modules to improve students' understanding of the digestive system. The findings of this preliminary study are expected to serve as a basis for designing effective, engaging, and tailored e-modules that reflect students' characteristics, thereby improving the quality of science learning in junior high schools (Lestari et al., 2025; Mutmainna & Hambali, 2025).

## METHOD

This research was conducted at SMPN 25 Pekanbaru during the odd semester of the 2025 academic year, specifically from July to August 2025. Data collection techniques included distributing questionnaires to students and teachers and conducting structured interviews with science teachers. The research instruments used were a PBL-based e-module needs questionnaire and interview guidelines. The questionnaire was validated through expert judgment by subject-matter and learning-media experts to assess the suitability of the indicators, the clarity of the language, and the relevance of the questionnaire items to the research objectives. Furthermore, the instrument's reliability was assessed using Cronbach's alpha to evaluate the questionnaire's internal consistency. The reliability test results showed Cronbach's alpha $\geq 0.70$, indicating that the instrument is reliable and suitable for use.

This type of research was descriptive, with both quantitative and qualitative approaches. A quantitative approach was used to describe students' and teachers' needs for teaching materials in the form of Problem-Based Learning (PBL)-based e-modules, using questionnaire data. Meanwhile, a qualitative approach was used to obtain more in-depth information on the implementation of learning and the use of teaching materials, using questionnaires and interviews with science teachers.

Data collection techniques included distributing questionnaires to students and teachers and conducting structured interviews with science teachers. The research instruments used were a PBL-based e-module needs questionnaire and interview guidelines. Data obtained from the questionnaire were analyzed descriptively quantitatively using percentage calculations, while interview data were analyzed descriptively qualitatively through the stages of data

reduction, data presentation, and conclusion drawing. The results of this study are expected to provide an overview of student and teacher needs as a basis for planning the development of PBL-based e-modules for the digestive system.

The research instrument, a PBL-based e-module needs questionnaire, was validated through expert judgment by two experts: a material expert and a learning media expert. Validation was conducted to assess the suitability of the indicators, clarity of language, and the relevance of the questionnaire items to the research objectives.

Furthermore, the instrument's reliability was assessed using Cronbach's alpha to evaluate the questionnaire's internal consistency. The reliability test results showed a Cronbach's alpha $\geq 0.70$, indicating that the instrument is reliable and suitable for research. Quantitative data analysis was conducted descriptively by calculating the percentage score for each questionnaire indicator. The analysis was conducted per indicator to obtain a more specific picture of needs. In addition, qualitative data from interviews were analyzed through data reduction, data presentation, and conclusion drawing. Interview results were used for data triangulation to strengthen and explain the questionnaire findings. Questionnaire data were analyzed using descriptive statistics, including calculation of scores, averages, and percentages.

## RESULTS AND DISCUSSION

This section presents research results obtained from student needs questionnaires and interviews with science teachers. These are then interpreted and discussed with reference to relevant theories and previous research findings. The presentation of the results and discussion is combined to provide a comprehensive understanding of the relationship between empirical findings and scientific interpretation.

### Results

This study aims to analyze the need to develop a Problem-Based Learning (PBL)-based e-module on the digestive system for eighth-grade junior high school students. Data were obtained through a student-needs questionnaire and interviews with science teachers and were analyzed descriptively using quantitative and qualitative methods.

The results of the student needs questionnaire were used to determine the initial learning conditions and the need for developing a PBL-based e-module for the digestive system. This study was conducted at SMPN 25 Pekanbaru in the odd semester of the 2025 academic year. The study subjects included eighth-grade students and science teachers. Student sampling was conducted using cluster sampling in grade VIII-7, with a total of twelve (12) students. Meanwhile, the teacher sample was determined using purposive sampling, with two (2) science teachers teaching the digestive system. The summary results of the student needs questionnaire are presented in Table 1.

**Table 1. Data Hasil Angket Responden**

| No | Indicator | Percentage | Category |
|---|---|---|---|
| 1 | The need for digital teaching materials | 56.25% | Good |
| 2 | Suitability of digestive system material | 32.60% | Low |
| 3 | Use of PBL | 15.90% | Very low |
| 4 | Attractiveness of e-module displays | 13% | Very low |
| 5 | Interactive features | 10.10% | Very low |

In addition to questionnaires, this study used interviews to obtain more in-depth information on the need to develop PBL-based e-modules. A summary of the interview results with science teachers is presented in Table 2.

