



Development of A Joyful Learning-Based E-Module With The Problem-Based Learning Model on Biodiversity

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Abstract:

Aims: This study aimed to develop and determine the feasibility of a joyful learning-based e-module integrated with the Problem-Based Learning (PBL) model for biodiversity learning, designed to support junior high school students' conceptual understanding and learning motivation.

Methods. The study used a Research and Development (R&D) approach based on the 4D model, limited to the define, design, and develop stages. The participants were 30 seventh-grade students at SMPN 2 Krui. Data were collected through conceptual understanding tests, learning motivation questionnaires, observations, interviews, and expert validation instruments and were analyzed descriptively.

Result. Preliminary analysis showed that students' conceptual understanding remained relatively low, with a mean score of 54.3 and 67% of students classified in the fair or poor categories. Learning motivation was also suboptimal, with a mean score of 56.8% and 67% of students classified in the moderate or low categories. In response, the team developed an interactive e-module by integrating contextual biodiversity problems, PBL learning syntax, joyful learning principles, multimedia resources, and immediate feedback. Expert validation showed high feasibility, with scores of 87.50% for material, 92.50% for media, and 95.00% for language, all categorized as very feasible.

Conclusion. These findings indicate that the developed e-module meets content, media, and linguistic feasibility standards and provides an integrated digital learning resource that addresses both the cognitive and affective dimensions of biodiversity learning. The e-module is therefore suitable for classroom implementation and further empirical testing to determine its effectiveness in improving students' conceptual understanding and learning motivation.

Keywords: e-module; joyful learning; Problem-Based Learning; biodiversity; conceptual understanding; learning motivation



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INTRODUCTION

Twenty-first-century learning emphasizes integrating technology with active learning strategies to improve the quality of education (Zou, 2025). In biology, particularly in biodiversity, students often struggle because the material is complex and abstract. Without appropriate learning media, students tend to memorize information without understanding the concepts in depth (Susilowati et al., 2024). In addition, the use of an appropriate learning model strongly influences students' learning outcomes. Problem-based learning models have been widely used to improve higher-order thinking skills and learning outcomes (Bakti & Santoso, 2021; Nuraisyah & Purwati, 2025). A preliminary study at SMPN 2 Krui showed that learning was still dominated by the lecture method and relied on textbooks as the main learning resource. This condition resulted in low student participation in learning activities, as reflected in the average conceptual understanding score of only 54.3, with 67% of students in the fair to poor categories. Furthermore, students' learning motivation was in the moderate category, with an average of 56.8%, and most students showed low engagement during the learning process.

The Problem-Based Learning (PBL) model has been shown to improve conceptual understanding by presenting contextual problems relevant to everyday life (Herlina, 2024; Dolmans et al., 2020). Meanwhile, the joyful learning approach helps create an enjoyable learning atmosphere that can increase students' motivation to learn (Jannah et al., 2025; Damayanti et al., 2025). Digital technology in learning, such as interactive e-modules, has also been shown to improve students' learning outcomes and engagement (Fajari et al., 2023). Digital media can also be combined with learning models such as PBL or project-based learning to improve creative and critical thinking skills (Ningrum & Widowati, 2025; Aydellia, 2025). Previous studies have shown that project-based learning tools and innovative learning media can improve students' creativity, collaborative skills, and engagement in biology learning (Mariyam et al., 2025; Ningrum & Widowati, 2025). In addition, learning based on the environmental context has been shown to support more meaningful conceptual understanding (Yani et al., 2022). Nevertheless, previous research has generally focused on cognitive aspects and has not optimally integrated affective aspects. Therefore, this study developed an e-module based on joyful learning and PBL as a learning innovation that integrates the development of both cognitive and affective aspects.

Several previous studies have shown that learning innovations through appropriate models and media play an important role in improving the quality of learning processes and

outcomes. Herlina (2024) demonstrated that the implementation of PBL improved students' critical thinking skills, although it did not use digital media. Jannah et al. (2025) found that the joyful learning approach increased learning motivation, but it was not accompanied by the development of digital teaching materials. Fajari et al. (2023) showed that interactive multimedia e-modules could improve learning outcomes, but these were not integrated with a particular learning model. Similarly, Dolmans et al. (2020) confirmed that PBL can improve conceptual understanding, but not through digital media.

Research on the development of environment-based teaching materials shows that using real-world contexts plays an important role in improving students' understanding of biodiversity. This approach enables students to relate the concepts learned to their surrounding environment, making learning more meaningful and less abstract. These findings confirm that real-world contexts can help students understand concepts more deeply and apply them (Yani et al., 2022).

