International Journal of Current Educational Research
Homepage: https://www.journal.iel-education.org/index.php/ijocer
Email: ijocer@iel-education.org
p-ISSN: 2961-8517; e-ISSN: 2961-8509

IJOCER, Vol. 3, No. 2, December 2024

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The Practicality of Innovative Blended Learning Through The Meaning (IBLTM) Model Making to Improve Science Literacy

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DOI: https://doi.org/10.53621/ijocer.v3i2.392

Sections Info

Article history:
Submitted: September 16, 2024
Final Revised: October 30, 2024
Accepted: November 2, 2024
Published: December 31, 2024

Keywords:
IBLTM Model;
Practicality;
Science Literacy.

ABSTRACT

Objective: Science literacy is essential for learners because it allows them to understand, analyze, and apply scientific concepts in everyday life and make decisions based on scientific information. This study aims to describe the practicality of the Innovative Blended Learning Model through Interpretation to improve students' science literacy. **Method:** The research method used was development research. Data collection used observation instruments. Data analysis was implemented using descriptive statistics for practicality tests. **Results:** The results of the trial showed that the level of practicality of the IBLTM learning model is high, which means that the IBLTM learning model is practical enough to be implemented in biology learning. **Novelty:** This research presents new findings related to the practicality of the IBLTM model by emphasizing how this model facilitates the process of deep meaning and active involvement of students in learning.

INTRODUCTION

Science literacy education should empower students to think analytically and solve problems while understanding and contributing to scientific discussions and decision-making in multiple domains. As stated by Rahmayani et al. (2019), the enhancement of science literacy from an early age is a pressing matter of making students informed citizens able to participate freely in community life. According to Kelp et al. (2023), science literacy education aims to enable students to engage in analytical and problem-solving behavior to comprehend and contribute to scientific discussion and decision-making in different fields. Rubini et al. (2019) insist that enhancing science literacy skills starting from an early age is a prerequisite for making students well-informed citizens who can participate effectively in community affairs.

While problems like climate change and health crises underscore the necessity of science literacy for informed decision-making, a strategy of communicating science is not necessarily accompanied by sustainable success. For this reason, the necessity of science education can also be illustrated in distance education. These kinds of courses can be offered in online environments, for example, during the COVID-19 pandemic, if information technology is focused on learning and quality online teaching (Darayseh, 2020; Yasaroh et al., 2022). This digital learning has engaged students with scientific literacy instead of traditional methods, which has never been achieved (Kelana et al., 2021). It would bring an adequate informational and cognitive support level into science learning post-pandemic recovery process expertly designed (Xu & Tang, 2021). The IBLTM model is Thereby, it proposed to improve science literacy through embedding deep elements of online and offline learning; its characteristics are tied to flexibility, interactive technology, collaboration, and problem-solving creativity in attempts so that students would find deep meanings and be actively involved while studying. The distinctiveness of the IBLTM could lie in its approach to learning, which embeds deep science concepts in real-life contexts. This allows students to cognitively engage with the material and internalize the concepts in their daily activities, resulting in a sustained improvement in their science literacy (Balaj et al., 2024; Emran et al., 2024; Putri & Yunani, 2024; Wu et al., 2024; Muharram & Purwarianti, 2024).

The structure of the model is defined in this way because, in a syntactic dimension, five operational stages help problem orientation, guided investigation, problem-solving discussion, negotiation, confirmation, and meaning sharing. The first stage is problem orientation, where basic concepts and learning objectives are explained to initiate some vague understanding for the students (Andy & Kardoyo, 2020). The second stage is guided investigation, where students conduct investigative activities to discover further related concepts that would enhance their scientific literacy (Rusilowati et al., 2019). Problem-solving students discuss findings and solutions resulting from investigations (Rochman et al., 2019). Negotiation and confirmation: Negotiation of ideas and confirmation of understanding are conducted through interaction and feedback (Asiri, 2018).

Learning in all stages concretes, abstracts symbols in the forms of pictures, words, graphs, and texts, which increase students' multi-senses; and the meaning stage makes it possible to understand how learning is connected with real-life situations for better understanding and relevance of the topic matter; which as a result increases students' scientific literacy. Therefore, this IBLTM model must improve scientific literacy and be geared toward learning in knowing, understanding, and applying in real-life situations. This study was conducted to describe the feasibility of the IBLTM model in improving students' scientific literacy. Since it focuses on meaning and active involvement, it must have been able to offer quality science education after the pandemic. This study explicitly describes the practicality of the IBLTM model in improving students' scientific literacy. The research question raised in this article is how practical is the IBLTM Model in the application of science learning in class X at Muhammadiyah 2 High School Sidoarjo?

