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Hybrid Learning Development: A Combination of Level of Inquiry and Moodle to Enhance Students' Critical Thinking Skills

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ABSTRACT

Higher education currently faces significant challenges in integrating information and communication technology (ICT) into the learning process and equipping students with Critical Thinking Skills. However, in the post-pandemic era, many universities rarely incorporate ICT into their teaching, and students' critical thinking abilities still need improvement. Hybrid Learning, which combines Level of Inquiry (LoI) and Modular Object-Oriented Dynamic Learning Environment (Moodle), can be an effective solution to address these issues. The combination of LoI and Moodle creates a learning environment that allows students to engage in independent and collaborative learning while developing skills through investigative activities. The aim of this research is to develop Hybrid Learning that integrates LoI and Moodle to enhance students' Critical Thinking Skills. This research employs an instructional development model by Fenrich, which includes: Analysis, Planning, Design, Development, Implementation, and Evaluation and Revision. The implementation stage utilizes a pre-experimental research design with a One Group Pretest-Posttest Design conducted at the Faculty of Science and Applied Technology at Undikma. The research instruments consist of validation sheets and critical thinking skill tests. Data analysis is conducted using quantitative descriptive methods and n-Gain tests. The results indicate that the developed Hybrid Learning model combining LoI and Moodle is valid and reliable for use in the learning process. The validation scores for the Syllabus (3.9), Lesson Plans (3.9), Student Worksheets (3.8), and Critical Thinking Skills tests (3.9). Additionally, the Hybrid Learning combining LoI and Moodle are effective in significantly improving students' Critical Thinking Skills.

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INTRODUCTION

Higher education in the era of the 5.0 Industrial Revolution faces significant challenges in integrating information and communication technology (ICT) into the learning process. Alongside this, higher education is also required to equip students, as the millennial generation, with 21st-century skills to compete in the job market (Care et al., 2018; Oktay et al., 2023). Critical Thinking Skills are a crucial part of the 21st-century skills that students must possess to tackle the increasingly complex challenges of the workforce (Angraini et al., 2023; Dewi et al., 2023).

Critical Thinking Skills involve analytical thinking, evaluative reasoning, formulating conclusions, and the ability to process deductive and inductive reasoning (Alismaiel, 2022; Shaw et al., 2020), which demand a high level of reasoning to achieve desired outcomes (Hamdani et al., 2022; Wechsler et al., 2018). Critical thinking is the rational process of determining what to believe or what actions to take (Kencanawati et al., 2021; Pangsuma et al., 2024). The expert opinion above emphasizes that Critical Thinking Skills are essential for students, as they serve as the foundation for decision-making regarding how to achieve desired goals. However, several previous studies indicate that students' Critical Thinking Skills still require improvement. The critical thinking skills of Indonesian students across various levels of education tend to perform poorly (Asmara et al., 2023; Hamengkubuwono et al., 2022; Umam & Susandi, 2022).

Based on the issues outlined above, there is a need for a learning approach that combines inquiry activities with the use of technology, specifically the Level of Inquiry (LoI) and the Modular Object-Oriented Dynamic Learning Environment (Moodle), delivered through a Hybrid Learning method. Hybrid Learning integrates online and offline learning using specific platforms (Krisna, 2024), providing flexibility for students to learn effectively (Mokoena & Hattingh, 2024). To support this learning activity, it begins with the development of teaching materials that align with LoI and Moodle learning.

The Level of Inquiry (LoI) refers to the stages involved in problem-solving, ranging from more structured to more independent phases (Artayasa et al., 2018; Dah et al., 2024). LoI emphasizes student engagement in active inquiry activities (Mursali et al., 2024), which can promote critical thinking (Asmara et al., 2023). This is because LoI encourages students to ask questions, gather information, and develop a deep understanding of a topic (Flegr et al., 2023). However, in practice, implementing LoI requires significant preparation and time; therefore, an online medium like Moodle is necessary to address these challenges.

Moodle is a platform that facilitates student-centered learning, encouraging active participation in all learning activities (Almusharraf & Khahro, 2020; Makruf et al., 2022). It is equipped with several features such as learning materials, assignments, quizzes, discussion forums, and more (Amin et al., 2023; Sumarwati et al., 2020), which greatly support hybrid learning (Schettini et al., 2020). Moodle can overcome the limitations of face-to-face learning, which is restricted by time and space, as students and instructors can interact anytime and from anywhere (Mulyatiningsih et al., 2023).