This study's novelty lies in developing an e-module that integrates the joyful learning approach with the Problem-Based Learning (PBL) model on biodiversity to improve junior high school students' conceptual understanding and learning motivation. Unlike previous studies, which generally focused on PBL, joyful learning, or e-modules separately, this study combines all three components into a single interactive, contextual, and enjoyable digital learning product. Furthermore, the e-module was developed using interactive multimedia, contextual problems, and learning activities that engage students' cognitive and affective aspects simultaneously. This integration is innovative because it not only helps students understand biodiversity concepts more deeply through problem-solving but also increases their learning motivation through engaging, student-centered learning experiences. Thus, this study offers more comprehensive digital teaching materials that meet the demands of 21st-century learning.

METHOD

This study employed the Research and Development (R&D) method based on the 4D model, which was limited to the define, design, and develop stages (Thiagarajan et al., 1974). The research subjects were 30 seventh-grade students of SMPN 2 Krui.

Research Procedure

The research stages were as follows:

1. *Define* stage: conducting a needs analysis, identifying student characteristics, and analyzing the concepts of the material to be developed.
2. *Design* stage: designing an e-module that integrates the Problem-Based Learning (PBL) model with the joyful learning approach.
3. *Development* stage: conducting expert validation, revising the product, and carrying out a limited trial.

Data Collection Techniques

Data were collected through:

1. Tests to measure students' conceptual understanding;
2. Questionnaires to determine students' level of learning motivation;
3. Observations during the learning process; and
4. Interviews to obtain supporting data.

Data Analysis Technique

The data were analyzed descriptively. Expert validation scores were converted into percentages and interpreted according to product feasibility categories (Hendra et al., 2021), while the test and questionnaire data were categorized to describe students' conceptual understanding and learning motivation. This approach aimed to describe the research results systematically so that each finding could be presented clearly and in a structured manner. Through this analysis, the data were described in depth by emphasizing the meaning, patterns, and relationships among the findings, thereby providing a comprehensive picture of the phenomena studied.

RESULTS AND DISCUSSION

Preliminary Study: Students' Conceptual Understanding and Learning Motivation

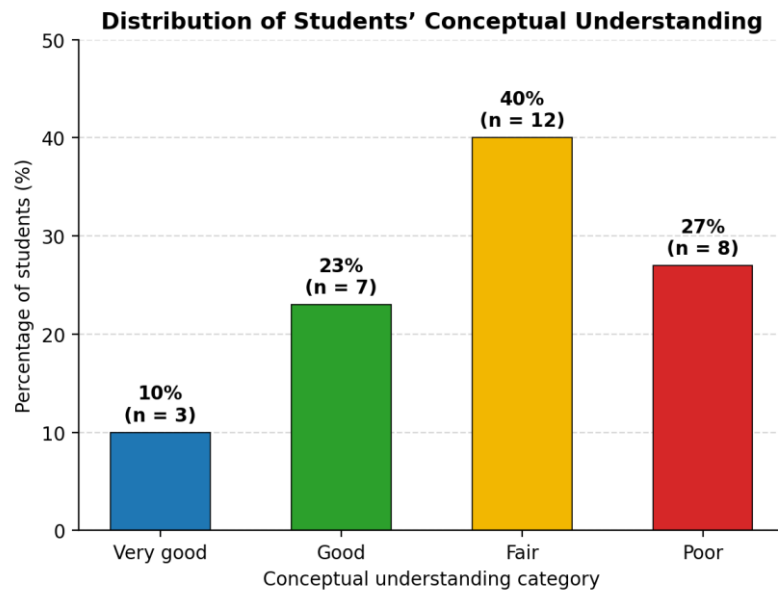


Figure 1. Distribution of students' conceptual understanding

As shown in Figure 1, the “fair” category dominated students' conceptual understanding, accounting for 40% (12 students), followed by the “poor” category at 27% (8 students), the “good” category at 23% (7 students), and the “very good” category at 10% (3 students). This pattern shows that most students were at an intermediate level of understanding, while the proportion of students who achieved a high level of understanding was still relatively limited. Moreover, a considerable number of students remained in the low category, indicating a gap in conceptual mastery.

This trend suggests that the learning process had not yet fully fostered deep, evenly distributed conceptual understanding. Students in the “fair” category generally understood concepts only partially and could not relate, analyze, or apply them in different contexts. Meanwhile, the presence of students in the “poor” category shows that some students still experienced fundamental difficulties in understanding the material. This is consistent with Allchin (2011), who emphasized that complete conceptual understanding is characterized not only by the ability to recall but also by the ability to explain and apply concepts contextually.

Therefore, based on this distribution, students' conceptual understanding was generally at an intermediate level and not yet optimal. This indicates the need for learning

innovations that emphasize active student engagement, strengthen thinking processes, and provide meaningful learning experiences. These efforts are expected to shift students' conceptual understanding from the “fair” category toward the “good” and “very good” categories and reduce the number of students in the low category.