**Table 2. Respondent Interview Results Data**

| No | Question | Answer |
|---|---|---|
| 1 | In your opinion, does current science learning require digital teaching materials such as e-modules? | Yes, it's very necessary. A common difficulty is that students struggle to visualize the digestive system because it's abstract and sequential. Printed textbooks are less effective at presenting these processes visually and dynamically. |
| 2 | What difficulties do you face when teaching the digestive system that require digital teaching materials? | The most difficult part for students to grasp is the process of food digestion within the digestive system, as well as the function of each organ and digestive enzyme. |
| 3 | What part of the Digestive System material do you think is most difficult for students to understand without the aid of digital media? | E-modules can help by displaying animations of the digestive process, interactive images, and videos, making the digestive system more concrete and easier for students to understand. |
| 4 | In your opinion, can an e-module diagram help explain Digestive System concepts more easily? | Yes, I have implemented the Problem-Based Learning (PBL) model. In my experience, students become more active in discussions and critical thinking, but it requires more time and thorough preparation. |
| 5 | Have you ever implemented the Problem-Based Learning (PBL) model in your learning? Describe your experience. | The support needed for effective PBL includes structured teaching materials, contextual problem-based e-modules, digital media, and clear PBL step-by-step guides. The e-module should have an attractive appearance, moderate use of color, clear fonts, easy navigation, and illustrations and animations. |
| 6 | In your opinion, what kind of support is needed for PBL to be effective in Digestive System material? | In my opinion, as a teacher, the Digestive System e-module should include clear learning objectives, concept maps, and systematically organized descriptions of material. |
| 7 | In your opinion, what kind of interface should an e-module have to be attractive and easy to use? | I believe interactive features are very helpful for improving students' understanding because the material on the digestive system is abstract and difficult to visualize when explained solely through text. With interactive features, students can directly observe the process of food digestion in the body, making the concepts learned more concrete. |
| 8 | What content is important to include in the Digestive System e-module to meet learning needs? | In my opinion, the Digestive System e-module should be complemented by learning videos that visually explain the digestive process, animations of the food's journey from the mouth to the anus, and interactive images of the digestive organs that can be clicked to display explanations of each organ's function. |
| 9 | In your opinion, to what extent can interactive features help improve student understanding? | Yes, it's very necessary. A common difficulty is that students struggle to visualize the digestive system because it's abstract and sequential. Printed textbooks are less effective at presenting these processes visually and dynamically. |
| 10 | What interactive features do you think are necessary in the e-module? (e.g., videos, animations, practice questions, automatic evaluation) | The most difficult part for students to grasp is the process of food digestion within the digestive system, as well as the function of each organ and digestive enzyme. |

## Discussion

Based on Table 1, the questionnaire results show that the indicator for the need for digital teaching materials achieved 56.25%, categorized as "Good." This finding indicates that students already have a need for digital teaching materials in science learning. However, the use of existing digital teaching materials remains suboptimal. This aligns with Lestari et al. (2025), who stated that although students are accustomed to using technology, digital teaching materials that support active learning are still limited, resulting in suboptimal learning. The indicator for the suitability of the digestive system material was 32.60%, categorized as "poor." This low result indicates that the learning materials used are not fully aligned with students'

needs. The material is still presented textually, lacks visualization support, and is not linked to contextual issues. Interviews with teachers revealed that "the digestive system material is quite difficult for students to understand if only using textbooks, because students need images, animations, or more concrete examples." This finding confirms that the material's low suitability contributes to students' poor conceptual understanding. Consequently, learning needs to be supported by teaching materials that can present concepts visually, contextually, and systematically. The indicator for the use of the Problem-Based Learning (PBL) model achieved a score of 15.90%, categorized as very poor. This low score indicates that science learning is still dominated by conventional methods and has not systematically integrated PBL steps. Teachers tend to deliver material directly without involving students in real-world problem-solving. Interview results indicated that "teachers have not implemented PBL optimally due to limited teaching materials that support PBL syntax." This suggests that the low implementation of PBL is due not only to teachers' understanding but also to limited learning media. Therefore, a PBL-based e-module specifically designed to facilitate students' critical thinking and problem-solving activities is needed.