Hybrid Learning has become a primary focus in higher education, particularly with the advancements in information and communication technology that enable the integration of online and face-to-face learning. Moodle is one of the popular online learning platforms used in the context of Hybrid Learning. The Level of Inquiry (LoI) has also been employed in various educational settings to develop students' skills (Artayasa et al., 2018; Mursali et al., 2024; Šmida et al., 2024). However, the combination of LoI and Moodle to support Hybrid Learning has not been previously explored. No studies have thoroughly explored this combination, especially in the context of hybrid learning to enhance critical thinking skills. This research presents an innovative development of the Hybrid Learning method by integrating the LoI approach with Moodle. The development of Hybrid Learning teaching materials is essential, given the need to enhance students' Critical Thinking Skills. Students must acquire skills that go beyond mere content understanding. Critical Thinking Skills enable students to compete and adapt in the workforce.

The development of Hybrid Learning that combines the Level of Inquiry (LoI) with Moodle can be an effective solution. LoI aids students in developing Critical Thinking Skills through the inquiry process, while Moodle provides an interactive platform integrated with various digital resources. Based on this, the research problem is formulated as follows: how valid and effective are the Hybrid Learning that combine LoI and Moodle, particularly in terms of improving students' Critical Thinking Skills? The aim of this study is to develop Hybrid Learning that integrates LoI and Moodle to enhance students' critical thinking abilities.

Hybrid learning that combines LoI and Moodle can create a learning environment that enables students to learn independently, collaboratively, and develop skills through inquiry activities. The combination of LoI and Moodle can significantly contribute to the development of effective teaching methods to enhance student skills. The findings of this research can serve as a

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guideline for educational institutions to develop learning strategies that are relevant to contemporary demands.

RESEARCH METHODS

Research Design and Procedure

This study is a development research aimed at producing hybrid learning that combines the Level of Inquiry (LoI) and Moodle. To support this, the research activities begin with the development of teaching materials based on the instructional development model (Fenrich, 2005). This development model consists of six phases: Analysis, Planning, Design, Development, Implementation, and Evaluation and Revision. This development model is used because its stages are well-suited for systematically designing and developing a hybrid learning product. The stages of the research can be seen in Figure 1.

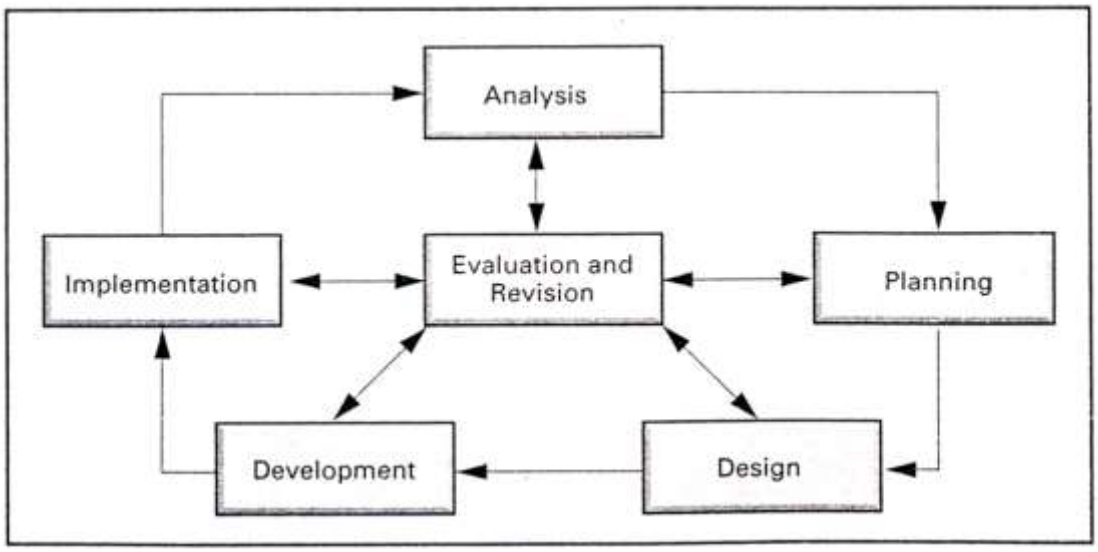

Figure 1. Instructional Development Cycle Model (Fenrich, 2005).

