Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

Need Analysis for Problem Based Learning E-Module on The Digestive System to Improve Student's Problem Solving and Critical Thinking Skills

Suwarti Lestari*, Harlita, Baskoro Adi Prayitno
Masters of Biology Education, Faculty of Education and Educational Sciences, Sebelas Maret Universit, Surakarta, 57126, Indonesia

ARTICLE INFO

Article history:

Received: 29 July 2025
Revised: 23 Aug 2025
Accepted: 03 Sept 2025
Published online: 15 Sept 2025

Keywords:

e-Module,
Problem Based Learning,
Digestive System,
Critical Thinking,
Problem Solving

* *Corresponding author:*

E-mail: suwartilestari@student.uns.ac.id

Article Doi:

https://doi.org/10.31258/jes.9.5.p.4308-4319

A B S T R A C T

Digital transformation in the education sector has increased the demand for adaptive and technology-based teaching materials, one of which is the development of interactive e-modules. This study aims to analyze the needs of students and teachers regarding the development of a Problem-Based Learning (PBL) e-module on the digestive system material to improve students' critical thinking and problem-solving skills. The research employed a descriptive quantitative method using a survey distributed to 72 eleventh-grade science students and 13 biology teachers in Sukoharjo Regency. The questionnaire covered aspects of technology usage, material comprehension, preferences for e-module features, and experiences with the PBL model. Results show that 56.9% of students reported learning difficulties, and only 41.67% achieved the minimum passing grade for the digestive system topic. Both students and teachers indicated high readiness and strong interest in using PBL-based e-modules. Teachers emphasized the importance of including features such as case studies, interactive videos, structured learning content, and problem-solving exercises. Therefore, the development of a PBL-based e-module is highly relevant to support a more interactive and effective biology learning experience and to foster 21st-century skills among students.

1. Introduction

Digital transformation in education field increasing demand for development of adaptive and technology based teaching materials according to the students' needs. One of the learning innovations relevant to technological developments is the development of interactive e-module. E-module enabling the learning activity to be flexible, independent and 21st century skills oriented, such critical thinking and problem solving skills (Anshari et al., 2016).

According to Zubaidah, (2018), there are seven skills that students need to facing life, the world of work, and citizenship in the 21st century, such as critical thinking and problem solving, collaboration and leadership, agility and adaptive, initiative and entrepreneurship, well communicated, ability to access and analysing information, the curiosity and imagination. In other word, skills that students must have are creative, critical thinking and problem solving (Trisnawati & Sari, 2019). Critical thinking and problem solving skills are the essential skill for a student to face the challenges in 21st century (Trilling & Fadel, 2010).

Critical thing and problem solving skills can be important skill that students must have to face all the challenges in 21st century (Kids, 2019). However, the result of the study show that Indonesian student's critical thinking are still relatively low. Susilawati et al., (2020) state that the student's critical thinking skills are still low. The results of the analysis about students' critical thinking showed that 64% were still in the low category and 15% were in the very low category. Meanwhile the study conducted by Muis (2024) in SMA Negeri 2 Makasar, stated that students' problem solving skill were still in the low category with 54,03% on problem understanding, 83,20% on plan completion, 37,89% on problem solving, and 38,67% on process and result review.

The fundamental issues found in Biology learning especially on digestive system material is the low level of student comprehension. Based on the pre-test results for 72 students in Sukoharjo 2 State High School, only 41,67% that has reached the minimum passing grade. This shows that more than half of students having trouble to comprehend the lesson. In addition, the survey results shows that 98,6% of students have smartphones, but only 8% of them has ever used an e-module as learning resource. It indicates there were big potentials in the use of e-modules as a learning medium that has not been optimized.

According to Anwar & Jurotun (Ramadhani et al., 2024), Problem Based Learning is a learning medium and teaching materials that use everyday issues as a context for students so they learn how to thinking critically and solving problems, also to gaining insights from the teaching materials. Study by Apriyani et al., (2017) shows that Problem Based Learning could improve students' critical thinking skills in Biology lesson. On average in the second post-test, students' critical thinking in PBL were 70,87, meanwhile in non-PBL were 60,80. Study conducted by Permana* et al., (2021), shows that E-module could improve students' problem solving skill. In this study as a whole, 35 students experienced an improvement in problem solving skills across various categories. Thus, this study aums to analyze the needs of students and teachers regarding the development of PBL based e-module on the digestive system to improve students' problem solving and critical thinking skills.