RESEARCH METHOD

The research process involves further developing the IBLTM learning model for gaining scientific literacy. The practicality was conducted by a limited trial of the IBLTM learning model in Biology learning on the material of biodiversity. Besides practicality, the classroom atmosphere during the learning process is also taken as an observation material. The teacher performs the setting of learning and the observer observes it.

Some preparations were made before implementing and immersing the IBLTM learning model into teaching. These were: 1) making the teachers learn the IBLTM learning model along with the help of supporting learning tools; 2) discussing with observers an overall picture of the IBLTM learning model and their roles in the research; and 3) modeling IBLTM learning to give direct experience to observers. The complete chart of this research can be seen in Figure 1.

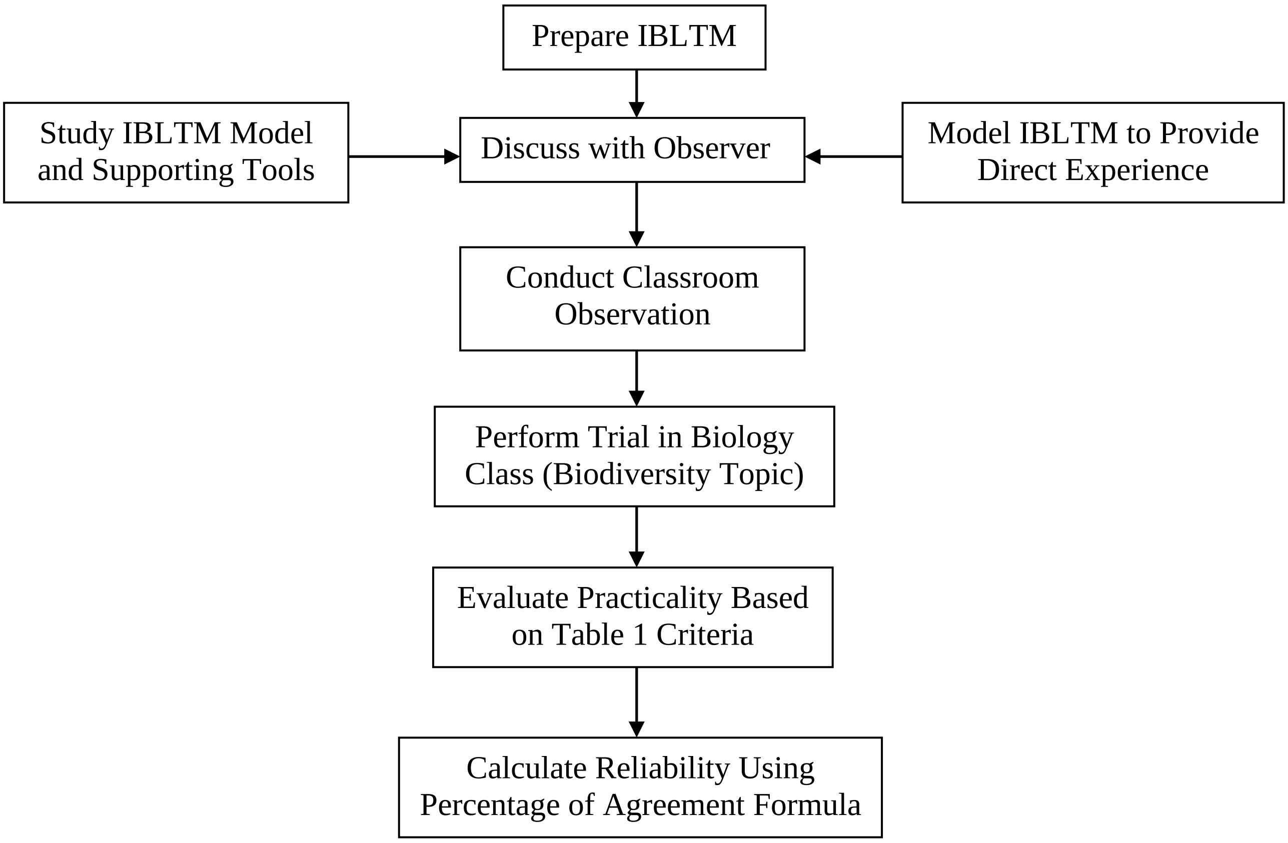

Figure 1. Research procedure.

The subjects in this research were X-1 class students of Muhammadiyah 2 High School Sidoarjo. The material used for biodiversity was the one in the trial. The observation results were then analyzed for their practicability amid the minimum completeness provisions, as elaborated in Table 1.

Table 1. Practicality criteria.