The Analysis phase aims to identify and determine the problems occurring in the learning activities, as well as to define the expected learning outcomes (Mursali, et al., 2023). Problem identification is conducted through observations and interviews with students and instructors. The next phase is Planning, which involves detailed planning of the learning activities, setting performance objectives, and developing assessment strategies. The Design phase focuses on creating and adopting the initial design of the teaching materials and preparing the Moodle LMS portal. At the end of the Analysis, Planning, and Design phases, a course device will be produced, serving as a prototype for the teaching materials.

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The next phase is Development. In the Development phase, a review and evaluation of the teaching material prototype are conducted through validation or feasibility testing based on learning aspects, the accuracy of concepts/materials, and media. This feasibility testing is carried out by three experts. The validated and revised teaching materials are then uploaded to the prepared LMS portal and subsequently implemented in the learning process. The Implementation phase involves the use of the developed product in the pre-experimental research stage. The Evaluasion and Revision phase is an ongoing activity conducted at each stage throughout the development cycle (Fenrich, 2005).

The design used in this pre-experimental study is the One Group Pretest-Posttest Design (Cohen et al., 2018). The research design is presented in Table 1.

Table 1. Pre-Experimental Research Design

Pretest	Treatment	Posttest
O1	X1	O2

Notes:
O_1 = Conduct a pretest to assess students' Critical Thinking Skills before the intervention.
X = Implement the treatment for students, which involves Hybrid Learning (a combination of the Level of Inquiry and Moodle).
O_2 = Conduct a posttest to evaluate students' Critical Thinking Skills after the intervention.

Instruments for Data Collection

The instruments used in this study are a validation sheet and a Critical Thinking Skills test. The validation sheet is used to assess the validity of the developed teaching materials. The Critical Thinking Skills test is designed to measure students' critical thinking abilities. This test is developed based on indicators of analytical thinking, evaluative reasoning, formulating conclusions, and the capacity for both deductive and inductive reasoning (Facione, 2015). This test is in the form of twelve open-ended items. It has undergone a validation process and reliability testing, and the results indicate that the test is both valid and reliable. The scoring of the test uses a rubric that has been developed with a scale ranging from 0 to 4.

Data Analysis

Data on the validity of the teaching materials is analyzed using qualitative descriptive analysis by averaging the scores obtained from the validators. The average scores are then described based on the criteria outlined in Table 2.

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Table 2. Criteria for Categorizing Validation Results

Interval	Category	Notes
1.0 ≤SV≤ 1.5	Poor	Cannot be used, needs to be considered carefully
1.6 <SV≤ 2.5	Fair	Can be used with major revision
2.6 <SV≤ 3.5	Good	Can be used with minor revision
3.6 <SV≤ 4.0	Very Good	Can be used without revision

(Modified from Ratumanan & Laurens, 2011).

The realiability of the test was determined based on assessment data from validators using the percentage inter-observer agreement formula. An instrument is considered reliable if the reliability score obtained is ≥ 0.70 (70%). The level of reliability is calculated using the following formula:

$$R = \left(1 - \left(\frac{A - B}{A + B}\right) \times 100\%\right)$$

Notes:
R = Test reliability (Percentage of Agreement)
A = Highest score given by the validator
B = Lowest score given by the validator

The data on students' critical thinking skills were analyzed using a normality test of the gain scores. Gain refers to the difference between the posttest and pretest scores. It indicates the improvement in students' critical thinking skills after the learning process. The normalized gain (n-gain) can be calculated using the following formula (Hake, 1998):

$$g = \frac{S_{postest} - S_{pretest}}{S_{maximum} - S_{pretest}}$$

Notes:
$S_{maximum}$ = Maximum (ideal) score from the pretest and posttest.
$S_{postest}$ = Posttest score.
$S_{pretest}$ = Pretest score.