The rapid digital transformation in the field of education has brought significant changes in how learning materials are delivered, emphasizing the need for adaptive and technology-integrated resources that cater to students' diverse learning needs. One of the key innovations in this context is the development of interactive e-modules, which provide flexible, independent, and skill-oriented learning experiences, particularly in fostering critical thinking and problem-solving skills.

These skills are among the core competencies required in the 21st century, alongside creativity, collaboration, adaptability, and digital literacy. However, studies have shown that Indonesian students still struggle with low levels of critical thinking and problem-solving abilities, particularly in science subjects such as biology. For example, mastery of the digestive system topic remains low, with a large proportion of students failing to meet the minimum passing grade. Despite the high rate of smartphone ownership among students, the use of e-modules as learning tools remains underutilized. At the same time, the Problem-Based Learning (PBL) model has been recognized for its potential to enhance student engagement and higher-order thinking by situating learning within real-world contexts. PBL can be effectively integrated into e-modules to create meaningful learning experiences that encourage student autonomy while addressing conceptual difficulties. Therefore, this study aims to analyze the needs of students and teachers regarding the development of a PBL-based e-module on the digestive system, with the ultimate goal of enhancing students' critical thinking and problem-solving skills in biology learning.

2. Methodology

This study employed a descriptive quantitative approach using the survey method to gather data that objectively describes the needs and readiness of both students and teachers in utilizing a Problem-Based Learning (PBL) based e-module on the topic of the digestive system in biology (Syahrum, 2014). The participants in this research consisted of 72 eleventh-grade science students from Sukoharjo 2 State Senior High School and 13 biology teachers from various senior high schools within the Sukoharjo Regency. Sugiyono (2018) say the student survey was designed to explore multiple aspects including their access to and use of technological devices, especially smartphones, for learning purposes; prior experience using e-modules; the level of understanding and difficulty they face when learning the digestive system topic; and their preferences for e-module features such as the inclusion of videos, illustrations, interactive quizzes, and problem-solving tasks.

Furthermore, the survey examined students' learning habits, their willingness to seek out independent learning materials, perceptions of the importance of e-modules in learning, and the frequency with which they would ideally use such modules in the learning process(Siyoto & Sodik, 2015). Meanwhile, the teacher questionnaire focused on their familiarity and experience with the PBL approach, how often they implement it in their classrooms, the sources they use for creating real-world problem contexts (such as current events, curriculum guidelines, or student interests), and the methods they use to guide students through the PBL process, such as step-by-step instruction or providing case-based examples (Siyoto & Sodik, 2015).

Teachers were also asked about their previous use of e-modules in biology instruction, their evaluation of the effectiveness of e-modules, and their opinions regarding the necessity and relevance of integrating PBL-based digital learning

tools specifically for teaching the digestive system. Additionally, the survey gathered input on the most essential features that should be included in the e-module, such as interactive animations, problem-based case studies, comprehensive material explanations, and access to additional learning resources like videos and scientific articles. All collected data were analyzed descriptively using percentages and visualized through tables and graphs to identify dominant trends and preferences. This method provided a comprehensive overview of the educational context, student readiness, and teacher expectations that form the basis for the development of an effective and engaging PBL-based e-module. The subject for this research consists 72 11th grade science students and 13 high school biology teachers form several high school in Sukoharjo regency. The instrument used was an e-module needs questionnaire covering aspects of technology use, the material comprehension, preferences for e-module features, and the experience from using PBL learning model. The data then were analyzed descriptively in the form of percentages and graphs.

3. Results and Discussion

The result of preliminary study regarding students' mastery of the concept of digestive system, out of 72 students, 41,67% scored above the minimum passing grade (>75), while 55,56% still under the minimum passing grade. This shows that students' comprehension in this material is still low. This may be due to the use of conventional learning models and media that are not interesting and not interactive.

Results of the questionnaire analysis that has been conducted by analyzing 72 students from two class of 11th grade science in Sukoharjo 2 State Highschool (SMA N 2 Sukoharjo) and 13 teachers from several highs school in Sukoharjo regency. The results of the questionnaire on student needs in the use of e-modules are presented in Figure 1.

