International Journal of Emerging Research and Review
Homepage : https://ijoerar.net/index.php/ijoerar
p-ISSN : 3024-8825; e-ISSN : 3021-8950

IJOERAR, Vol. 4, No. 1, March 2026
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International Journal of Emerging Research and Review

Validity of CELL Model to Nurturing Student's Ethnoscience Literacy and Collaborative Skill

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DOI: https://doi.org/10.56707/ijoerar.v4i1.154

Sections Info

Article history:
Submitted: December 5, 2026
Final Revised: December 13, 2026
Accepted: December 17, 2026
Published: January 01, 2026

Keywords:
Validity
CELL Model
Ethnoscientific Literacy
Collaborative skill

ABSTRACT

Objectives: *Ethnoscience literacy learning trains students to understand and solve complex problems with a holistic, culture-based approach. Collaborative skills prepare students to work in teams to face the challenges of interconnected life in the 21st century. Previous research found that students' scientific literacy competencies and collaboration skills in several regions in Indonesia still need improvement. Scientific literacy integrated local wisdom and students' socio-emotional skills. Learning interventions are needed to prepare students to face global challenges. This study aims to validate the CELL learning model.* ***Method:*** *Educational development research was used as the research design, involving two criteria: content validation and construct validation. Three experts in the fields of pedagogy, science content, and learning assessment validated the CELL learning model.* ***Results:*** *The research results and data analysis indicated that the CELL learning model has consistently provided relevant results. The CELL model has met strict validity and reliability standards (with an agreement percentage >75%).* ***Novelty:*** *Validated learning support components includes lesson plans, student textbooks, student worksheet, ethnoscience literacy tests and collaborative skills. The CELL learning model can be applied to train students' ethnoscience literacy competencies and collaborative skills by integrating science with local wisdom and students' socio-emotional development. The CELL learning model is suitable for meaningful science learning and developing students' social skills.*

INTRODUCTION

Globalization has resulted in complex data transfers, and access to information has become crucial for producing knowledge. Society tends to rely heavily on information for educational purposes, interaction, and communication with others. Therefore, a responsive and adaptive education system design is required (Stein, 2021 ;Hadar, 2020). The Partnership for 21st Century Learning Framework states that students need to be equipped with 21st-century skills, including knowledge construction, real-world problem-solving, the use of learning technology, and communication and collaboration skills (Stehle & Peters, 2019). Current curriculum demands emphasize enjoyable, in-depth, and meaningful learning, one of which is through the phenomenon of local community wisdom (ethnoscience). This statement indicates that ethnoscience literacy competencies and collaboration skills are crucial and require ongoing training. Students can understand, construct, analyze, and evaluate scientific knowledge developing in society based on facts and data. Students are also able to collaborate in solving local community problems. Therefore, a learning model is needed that makes students more literate, selective and critical of information developing in society and the digital world.

Ethnoscience is knowledge gained from the study of local wisdom contained within the culture of a particular community or ethnic group (Dewi et al., 2021). This local knowledge is generated through reasoning and ideas, including traditional culture, beliefs, and community perspectives on a matter. Indigenous knowledge can take the form of material phenomena deemed important and organized by the community. This knowledge can include information about the use and management of resources, flora and fauna classification systems, social interactions, cultural practices, and even spirituality (Nalau, 2018; Kasi, 2021). The knowledge generated by local communities is holistic-integrative, functional, and adaptive to changes in the natural, cultural, social, and economic environments (Zidny & Eilks, 2022; Parmin, 2019). Thus, ethnoscience literacy can be defined as the ability to find information, understand, analyze, evaluate and reflect on scientific phenomena of community wisdom so that students are able to play an active role in solving scientific problems and issues in local and global communities.

Collaboration is the skill of working together and interacting effectively with others to achieve shared goals (Järvenoja et al., 2020). Collaboration skills are part of social intelligence, involving interpersonal and intrapersonal intelligence. Collaboration skills are formed from the growth of empathy and courage to communicate, so that each member can contribute according to their expertise in achieving the same goal. Students with collaborative skills will exchange thoughts, ideas, and feelings with fellow students at the same level (Dewi, 2021). Collaboration skills in learning emphasize social interaction in building knowledge. Students can collaborate intellectually, both among themselves and with the teacher in their learning activities.