The normalized gain (n-gain) can be classified as follows:

Table 3. Criteria for Categorizing n-Gain (g)

Interval	Category	Description
0.7 ≤ g	High	Indicates a substantial improvement in Critical Thinking Skills
0.3 ≤ g < 0.7	Moderate	Indicates a moderate improvement in Critical Thinking Skills
g < 0.3	Low	Indicates minimal or no improvement in Critical Thinking Skills

RESEARCH RESULT

The development of Hybrid Learning materials that combine the Level of Inquiry and Moodle refers to the instructional development model proposed by Fenrich (Fenrich, 2005), which

consists of six phases: Analysis, Planning, Design, Development, Implementation, and Evaluation and Revision.

Analysis

The Analysis phase involves identifying and determining the problems occurring in the learning activities, as well as defining the expected learning outcomes. Problem identification is conducted through observations and interviews using a needs analysis questionnaire. This questionnaire is completed by students who have taken the General Biology course and by the instructors teaching the course. The needs analysis results indicate that the General Biology course has not been implemented to its full potential. The analysis shows that teaching methods frequently employed include lectures, discussions, question-and-answer sessions, and assignments to convey the material. However, these methods often lack confirmation or clarification from the instructors, which negatively affects students' learning outcomes, particularly concerning higher-order thinking skills. Additionally, theoretical lessons are conducted separately from practical activities. The practical sessions are carried out before the theoretical discussions by the instructors, resulting in students lacking a solid foundation for conducting these activities. Practical work is done using simple laboratory manuals that include problems, procedures, and the necessary tools and materials.

The needs analysis results also indicate that a Learning Management System (LMS) is crucial for supporting online learning activities to effectively achieve learning objectives. The General Biology course more frequently utilizes WhatsApp Group (WAG) as an online learning medium. However, the use of WAG can make it difficult for students to focus and concentrate on learning due to interruptions from incoming messages and phone calls during sessions. Additionally, WAG has several other limitations, including a heavy reliance on internet connectivity and quick memory capacity issues, as almost all courses use this medium. The needs analysis further reveals that the assessment of students' Critical Thinking Skills is rarely conducted. Based on these findings, the desired learning outcomes must align with 21st-century demands, specifically by training students' competencies related to higher-order thinking skills, including critical thinking.

Planning

The next phase is Planning. In this phase, detailed planning is conducted regarding learning activities, team formation, scheduling, performance objectives, and the development of assessment strategies. Based on the results of the problem analysis and the desired learning outcomes, along

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with a review of the literature, the learning activities in this study will employ the Level of Inquiry model. The expected performance objective is to produce Hybrid Learning materials based on the Level of Inquiry model supported by Moodle, and to assess its impact on students' Critical Thinking Skills. The assessment strategy in this study is designed to evaluate the feasibility of the product and to create a field test design that will be used in the implementation phase. The components assessed in this context include the validation instruments used to evaluate the suitability of the hybrid learning material prototype designed in the Design phase.

Design

The Design phase focuses on developing and adopting the initial design of the course materials and preparing the LMS portal. The course materials are structured based on the Level of Inquiry model, covering topics such as cytology, reproductive systems, photosynthesis, ecology, and biodiversity. The outcome of this initial design stage is a prototype for General Biology teaching materials that includes: the syllabus, lesson plans, student worksheets, PowerPoint presentations, Critical Thinking Skills tests, and validation sheets. The next step involves preparing the Biology LMS portal using the Moodle platform. The prepared and built Biology LMS portal requires a server that serves as a storage location for documents and applications, allowing access via a specific address. A screenshot of the Biology LMS Portal is presented in Figure 2.