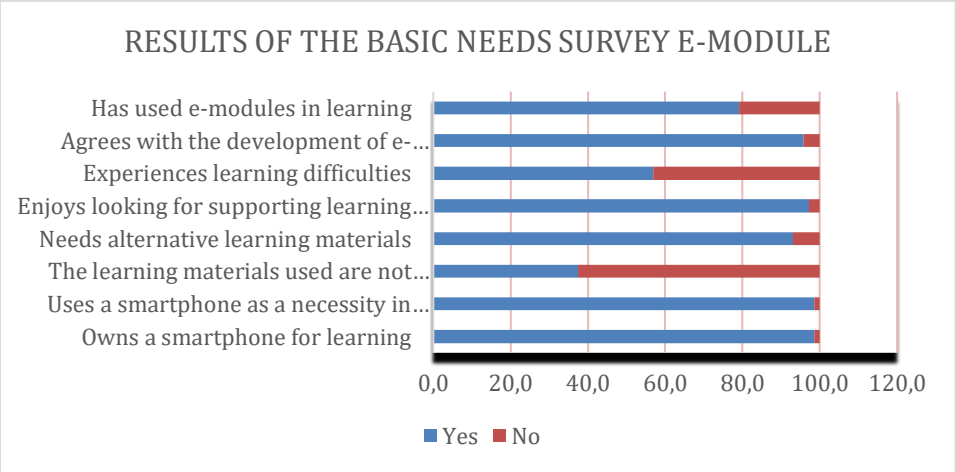

Figure 1. Results of the Basic Needs Survey E-module

Figure 1 shows survey result that describe basic requirements for e-module as learning media. From the data presented, it is known that most of respondent

(79,2%) have used e-modules, although there are still 20,8% of them have ever use the e-modules before. 95,8% students agreed with the development e-module as learning media, showing a high level of interest and support to this innovation.

However, there are 56,9% students admitting to having learning difficulties, indicates the needs of e module that more interactive and easy to understand. In the other side, 97,2% students enjoy searching for their own teaching materials, demonstrating independence in learning that can be support through the provision of e-modules. 91,7% students stated the needs of additional teaching materials, while only 37,5% stated that the teaching materials currently in use very sufficient. This reinforces the importance of developing alternative teaching materials, such as e-modules.

In term of technology readiness, most of students the 98,6% are owning and using smartphone to support learning activity, shows that technological device is not an obstacle to e-module implementation. In general, this survey results show that students have the readiness, need, and willpower to use e-modules as learning media, so that the e-module development is very relevant to meet the needs of students.

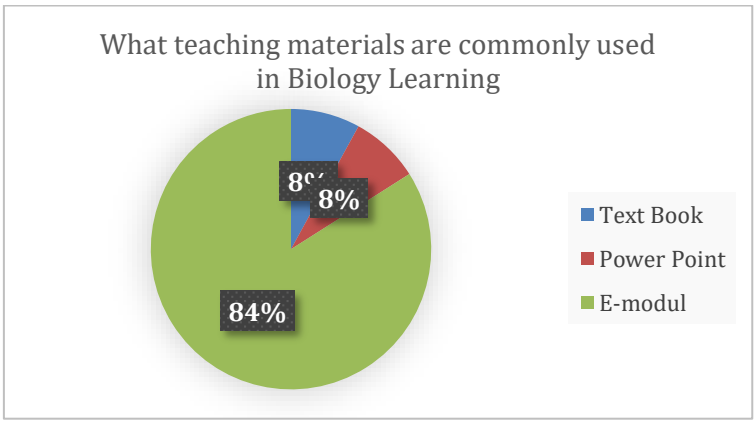

Figure 2. The Commonly Used Teaching Material in Biology Learning

Figure 2 shows the most commonly used types of teaching materials in Biology learning activity. Based on the survey results, it is known that most of the teachers, 83% of them use powerpoint (PPT) as the main medium for presenting material to students. Meanwhile only 8% of teachers that use text book and other 8% use e-module. This data indicates that the use of precentation-based digital teaching materials is more dominant than printed teaching materials such as textbook and interactive teaching materials such as e-modules. The low use of e-module, indicates that the use of more interactive digital learning technologies has not been optimally implemented by teachers in biology lessons.

Therefore, the development of e-module as an alternative is very relevant to do so in order to support interesting and interactive e module and also in line with current developments in educational technology.