Interval Score	Criteria
$3.25 \leq P \leq 4.00$	Very Good
$2.50 \leq P < 3.25$	Good
$1.75 \leq P < 2.50$	Medium
$1.00 \leq P < 1.75$	Poor

Observation reliability was calculated using the percentage of agreement formula.

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

Description: R = Reliability coefficient
A = Frequency of aspects observed by observers with giving high-frequency
B = Frequency of aspects observed by observers with giving low frequency
The results are considered reliable if the reliability value is ≥ 75.00%.

RESULTS AND DISCUSSION

Results

The results are considered acceptable if the reliability coefficient is ≤ 75.00%. The IBLTM learning model was modeled through an inductive method and put into practice in direct contact with the teachers and observers. Moreover, a pilot test was administered with the help of a teacher. With educational gadgets, a teacher applied biology learning based on the IBLTM learning model. The feasibility of implementing the IBLTM learning model during learning has been presented in Table 3, Table 4, and Table 5.

Table 3. Implementation of IBLTM model learning observation by observer 1.

Learning Model Phase	IBLTM Learning Biodiversity Material	
	Implementation	Information
Orienting students to the problem	3.50	Very Good
Guided investigation	3.50	Very Good
Discussion of problem-solving	3.00	Good
Negotiation and confirmation	3.00	Good
Meaning	3.75	Very Good
Time allocation	3.25	Very Good
Average	3.33	Very Good

Table 3 Represents the Implementation of the IBLTM Model on Biodiversity material by Observer 1. 'Student Orientation to the Problem' and 'Guided Inquiry' returned a score of 3.50, i.e., very good implementation in this Phase of the investigation because the problem was very well presented well and guidance during the inspection, was found to be made use of effectively. 'Problem-Solving Discussion' and 'Negotiation and Confirmation' both returned a score of 3.00, where discussion and confirmation of the findings stipulated by students were done, albeit lukewarm, which further room for improvement lies in encouraging active student participation. The Phase that dealt with reflecting on what has been learned returned a score of 3.75; thus, 'Meaning' got the highest score. This implies a very good association of new knowledge with previous experiences. Allocation of time also drew a very good rating, i.e., 3.25, showing effective time management during learning. The average implementation score was 3.33, which typifies the good category. This shows that implementing the IBLTM model has been workable in supporting learning Biodiversity material.

Table 4. Implementation of IBLTM model learning observation by observer 2.

Learning Model Phase	IBLTM Learning Biodiversity Material	
	Implementation	Information
Orienting students to the problem	3.50	Very Good
Guided investigation	3.38	Very Good
Discussion of problem-solving	2.88	Good
Negotiation and confirmation	3.13	Good
Meaning	3.75	Very Good
Time allocation	3.13	Good
Average	3.29	Very Good

Table 4 presents an excellent learning score on the Biodiversity topic, as measured by the application of the IBLTM model. This corresponds to an average of 3.29. The meaning phase registers the highest score of 3.75 - students can relate concepts to authentic experiences. Problem orientation and guided inquiry were well implemented, as were problem-solving discussions and confirmation negotiations. However, it is noted that the latter two aspects were good but still need improvements in terms of participation and interaction. Though time allocation was fair enough, its management would be optimal for each learning support phase. The IBLTM model is generally effective and viable in enhancing scientific literacy.

Table 3. The practicality of the IBLTM learning model.

Learning Model Phase	IBLTM Learning Biodiversity Material			
	Average Implementation	Description	% R	Description
Orienting students to the problem	3.56	Very Good	100	Reliable
Guided investigation	3.41	Very Good	96	Reliable
Discussion of problem-solving	2.84	Good	96	Reliable
Negotiation and confirmation	3.28	Very Good	96	Reliable
Meaning	3.84	Very Good	100	Reliable
Time allocation	3.00	Good	96	Reliable
Average	3.32	Very Good	99	Reliable

Table 3 shows that the IBLTM Learning Model in learning biodiversity material is reasonably practical, with an average implementation value of 3.32 (Very Good) and a reliability of 99.00%. Every problem orientation (3.56, 100.00%), guided inquiry (3.41, 96%), negotiation and confirmation (3.28, 96.00%), and meaning (3.84, 100.00%) were implemented well and reliably, even though both the discussion of problem-solving and time allocation had lower implementation values for each Phase (2.84, 3.00) were relatively reliable (96.00%). This indicates that IBLTM is a pragmatic model that effectively enhances students' scientific literacy.