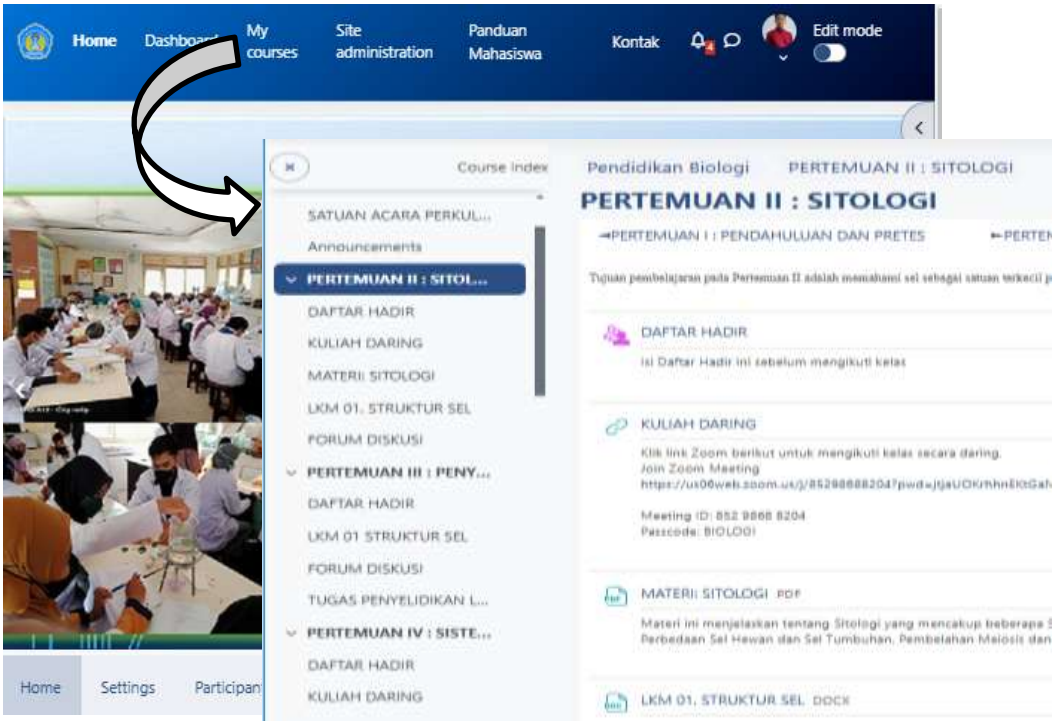

Figure 2. Screenshot of the Biology LMS Portal

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The hybrid learning activities using the Biology LMS involve both online and offline meetings. During the online sessions, the lecturer guides students in identifying issues related to the topic, selecting the necessary tools and materials, and designing the investigation procedures previously developed. All of these activities are integrated through the Biology LMS. Once the prototype of the General Biology teaching materials and the Biology LMS portal are completed, the process moves on to the Development phase.

Development

In the Development phase, a review and evaluation of the General Biology teaching material prototype (components of the Biology LMS) produced in the previous phase are conducted. These components include the the syllabus, lesson plans, student worksheets, and assessment instruments. This review and evaluation are carried out through validation activities or feasibility testing by three experts (in pedagogy, concept/material accuracy, and media), as well as reliability testing of the instruments used. Following the validation, the process proceeds to field testing. The results of the Development phase are outlined as follows.

Results of the Validation and Reliability of the Syllabus

The validity of the Syllabus is assessed based on several components, including: identity, Graduate Learning Outcomes, Course Learning Outcomes, study materials, teaching methods, time allocation, assessment, and learning resources, as well as language. A summary of the validity and reliability assessment results for the sillabus is shown in Table 4.

Table 4. Average scores of validity and reliability of a syllabus

No	Component	Validity	Category	Reliability	Category
1	Course Identity	4.0	Very Good	100%	Reliable
2	Graduate Learning Outcomes	4.0	Very Good	93%	Reliable
3	Course Learning Outcomes and Indicators	3.9	Very Good	90%	Reliable
4	Study Materials	4.0	Very Good	97%	Reliable
5	Teaching Methods	3.7	Very Good	100%	Reliable
6	Time Allocation	4.0	Very Good	86%	Reliable
7	Assessment and Learning Resources	3.9	Very Good	97%	Reliable
8	Language	4.0	Very Good	100%	Reliable
Average		**3.9**	**Very Good**	**95%**	**Reliable**

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The validity assessment results also provide suggestions and revisions for the Syllabus, which are summarized in Table 5. Based on the validity and reliability evaluation results, along with the revisions made, the developed Syllabus is declared valid and ready for implementation in teaching.

Table 5. Suggestions and revisions for a syllabus

No	Suggestions and revisions for a syllabus
1	Align the time allocation used in the learning plan description with the time indicated in the table.
2	Adjust the operational verbs used to formulate Graduate Learning Outcomes, Course Learning Outcomes, and learning indicators.