The indicator for the attractiveness of the e-module's appearance achieved a score of 13%, categorized as very poor. This result indicates that the visual aspect of the teaching material has not effectively attracted students' attention. An unattractive design can reduce students' interest and motivation to learn. Interview results support this finding, with teachers stating that "students are more interested in learning using media with color, images, and animations than using printed textbooks." Consequently, e-module development needs to consider an attractive visual design to increase student motivation and active engagement.

The interactive features indicator achieved the lowest percentage, at 10.10%, categorized as very poor. This low score indicates that the teaching materials used lack interactive features such as videos, animations, interactive practice exercises, and automatic evaluation. Interview results indicated that "learning media rarely provide interactive exercises, so students quickly become bored." This finding confirms that interactive features play a crucial role in helping students understand the abstract and sequential nature of the digestive system. Therefore, developing interactive e-modules is a relevant solution for improving the quality of science learning.

This study has several limitations, including the relatively small sample size and the involvement of only one class in one school. Therefore, this research is a preliminary study, and the results cannot be widely generalized. Nevertheless, the results provide an important initial insight into student and teacher needs for the development of PBL-based e-modules on the digestive system.

The suitability indicator for the digestive system material was 32.60%, categorized as poor. This low achievement indicates that the current learning materials are not fully aligned with student needs. The material is still predominantly presented in text, lacking adequate visualization, and not yet linked to contextual issues relevant to students' lives. This situation makes it difficult for students to grasp the abstract concept of the digestive system. The results of this questionnaire are supported by interviews with teachers, who stated that "the digestive system material is quite difficult for students to understand if explained solely through textbooks, because students need pictures, animations, or more concrete examples." This finding aligns with Hafizah et al. (2024), who stated that abstract biology material requires visual support for better understanding. Consequently, learning needs to be supported by teaching materials that present concepts visually and in context to improve students' understanding.

The indicator for the use of the Problem-Based Learning (PBL) model was categorized as very poor at 15.90%. This low result indicates that science learning is still dominated by conventional methods and has not systematically integrated PBL steps. Teachers tend to deliver

material directly without involving students in solving real-life problems. Interviews revealed that “teachers are not yet accustomed to implementing PBL due to the limited teaching materials that fully support PBL syntax.” This indicates that the low implementation of PBL is not solely due to a lack of teacher understanding, but also due to limited learning media. Consequently, PBL-based e-modules specifically designed to facilitate students’ critical thinking and problem-solving are needed, as supported by the findings of Azura et al. (2025). The e-module’s visual appeal indicator scored 13%, categorized as very poor. This result indicates that the visual aspects of the teaching materials are not yet optimally engaging students. An unattractive design can reduce students’ interest and motivation.

This questionnaire finding is reinforced by interview results, which stated that "students are more interested in learning using media with color, images, and animation than using traditional printed textbooks.” This confirms that visual displays play a crucial role in increasing student engagement. Therefore, the implication of this finding is the need to develop e-modules with engaging visual designs to increase student motivation and active engagement in biology learning. The interactive features indicator scored the lowest, at 10.10%, and was categorized as very poor. This low score indicates that the teaching materials used lack interactive features such as videos, animations, interactive practice exercises, or automatic evaluation. Interactive features are essential to help students understand the sequential and abstract nature of the digestive system.

Interview results indicated that “learning media rarely provide interactive exercises, resulting in students quickly becoming bored.” This finding aligns with Mutmainna and Hambali (2025), who stated that e-modules with interactive features can increase student engagement and facilitate a more concrete understanding of concepts. Therefore, the implications of these results underscore the importance of developing interactive e-modules to improve learning quality.

Interviews with science teachers revealed a clear need to develop digital teaching materials in the form of e-modules for the Digestive System. Teachers stated that science instruction currently requires digital teaching materials, particularly e-modules, to support classroom learning. This finding aligns with the findings of Anggrella and Sudrajat (2024) and the OECD (2023), which state that digital teaching materials can improve the quality of science learning through more flexible, visual, and interactive presentations compared to conventional printed textbooks.

The main challenges teachers face in teaching the Digestive System are its abstract, sequential nature and the complex biological processes involved. Students often struggle to visualize the flow of food digestion in the human body and understand the function of each organ and digestive enzyme. This finding aligns with research by Hafizah et al. (2024) and Lestari et al. (2025), which states that the digestive system requires visual media for a more concrete understanding of the concepts. Printed textbooks are considered ineffective because they cannot present the digestive process in a dynamic, interactive way, further emphasizing the importance of using digital media.