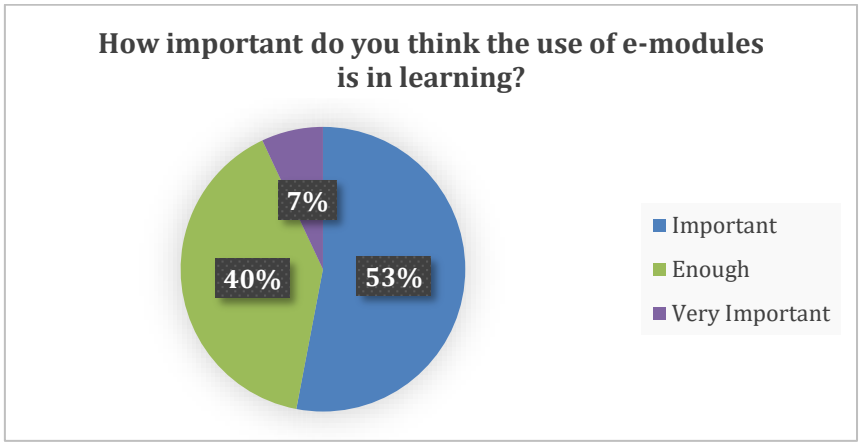

Figure 3. The Importance of E-Modules in Learning Activity

Figure 3 shows data about students perception regarding the importance of e-module in the learning activity. The questionnaire result shows that the majority of respondents, 53% of them states that the use of e-module in the learning activity is important. While 40% of students consider that the use of e-modules to be quite important, and only 7% consider the use of e-modules to be very important. These findings indicate that the most of students realize the benefits and the importance of e-module as learning support tool, although there are few consider them to be very important. This suggests that e-modules are seen as a relevant and necessary alternative teaching material, but are not yet fully considered a primary necessity in the learning process. Therefore, the development and utilization od more effective and engaging e-modules needs to be continuously improved in order to provide more meaningful learning experience and encourage students to appreciate the importance of digital-based learning media.

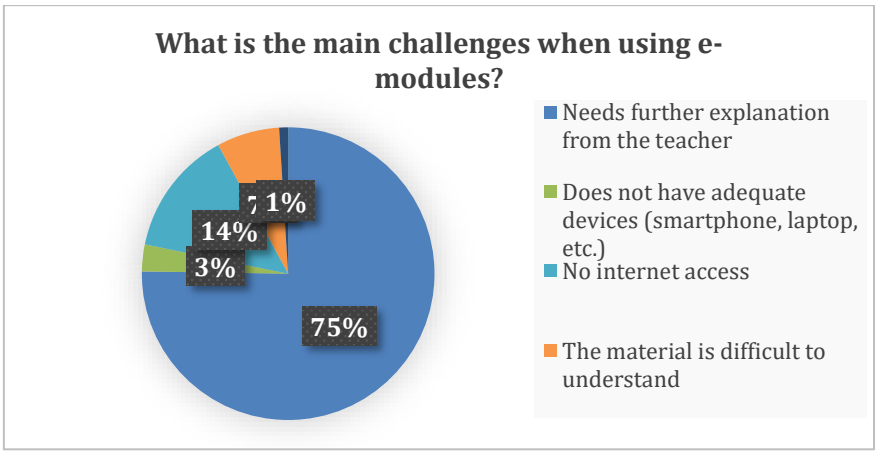

Figure 4. The Most Dominant Challenges using E-modules

Figure 4 shows that the main challenges faced by students when using e-modules in the learning process. The questionnaire results show that the most dominant challenge is the need for further explanation from teachers, as expressed by 76% of respondents. This indicates that although e-modules provide freedom of learning, students still need teachers to play a role as facilitators who provide additional

explanations. In addition, 14% of students stated that they did not have internet access, and 7% had difficulty understanding the material in the e-modules. Meanwhile 13% of students admitted that they did not have adequate devices, such as cell phones or laptops, to access the e-module. These findings indicate that while e-modules can serve as flexible alternative teaching material, their success remains dependent on teacher support, access to devices and the internet, as well as the quality of the material presentation, which should be easy to understand. Therefore, in developing e-modules, it is important to consider these supporting factors and challenges to ensure their implementation is more effective and equitable.