Results of the Validation and Reliability of the Lesson Plans

The validity of the Lesson Plans is assessed based on aspects such as identity, graduate learning outcomes, course learning outcomes, learning indicators, study materials, teaching methods and activities, time allocation, assessment, and learning resources, as well as language. The scores for validity and reliability are provided for each component of the Lesson Plans. Summary of the validity and reliability assessment results for the Lesson Plans is presented in Table 6.

Table 6. Average scores of validity and reliability of lesson plans

No	Component	Validity	Category	Reliability	Category
1	Course Identity	4.0	Very Good	100%	Reliable
2	Graduate Learning Outcomes	3.8	Very Good	93%	Reliable
3	Course Learning Outcomes	4.0	Very Good	100%	Reliable
4	Indicators	4.0	Very Good	93%	Reliable
5	Study Materials	3.9	Very Good	96%	Reliable
6	Teaching Methods	3.9	Very Good	100%	Reliable
7	Time Allocation	3.8	Very Good	100%	Reliable
8	Assessment and Learning Resources	3.9	Very Good	94%	Reliable
9	Language	3.9	Very Good	96%	Reliable
	Average	**3.9**	**Very Good**	**97%**	**Reliable**

The assessment results from the validators also provide suggestions for the lesson plans, which are summarized in Table 7. Based on the validity and reliability evaluation results, as well as the revisions made, the lesson plans is declared valid and ready for implementation in teaching.

Table 7. Suggestions and revisions for lesson plans

No	Suggestions and Revisions for Lesson Plans
1	Adjust the operational verbs used to formulate Course Learning Outcomes and learning indicators
2	Improve the formulation of the learning steps in the lesson plans to ensure that the learning process is more student-centered.
3	Add activities to summarize the learning outcomes at the end of each session.

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Results of the Validation and Reliability of Student Worksheets

The validity of the Student Worksheets is assessed based on four (4) aspects: content, study materials, presentation, and language usage. A summary of the validity and reliability assessment results for the Student Worksheets is presented in Table 8 below.

Table 8. Average scores of validity and reliability of student worksheets

No	Component	Validity	Category	Reliability	Category
1	Content	3.8	Very Good	97%	Reliable
2	Study materials	3.8	Very Good	97%	Reliable
3	Presentation	3.9	Very Good	99%	Reliable
4	Language usage	3.7	Very Good	90%	Reliable
Average		**3.8**	**Very Good**	**96%**	**Reliable**

The assessment results from the validators also provide suggestions for the Student Worksheets, which are summarized in Table 9. Based on the validity and reliability evaluation results, as well as the revisions made, the developed Student Worksheets is declared valid and ready for implementation in teaching.

Table 9. Suggestions and revisions for student worksheets

No	Suggestions and Revisions for Student Worksheets
1	Improve the formulation of the problems presented to students in the
2	Adjust and refine the titles of each table in the student worksheet.
3	Revise several exercise questions to enhance clarity and understanding.

Results of the Validation and Reliability of the Critical Thinking Skills Test

The validity of the critical thinking skills test items is evaluated based on aspects such as content, construct, and language. A summary of the validity and reliability assessment results for the critical thinking skills test is presented in Table 10.

Table 10. Average scores of validity and reliability of the critical thinking skills test

No	Component	Validity	Category	Reliability	Category
1	Content	4.0	Very Good	96%	Reliable
2	Construc	3.9	Very Good	96%	Reliable
3	Language	3.9	Very Good	100%	Reliable
Average		**3.9**	**Very Good**	**98%**	**Reliable**

The assessment results from the validators also provide suggestions for the critical thinking skills test, which are briefly summarized in Table 10. based on the validity and reliability evaluation results, as well as the revisions made, the Critical Thinking Skills test can proceed to the empirical validity and reliability testing phase.

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Results of the Limited Trial

The limited trial was conducted within a pre-experiment research scheme using the One Group Pretest-Posttest Design. This trial was carried out in one class during the second semester of the 2023/2024 academic year. The results of the limited field trial are presented in Figure 3.