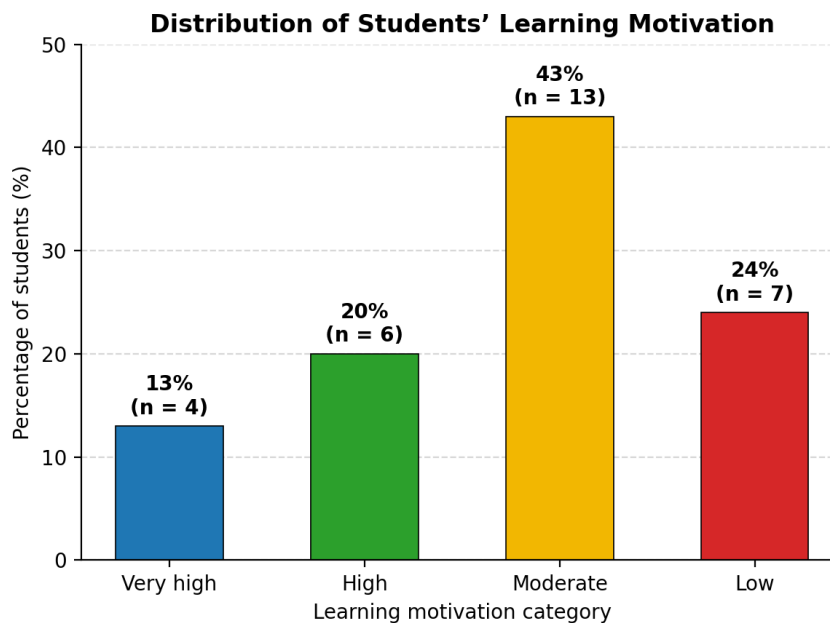


Figure 2. Distribution of students' learning motivation

As shown in Figure 2, students' learning motivation was dominated by the moderate category at 43% (13 students), followed by the low category at 24% (7 students), the high category at 20% (6 students), and the very high category at 13% (4 students). This distribution shows that most students had not yet reached an optimal level of motivation, as only a small proportion were in the very high category. In addition, a notable proportion of students remained in the low category, indicating a gap in classroom learning engagement.

This condition suggests that the learning process had not yet fully encouraged active participation and learning interest evenly among students. Students in the moderate category tended to show situational engagement, being active only under certain conditions without strong intrinsic motivation to learn consistently. Meanwhile, the presence of students with low motivation indicates obstacles in the learning process, such as a lack of methodological variety, minimal interaction, or limited relevance of the material to students' experiences. This aligns with Diseth (2025), who stated that learning motivation is strongly influenced by the quality of the learning environment and the strategies teachers use.

Thus, based on this distribution, students' learning motivation was generally moderate and unevenly distributed. This implies a need for more innovative, interactive, and student-centered learning design. Implementing learning models that enhance students' emotional and cognitive engagement is expected to shift motivation from the moderate and low categories toward the high category, ultimately improving overall learning outcomes.

Development of the E-Module

The e-module was designed using interactive multimedia that presents information visually, aurally, and through animation, making complex material easier for students to understand. This varied presentation not only makes learning more engaging but also reduces cognitive load because it delivers information gradually and in a structured manner. Consequently, students can build conceptual understanding more effectively without being overloaded by information (Fajari et al., 2023; Zou, 2025).

Building on these advantages, the e-module was developed by integrating contextual problems through Problem-Based Learning (PBL) and joyful learning principles to create more meaningful and enjoyable learning experiences. In addition, an immediate feedback feature allows students to evaluate their understanding independently. Therefore, the main characteristics of the developed e-module are that it is interactive and contextual and can optimally increase students' engagement and understanding.

Expert Validation of the E-Module

Applying the PBL model in the e-module gives students opportunities to develop critical thinking skills while connecting learning concepts to real-life situations (Dolmans et al., 2020). Meanwhile, the joyful learning approach increases learning motivation through more enjoyable learning experiences (Damayanti et al., 2025).

Multimedia in the e-module also helps reduce students' cognitive load, making it easier for them to understand complex concepts (Fajari et al., 2023).

The e-module was validated by three validators, namely a material expert, a media expert, and a language expert, to ensure the feasibility of the product before it was implemented with students.

The validation results show that the joyful learning- and PBL-based e-module has potential as an effective learning innovation for improving students' conceptual understanding and learning motivation. The validation assessed several aspects: content

feasibility, presentation quality, media feasibility, and conformity with the principles of joyful learning and the PBL model.

Based on the validation by the material, media, and language experts, the developed e-module consistently fell into the very good category, with mean scores of 3.5, 3.7, and 3.8, respectively. These findings indicate that the e-module comprehensively meets the substantive, visual, and linguistic aspects and is therefore feasible for use in learning with minor revisions. Overall, the high scores across all aspects suggest that the e-module development followed systematic, integrated instructional design principles, as proposed by Thiagarajan et al. (1974), who stated that good teaching materials must meet content, presentation, and language feasibility in an integrated manner.