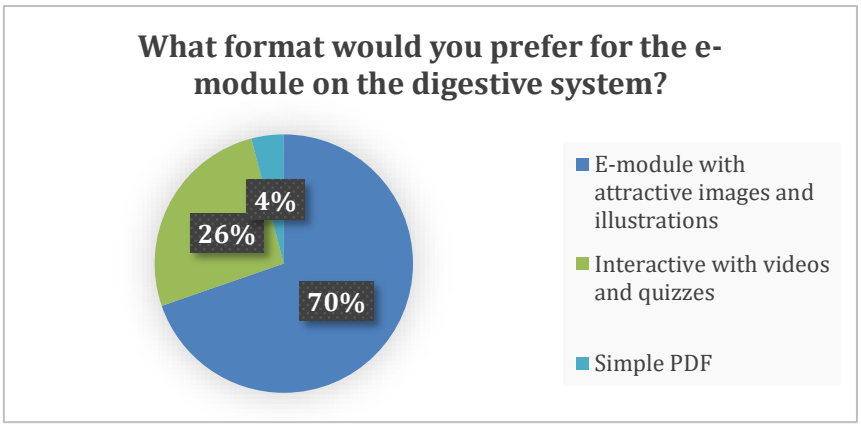

Figure 5. Students' preference for format of e-modules on the digestive system

Figure 5 shows students' preferences for the most preferred format of e-modules on the digestive system. Most respondents, namely 69% chose e-modules with attractive visual aspects are very important in increasing students' interest and understanding of the material. Furthermore, 26% of students liked interactive e-modules, especially those that included videos and quizzes, indicating that students also appreciated formats that involved active participation in the learning process. These results indicate that the development of e-modules should be directed to ward visual, interactive, and engaging learning models to effectively and enjoyably address students' learning needs.

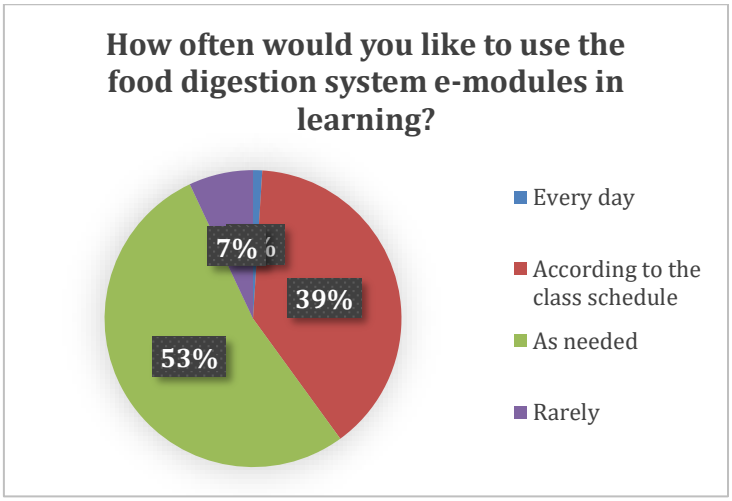

Figure 6. Intensity of use of the food digestion system e-modules

Figure 6 shows data on the intensity of use of the preferred food digestion system e-module by students in the learning process. Based on the questionnaire result, 53% of respondents stated that they wanted to use the e-module as needed. This shows that most students want flexibility in accessing the e-module, tailored to their individual learning conditions and needs. Furthermore, 39% of students want e-modules to be used according to the lesson schedule, indicating that the integration of e-modules into formal learning activities is also considered important. Meanwhile, only 7% of students want to use e-modules every day, and 1% of respondents said they rarely want to use them. This data indicates that although the e-modules considered an important and necessary learning medium, their use needs to be designed flexibly so that they can be adapted to the diverse learning needs of students. This is an important consideration in designing e-modules that are effective, adaptive, and responsive to user preferences. Meanwhile, the results of the analysis of teachers' needs in developing e-modules are presented in Table1.