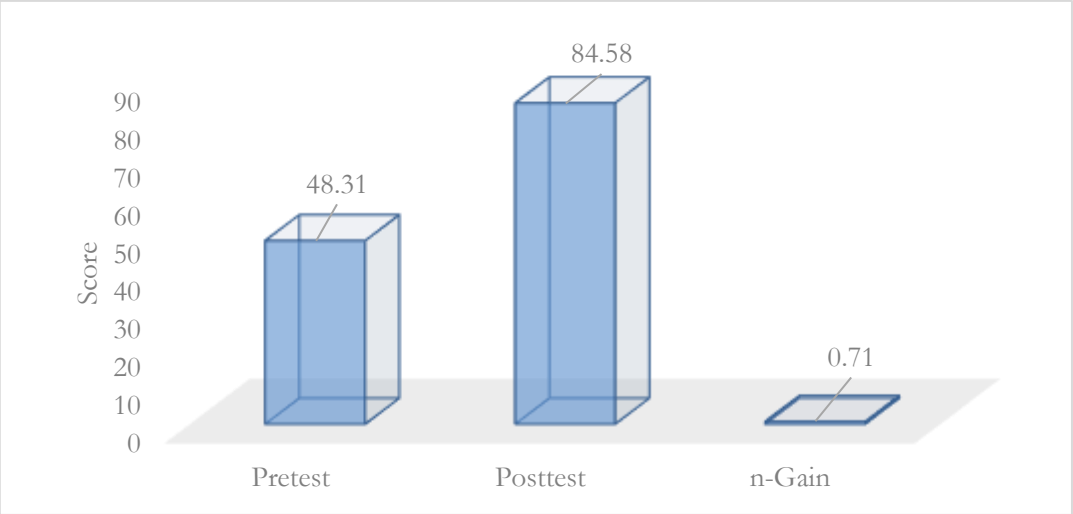

Figure 3. Pretest, posttest, and n-gain results of students' critical thinking skills

Based on Figure 3, it is evident that the average score of students' Critical Thinking Skills has increased. This is reflected in the difference between the pretest and posttest scores, further supported by the n-Gain values for each variable. The Critical Thinking Skills had a pretest score of 48.31 and a posttest score of 84.58, with an n-Gain of 0.71 categorized as high. These results indicate that Hybrid Learning, which combines the Level of Inquiry approach with Moodle, is effective in enhancing students' Critical Thinking Skills. During the limited trial, the researcher also evaluated the challenges encountered throughout the learning process. Several issues and their follow-up actions are summarized in Table 11 below.

Table 11. Challenges and follow-up actions during the trial

No	Challenge	Follow-Up Actions
1	Students faced difficulties logging in and operating the LMS.	Provided training on how to operate the LMS.
2	Students did not fully understand terms used in learning, such as hypothesis, variable, and inquiry procedure.	Offered detailed explanations of these terms and clarified the learning procedures before implementation.
3	Students struggled to design or outline inquiry procedures.	Guided students to find appropriate references and consult on their proposed designs.

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No	Challenge	Follow-Up Actions
4	Students had difficulty finding suitable references.	Taught students how to search for references from textbooks, scientific articles, the internet, and other sources.
5	Students struggled to analyze data and formulate appropriate conclusions related to their inquiries.	Provided guidance and support for students in analyzing data and drawing conclusions based on their inquiries.

DISCUSSION

This research has produced a product in the form of teaching materials for Hybrid Learning in General Biology, combining the Level of Inquiry approach and Moodle. The Level of Inquiry model was chosen because, based on the analysis results, it is the most suitable for first-year students enrolled in the General Biology course. This is supported by experts' opinions stating that the Level of Inquiry learning model can train foundational experience in conducting investigations for students (Bacak & Byker, 2021). The Level of Inquiry approach emphasizes skills and can enhance students' knowledge and confidence in the investigative process.

The characteristics of the Level of Inquiry learning model must be aligned with the General Biology material being taught. The selection of material in General Biology is crucial to support the achievement of the desired learning objectives. In line with this, Usmeldi & Amini (2019) state that during the learning activities, it is important to choose materials that enable students to construct knowledge and skills independently. These five key topics can be taught by involving students in investigative activities, making them highly relevant to the Level of Inquiry learning model. The implementation of the Level of Inquiry can be integrated with technology, thereby supporting the development of Hybrid Learning teaching materials.