Teachers also revealed that the most difficult part of the material for students to understand is the digestive process, including the roles of each organ and digestive enzymes. This finding supports multimedia learning theory, which posits that biological processes that cannot be directly observed require visual aids, such as animations, interactive images, and videos, to facilitate comprehension (Mayer, 2020). Therefore, e-modules are seen as an appropriate solution to bridge the gap in students’ understanding of abstract concepts.

Furthermore, teachers stated that e-modules can help explain the concept of the Digestive System by presenting animations of the digestive process, interactive images, and instructional videos. This visual and interactive presentation of material is considered effective at concretizing abstract concepts, making them easier for students to understand. This aligns

with the opinion of Susilana and Riyana (2020), who stated that interactive learning media can enhance meaningful learning by connecting concepts to students' learning experiences.

Regarding the implementation of the Problem-Based Learning (PBL) model, teachers reported that it had previously been applied in science lessons and had increased student engagement in discussions and developed critical thinking skills. This finding aligns with Arends (2021) and Hmelo-Silver et al. (2021), who emphasized that PBL is effective in developing critical thinking and problem-solving skills. However, teachers emphasized that implementing PBL requires time and thorough preparation, particularly in providing structured teaching materials. Therefore, contextual problem-based e-modules equipped with systematic step-by-step PBL guidelines are needed for optimal implementation (Trianto, 2021; Yustina et al., 2022).

In terms of appearance, teachers expect e-modules to be attractive but not overly so, with a proportional use of colors, clear fonts, and easy-to-use navigation. Good visual design is considered capable of increasing students' interest and motivation to learn. This finding aligns with Sartika et al. (2024), who stated that the attractiveness of an e-module's appearance influences students' active engagement in biology learning. In addition to appearance, e-module content is also a primary concern. Teachers emphasized that the Digestive System e-module needs to include clear learning objectives, concept maps, and systematically organized descriptions of material. Structured content presentation is considered to help students understand the interrelationships between concepts and facilitate independent learning (Susilana & Riyana, 2020). Teachers also believe that interactive features are very helpful for improving students' understanding, given that the Digestive System material is abstract and difficult to grasp through text alone. With interactive features, students can directly observe the process of food digestion in the body, thereby making the concepts learned more concrete. These findings align with research by Mutmainna and Hambali (2025), which found that interactive e-modules significantly increase student engagement and conceptual understanding.

Teachers believe that the essential interactive features for e-modules include instructional videos, digestive tract animations, interactive images of the digestive organs, practice questions, and automated evaluations. These features are expected to support active learning, enhance conceptual understanding, and assist teachers in evaluating learning. Overall, interview results indicate that the development of Problem-Based Learning (PBL)-based e-modules for the Digestive System is urgently needed as an innovative solution to address learning difficulties and improve student conceptual understanding through visual, interactive, and contextual presentation of material (Azura et al., 2025; Lestari et al., 2025).

## CONCLUSION

Based on the research and discussion conducted, it can be concluded that science learning about the digestive system in eighth-grade junior high school still faces various obstacles, particularly regarding the availability and use of digital teaching materials. The needs analysis indicates that although students have a fairly good need for digital teaching materials, the currently available teaching materials are not yet fully capable of supporting optimal learning.

The low percentages for indicators of the suitability of the digestive system material, the use of the Problem-Based Learning (PBL) model, the attractiveness of the display, and the interactive features indicate that the learning remains conventional and not fully oriented towards active and contextual learning. These findings indicate that students are not yet accustomed to being trained in critical thinking and problem-solving through problem-based learning, which impacts low student engagement and conceptual understanding.

This research is a preliminary study conducted in one class at one school, so the results cannot be generalized widely. However, the results provide an important contextual overview

as a basis for planning and developing PBL-based e-module teaching materials for science learning. As a recommendation, further research is suggested to develop and test the effectiveness of PBL-based e-modules with a wider sample and to examine their impact on learning outcomes, critical thinking skills, and student motivation.

**ACKNOWLEDGEMENT**

The author would like to thank SMPN 25 Pekanbaru, especially the principal, science teachers, and eighth-grade students, for their support and cooperation during the research. He also thanks all those who provided assistance, input, and support, ensuring the successful completion of this research.

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