Table 1. Analysis of Developing e-Modules

No.	Question	Answer Choises	Frekuensi	Persentase
1	Have you ever use the PBL learning model before?	Yes	13	100%
		No	0	0%
2.	How often do you use PBL in your teaching?	Frequently	7	53.85%
		Sometimes	6	46.15%
3.	How do you select relevant issues to use in PBL learning?	Based on current events	10	76.92%
		Based on the curriculum	1	7.69%
		Based on students' interests	2	15.38%
4.	How do you select relevant issues to use in PBL learning?	Give students complete freedom	3	23.08%
		Provide similar case examples	5	38.46%
		Provide step-by-step problem solving guidelines	5	38.46%
5.	Have you ever used e-modules as learning medium?	Yes	12	92.31%
		No	1	7.69%
6.	If so, do you think e-modules are effective in learning?	Effective	9	69.23%
		Very effective	3	23.08%
		Less effective	1	7.69%
7.	Do you think that PBL based e-modules are necessary for biology learning?	Necessary	7	53.85%
		Very Necessary	6	46.15%
8.			6	46.15%

	In your opinion, how can PBL-based e-modules help overcome challenges in biology learning?	Helping students think critically through problem analysis		
		Increasing student engagement in learning	4	30.77%
		Improving students' understanding of concepts	3	23.08%
9.	Do you think e-modules are necessary for teaching about the digestive system?	Necessary	7	53.85%
		Very Necessary	6	46.15%
10.	How important is it for e-modules on the digestive system to include PBL case studies?	Important	6	46.15%
		Very Important	7	53.85%
11.	Do you think the digestive system e-modules needs to be supplemented with acces to additional learning resources (e.g,, links to external videos, articles, or journals)	Yes	13	100%
		No	0	0%

Based on Table 1, it shows that of 13 biology teachers in several high school in Sukoharjo Regency who were respondents in this study, all of them had used the PBL learning model with a slightly higher frequency than those who occasionally used the PBL learning model. Meanwhile, the problem used in the learning activity were mostly based on current events (76,92%) by providing similar examples and step-by-step problem solving guidelines (36,48%). In addition, almost all teachers had used e-modules as a learning medium, and only one teacher had never use them. According to the teachers surveyed, the e-modules are effective in learning and they feel that PBL-based e-modules are needed (53,85%) and very much needed (46,15%) in biology learning, especially in the subject of the digestive system. PBL-based e-modules can help students think critically through problem analysis, thereby helping to overcome challenges in Biology learning. As result, all teachers agree that e-modules are necessary (53,85%) and very necessary (46,15%) in Biology learning, particularly in the Digestive System material. Similarly, e-modules are important (46,15%) and very important (53,85%) in the digestive system of food by providing PBL-based case examples and acces to additional learning resources (e.g., links to external videos, articles, or journals).

Furthermore, teachers stated that the main obstacles in implementing PBL were mostly due to time constraints and students' lack of activity in learning, and that they need more explanation from the teachers regarding the material. To address this, teachers provide questions with similar case examples and adapt the taught material to the available learning time. When creating e-modules, the key features to include in PBL-based e-modules are case examples or problems for student analysis, interactive videos or animations, comprehensive and clear learning

materials, and problem-solving exercises. Meanwhile, features that teachers consider highly important to include in the e-module on the digestive system include interactive animations or videos about the digestive process, relevant case examples or problems for students, and evaluations in the form of interactive quizzes or tests.

Based on students' need analysis results in the use of e-modules, it was found that the development of e-modules is important and necessary to facilitate students' understanding and ability to learn independently through the developed e-modules with the addition of practice questions and instructional videos, attractive e-module displays accompanied by interesting images and illustrations, and the use of clear and easy-to-understand language as key points in the development of e-modules. Meanwhile, the results of the teachers' need analysis stated that the most important features included in PBL based e-modules are case studies or problem for student analysis, interactive videos or animations, comprehensive and clear learning materials, and problem-solving exercises, while still aligning the material with the learning time.

Thus, this study is expected to contribute in the development of PBL-based digital teaching materials that can improve students' problem solving and critical thinking skills, especially in the subjectof the digestive system. The results of this study are also expectedto serve as a reference for teachers in designing biology lessons that can train students' critical chinking and problem solving skill

4. Conclusion

Based on the results of the needs analysis conducted on both students and teachers, this study concludes that the development of a Problem-Based Learning (PBL) based e-module on the digestive system is highly relevant and necessary. The findings show that both parties have a clear interest and readiness to adopt digital learning materials, especially those that are interactive, visually engaging, and support the development of 21st-century skills such as critical thinking and problem-solving. Students expressed a strong desire for learning tools that are flexible, easy to understand, and visually rich, while teachers emphasized the importance of integrating real-life problems, clear instructional materials, and interactive features to support meaningful learning experiences.