The use of technology in the form of Moodle is one adaptation to the implementation of learning that relies on both face-to-face (in-person) and online teaching methods (Almusharraf & Khahro, 2020; Chootongchai & Songkram, 2018; Gunawan et al., 2019). Moodle can address the limitations of in-person learning, which are constrained by space and time, allowing students and instructors to interact and communicate anytime and from anywhere (Herayanti et al., 2018). Moodle is a learning management system (LMS) that creates a digital learning environment, thus greatly supporting both online and in-person learning processes (Amalia et al., 2022; Makruf et al., 2022). An online learning system supported by technology is highly recommended for higher education (Makruf et al., 2022), as it can enhance thinking and innovation skills, as well as foster creativity and motivation among students (Chootongchai & Songkram, 2018; Yu et al., 2018).

The Hybrid Learning teaching materials developed in this research have been validated and deemed appropriate by the validators, making them suitable for use in learning activities. Validity testing is essential to determine the quality or feasibility of the developed product (Quinto, 2022; Sutiani et al., 2021). The validity of these Hybrid Learning materials is generally assessed based on three aspects: learning (teaching materials), the accuracy of concepts/content, and the learning media (Amalia et al., 2022; Khotimah et al., 2021; Sutiani et al., 2021). Overall, the validity test results reached the categories of good and very good, indicating the need for revisions according to the suggestions provided by the validators. The components of the Hybrid Learning materials that have been revised were then input and developed into the Biology LMS portal, which has been prepared according to the expected specifications.

The results of the limited trials provided pre-test and post-test data on students' Critical Thinking Skills. The trial results indicated that students' Critical Thinking Skills improved significantly, achieving a high category (n-Gain = 0.71). The results of the study show a significant improvement in students' critical thinking skills, with an n-Gain score falling into the high category. Compared to previous studies, which generally reported n-Gain scores in the low and medium category (Rizky & Prahani, 2024; Rosyida & Prahani, 2025). This finding indicates that the Hybrid Learning model combining Level of Inquiry (LoI) and Moodle demonstrates greater effectiveness. This is due to the integration of the strengths of face-to-face and online learning into a complementary whole. The level of inquiry encourages students to actively explore, formulate questions, analyze data, and draw conclusions independently (Asmara et al., 2023; Bacak & Byker, 2021). This process directly trains critical thinking skills, as students are not only receiving information but are also encouraged to understand and evaluate it in depth (Artayasa et al., 2018).

On the other hand, Moodle as an online platform provides a flexible, resource-rich, and interactive learning environment (Makruf et al., 2022; Utari et al., 2023). Students can access learning materials, engage in forum discussions, and complete assignments and quizzes independently, anytime and anywhere (Schettini et al., 2020). These features enable students to reflect on their learning, deepen their understanding, and develop arguments in a more structured manner (Mursali et al., 2023). The combination of an investigative approach through the level of inquiry learning and technological support through Moodle creates an active, reflective, and student-centered learning environment, which ultimately has a positive impact on enhancing their critical thinking skills.

Based on the trial and evaluation activities, several challenges and follow-up actions were identified as materials for improvement or revision of the learning activities. The challenges and follow-up actions taken are presented in Table 11. After revisions were made, the developed Hybrid Learning materials became ready to be implemented in the Biology LMS for learning activities. In addition, this study has several limitations that should be considered. First, the product trial was conducted in a limited scale, so the generalizability of the findings remains constrained. Second, the study focused solely on improving critical thinking skills, and therefore, its effectiveness in other aspects such as collaboration or learning motivation has not been measured. Therefore, it is recommended that future studies conduct trials on a broader scale and examine the impact of Hybrid Learning on various student competencies, as well as across different topics or courses.

CONCLUSION

This research has produced a product in the form of Hybrid Learning that combines the Level of Inquiry and Moodle, which is valid, practical, and effective. Based on the results of the study, the following conclusions can be drawn: (1) The developed Hybrid Learning materials are deemed valid and suitable for use in teaching. (2) The Hybrid Learning model, incorporating the Level of Inquiry and Moodle, effectively enhances students' Critical Thinking Skills. Thus, the Hybrid Learning materials taught through the Level of Inquiry with the support of Moodle can serve as a solution for improving Critical Thinking Skills and can be referenced for development in both Biology topics and other educational subjects. In the future, this research can be further improved through broader trials and application across diverse instructional contexts.

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