Discussion

The study results have justified that the IBLTM model improves students' scientific literacy outcomes after learning biodiversity. The average value of the observer's practice score was the Excellent value of 3.32 with 99.00% reliability; this is excellent because it can be practically applied. Further increased mean scores at the interpretation stage indicated that students could relate the lessons they learned with authentic experiences that were most valuable to each other. In cooperation with research by Setiawan et al. (2018) and Nurhasanah et al. (2022), who stated that integrative learning models on meaning and real experience have a substantial influence in enhancing conceptual understanding as to how far students link the theory to the context of life. This further corroborates the findings of Aminah et al. (2022), Sinaga et al. (2021), and Afifah and Nafi'an (2019) in their research work. According to the significance, each answer explicitly carries another most important role in the realization stage for students' deep absorption insight.

This stage gets the highest score in both observations, implying that students memorize the material and understand the context and application of important indicators for mastering scientific literacy. Problem-solving discussions and confirmation negotiations tend to secure lower scores (average 3.00), indicating little empowerment towards student interaction and activeness. Rahmawan et al. (2020) and Tarigan et al. (2019) further corroborate that discussion modeling in inquiry-based learning models generally poses a considerable challenge and demands even more teacher facilitation skills considering how to draw student participation more effectively. The IBLTM model, as compared with others, is better for learning time management. Optimal blended learning models are the more effective in time efficiency in learning (Putri, 2021; Sari et al., 2018; Rahman et al., 2020; Ngabekti et al., 2020; Sabtiawan et al., 2021)

Time allocation has been rated as very good for all three learning activities (3.25 in Observer 1 and 3.13 in Observer 2) — meaning that learning time was well managed to support each Phase of IBLTM. The most important Phase that still needs discussion, time management, is known as having the highest average Sulisworo, (2018); Octavia et al., (2021); Putera & Ariany, (2021); and Hashim & Hamidon, (2022) all find that more time is taken to learn in blended teachings compared to the teaching that is entirely traditional because it is interactive and incorporates the total contribution of each student. Thus, this is not a question at all. It is a question-formulation strategy.

From the perspective of the model's practicality, this model can be applied stably with a very high level of reliability. Therefore, the results obtained with the use of the IBLTM model are reliable in diverse learning contexts. This finding is consistent with the reports made by Candiasa et al. (2019), Dubauskienė et al. (2020), and Raud et al. (2018), strongly emphasizing reliability in innovative learning models, making sure that the strategies implemented can be reproduced to produce similar results over time. Problem orientation and guided inquiry were very well-rated aspects, concluding that students could follow a well-structured learning trajectory — significant for a learning model that marries inquiry with experiential learning.

The findings justify that the study's results can be generalized and that the IBLMP model is pertinent for facilitating more relevant learning and enhancing science literacy for students. The models' pros are, thus, majorly in the construction of meaning with students anchoring new information to previous experiences, a fact that traditional learning models tend to overlook (Istiqomah et al., 2023). However, optimal results necessitate further improvement in reinforcement and more optimal time management so that all steps of learning can be executed effectively and efficiently in the discussion and interaction phase.

These findings are, therefore, the basis for further research aimed at finding more effective strategies to enhance student engagement in discussion and verification of the learning phase's end results.

CONCLUSION

Fundamental Finding: This research has confirmed that the Innovative Blended Learning Through Meaning (IBLTM) model has very high practicality and the average implementation score in very good criteria. This proves that the IBLTM is a reliable and effective learning approach for classroom application. Very high, meaning a high-meaning phase score reflects how well the model provides meaningful learning experiences by associating science concepts with students' prior knowledge and real-world contexts. The model scored very high in this aspect. **Implication:** The practical implications of this study are that science teachers may enhance students' science literacy using the IBLTM model. The staged progression from problem-based orientation through guided inquiry and meaning-making in this model contributes to improved critical thinking and conceptual understanding. Hence, science educators must apply this model to enhance students' engagement with the content and resultant learning. **Limitation:** Thus, from this study, science literacy among students can be improved if teachers use the IBLTM model. The structured stages, from problem-based orientation to guided inquiry and meaning-making in this model, contribute to improving critical thinking skills and conceptual understanding. Hence, science educators must practice enhancing student interaction with content and learning from it. **Future Research:** Future studies should investigate the feasibility of scaling the IBLTM model across secondary, primary, and tertiary education. Additional study is warranted to determine the efficacy and sustainability of the model when applied to other content areas apart from biology. Only afterward can its sustainability and efficacy, in general, be gauged regarding enhancing scientific literacy in varying educational settings.

ACKNOWLEDGEMENTS

The authors appreciate all the observers and respondents during the study for their invaluable contributions and insights. Each of their participation was of great importance in assessing the applicability of the IBLTM model and providing such rich data for this study. Many thanks also go to the teachers who, despite hectic schedules, have implemented this model in their classes and provided direct feedback on its implementation and effect.

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