The research successfully identified the gap between students' current learning experiences and their potential to benefit from more innovative and technology-enhanced teaching materials. It also highlighted the underutilization of e-modules despite the high accessibility of digital devices. The study did not aim to implement or test the e-module yet, but the comprehensive survey data served as a strong foundation for the next stage of development. Therefore, the research can be considered successful in achieving its objective of analyzing the needs and readiness for PBL-based e-module development. This conclusion reinforces the idea that future instructional design in biology, especially for complex topics like the digestive system, should move towards digital and problem-based formats. The

study provides valuable input for curriculum developers and educators in designing more effective learning tools that not only enhance understanding but also foster independent and critical thinking among students.

Acknowledgement

Author would like to express gratitude to all high school biology students and teachers in Sukoharjo Regency who were willing to participate as respondents in this study. Special thanks are also extended to the Supervisor at the Master's Pogram in Biology Education, Faculty of Education and Educational Sciences, Sebelas Maret University for their guidance and support throughout the conduct of this research. May the results of this study contribute meaningfully to the development of more innovative and contextually relevant Biology learning materials.

References

Anshari, M., Alas, Y., Hj Mohd Yunus, N., Pg Hj Sabtu, N. I., & Sheikh Abdul Hamid, M. H. (2016). Online learning: Trends, issues, and challenges in the big data era. *Journal of E-Learning and Knowledge Society*, *12*(1), 121–
Anshari, M., Alas, Y., Hj Mohd Yunus, N., Pg Hj Sabtu, N. I., & Sheikh Abdul Hamid, M. H. (2016). Online learning: Trends, issues, and challenges in the big data era. *Journal of E-Learning and Knowledge Society*, 12(1), 121–134.

Apriyani, L., Nurlaelah, I., & Setiawati, I. (2017). Penerapan Model PBL Untuk Meningkatkan Keterampilan Berpikir Kritis Ditinjau Dari Kemampuan Akademik Siswa Pada Materi Biologi. *Quagga*, 9(1), 41–54., 9(1), 41–54.

Kids, B. (2019). for.(2019). Framework for 21st century learning definitions. Partnership for 21st Century Learning.

Permana, I., Zulhijatiningsih, Z., & Kurniasih, S. (2021). Efektivitas E-Modul Sistem Pencernaan Berbasis Problem Solving Terhadap Kemampuan Pemecahan Masalah. *Jurnal IPA & Pembelajaran IPA*, 5(1), 36–47. https://doi.org/10.24815/jipi.v5i1.18372

Siyoto, S., & Sodik, M. A. (2015). Dasar metodologi penelitian. literasi media publishing.

Sugiyono. (2018). Metode Penelitian Kuantitatif, Kualitatif, R&D. Alfabeta.

Susilawati, E., Agustinasari, A., Samsudin, A., & Siahaan, P. (2020). Analisis Tingkat Keterampilan Berpikir Kritis Siswa SMA. *Jurnal Pendidikan Fisika Dan Teknologi*, 6(1), 11–16. https://doi.org/10.29303/jpft.v6i1.1453

Syahrum, & S. (2014). Metodologi Penelitian Kuantitatif. In Citapustaka Media. https://doi.org/10.59188/jcs.v2i5.343

Trilling, B., & Fadel, C. (2010). 21St Century Skills: Learning for Life in Our Times. *Choice Reviews Online*, 47(10), 47-5788-47–5788. https://doi.org/10.5860/choice.47-5788

Trisnawati, W. W., & Sari, A. K. (2019). Integrasi Keterampilan Abad 21 Dalam Modul Sociolinguistics: Keterampilan 4C (Collaboration, Communication,

Critical Thinking, Dan Creativity). *Jurnal Muara Pendidikan,* 4(2), 455–466. https://doi.org/10.52060/mp.v4i2.179

Zubaidah, S. (2018). Keterampilan Abad ke-21. Jurnal Pendidikan Biologi, June, 1–25.

How to cite this article:

Lestari, S., Harlita., & Prayitno, B. A. (2025). Need Analysis for Problem Based Learning E-Module on The Digestive System to Improve Student's Problem Solving and Critical Thinking Skills. *Journal of Educational Sciences*, *9(5)*, 4308-4319.