Recapitulation of Expert Validation Results

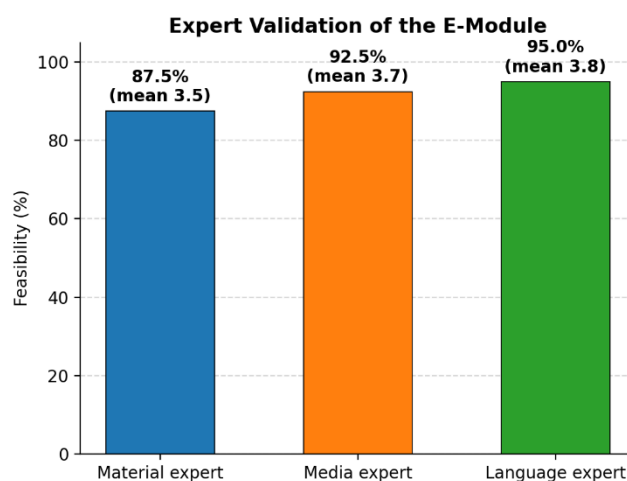


Figure 3. Recapitulation of expert validation results

As shown in Figure 3, the recapitulation of expert validation indicates that the joyful learning- and Problem-Based Learning (PBL)-based e-module was rated as very feasible by the validators. The assessment covered the material aspect (mean score = 3.5; 87.5%), the media aspect (mean score = 3.7; 92.5%), and the language aspect (mean score = 3.8; 95%). According to Hendra et al. (2021, p. 421), a score range of 76–100% falls into the very feasible category. Thus, all assessment aspects of the developed e-module met the very feasible criteria, and the product was considered suitable for use in the learning process.

The high percentage for the material aspect shows that the e-module presents learning concepts systematically, accurately, and contextually, thereby supporting students' conceptual understanding. This aligns with Allchin (2011) and Susilowati et al. (2024), who

stated that relevant and contextual presentation of concepts plays an important role in science learning. In addition, integrating the Problem-Based Learning (PBL) model into the e-module strengthens students' critical thinking skills through contextual problem-solving activities, as stated by Herlina (2024) and Dolmans et al. (2020).

For the media aspect, 92.5% indicates that the visual display, use of interactive multimedia, and navigation of the e-module met very good feasibility standards. This indicates that the e-module can increase student engagement and support more flexible learning in line with developments in digital technology. This finding is supported by Fajari et al. (2023) and Zou (2025), who emphasized that interactive digital learning media can increase students' motivation and participation in learning.

Meanwhile, the language aspect received the highest percentage (95%) in the very feasible category. This result shows that the language used in the e-module is communicative, easy to understand, and appropriate for the characteristics of the students, although minor revisions were still needed for several learning instructions. Overall, the synergy among the material, media, and language aspects shows that the developed e-module meets the product feasibility standards based on the categories proposed by Hendra et al. (2021) and therefore has the potential to support improvements in students' learning motivation, conceptual understanding, and critical thinking skills.

Febriyani et al. (2025) found that educators use the Problem-Based Learning Model and Audiovisual Media to make learning enjoyable, ensuring students stay engaged and not bored when learning economics subjects.

CONCLUSION

Based on the results and discussion, students' conceptual understanding in the preliminary study was in the fair category, with an average score of 54.3, while their learning motivation was in the moderate category, with an average of 56.8%. These conditions indicate that the learning process had not yet optimally developed students' cognitive and affective aspects. Therefore, an e-module based on joyful learning and Problem-Based Learning (PBL) was developed as an innovative alternative teaching material that supports more interactive, contextual, and student-centered learning.

Validation results showed that the developed e-module was in the very feasible category based on the material expert's assessment (mean score: 3.5; 87.5%), the media

expert's assessment (mean score: 3.7; 92.5%), and the language expert's assessment (mean score: 3.8; 95%). According to Hendra et al. (2021, p. 421), percentages in the range of 76–100% fall into the very feasible category. Thus, the developed e-module meets the feasibility aspects of content, media, and language and is suitable for use in learning.

The integration of the PBL model into the e-module helps students connect concepts with real-world problems and practice their conceptual understanding, while the joyful learning approach creates more enjoyable learning experiences and increases students' learning motivation. In addition, the use of interactive multimedia in the e-module supports conceptual understanding through a more engaging and easy-to-understand presentation of material. Therefore, the joyful learning- and PBL-based e-module has the potential to become an innovation in biology learning, particularly in the topic of biodiversity, while supporting 21st-century learning oriented toward the development of higher-order thinking skills.

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