Various learning models that have been researched and assessed positively in training students' ethnoscientific literacy and collaboration skill include inquiry-based learning models (Hastuti, 2022), open inquiry (Parmin & Fibriana, 2019; Kang, 2020), guided inquiry (Alim, 2020). Learning models using the Contextual Teaching approach are also used to improve local wisdom-based scientific literacy skills that are directly integrated with chemical topics (Yuliana, 2021; Sumarni, 2020; Dewi, 2021;Azura & Hariyono, 2023). Inquiry-based learning is oriented toward investigative activities that actively engage students in scientific questions. However, in other situations, students' basic reading skills are very low, impacting their ability to analyze observational data and understand contextual knowledge (Shaffer & Denaaro, 2019). Research on students' ethnoscience literacy competencies in several regions in Indonesia still needs improvement. Only 37.30% of junior high school students out of 65 students have achieved the ability to explain scientific phenomena and local wisdom in coastal ecosystems (Shofatun, 2021). Inquiry-based science teaching is highly recommended for practicing scientific literacy (Aditomo & Klime, 2020). Collaborative inquiry can be a medium to facilitate learning to improve students' scientific literacy competencies and social skills, such as cooperation and teamwork.

Student involvement in learning through local wisdom is considered to train students' understanding of scientific concepts and communication, problem-solving skills, and awareness of cultural identity (Rahmawati, et al., 2020). This condition can be more easily implemented through learning that trains students' collaborative skills (Arends, 2012) thereby increasing the activity of achieving sustainable acquisition, learning motivation, and student interest in science (Peterscu, 2018). Teachers can practice ethnoscience literacy skills through collaborative activities in designing experiments and collecting data. Collaborative activities to practice ethnoscience literacy skills can be facilitated by stimulating interesting phenomena or problems closely related to life in the local community.

The results of theoretical and empirical studies on the advantages and limitations of inquiry learning models (Pedaste, 2015; Shaffer & Denaaro, 2019), ethnopedagogy (Rahmawati, 2020; Sándor, 2019) and Integrated Teaching Strategy (Villanueva, 2010) have developed the Collaborative Ethnoscientific Literacy Learning (CELL) learning model. The development of the CELL model is supported by sociocognitive and constructivist learning theories such as attention, retention, production, motivation, the reciprocal causation model, scaffolding, and Zone of Proximal Development. Students can conduct collaborative investigations (phase 3) by enriching the content of local wisdom science and simultaneously providing opportunities for students to construct the knowledge they have acquired through the construction and reflection phases. When students share information and share ideas with others, distributed cognition occurs, it called distributed cognition learning (Moreno, 2010). The Reciprocal Causation model shows the interconnected relationship between environmental components, behavior, and personal beliefs that influence each other in student learning activities. Students can have ethnoscience literacy skills when the learning environment stimulates and encourages scientific-oriented activities with the availability of richer learning resources, one of which is local wisdom knowledge. Teachers should facilitate and provide teaching materials and a conducive environment to support students in constructing their own knowledge. Students need social interaction so that they can encourage the process of constructing knowledge obtained from the potential of local wisdom and the development of students' ethnoscience literacy skills.

This CELL learning model is predicted to have various advantages including facilitating learning activities that integrate ethnoscience content using multiple modalities strategies, training students in conducting collaborative investigations with enrichment of local wisdom science content and providing opportunities for students to construct the knowledge they have acquired through the construction and reflection phases. So, how is the validity of the Collaborative Ethnoscientific Literacy Learning (CELL) learning model in training ethnoscience literacy competencies and collaboration skills of junior high school students.

RESEARCH METHOD

This type of research is classified as Research and Development (R&D) adapted from the Plomp Model development design (Plomp & Nieveen, 2013). The development of the CELL model is at least valid, practical, and effective (Plomp & Nieveen, 2007). Tessmer (1993) explains that the quality of research and development products is effective, efficient, motivating for users, easy to use, and affordable. The validity of the CELL model is designed logically and consistently based on the state of the art of knowledge. The CELL model is said to be valid if it meets content validity and construct validity. The development product is said to be practical if it is easy for teachers to implement. The

CELL model is said to be effective when it is able to improve students' ethnoscience literacy competencies and collaboration skills.

The purpose of this educational development research is to create specific educational materials and assess the effectiveness of these material. The educational development research stages of the Plomp model consist of five stages: 1) Preliminary research, 2) Prototype design and construction), 3) Validation, 4) Assessment and 5) Implementation. This study presents the results of the validation stage. The validation stage was carried out by three experts in the fields of pedagogy, science content and assessment to validate the CELL learning model book, learning tools and research instruments. These validators possess extensive experience in their fields and hold the highest educational qualifications, from doctoral programs to professorships, as experts in their fields. Validation instruments are used to determine the suitability and quality of the product on a scale of 1-5. The validity of the CELL model product development results must meet at least the minimum standard criteria of $0.50 \leq V < 0.75$, categorized as valid. Differences arising from the validation process are then discussed in a group discussion forum to reach a consensus. The steps of the research method are interpreted in Figure 1.

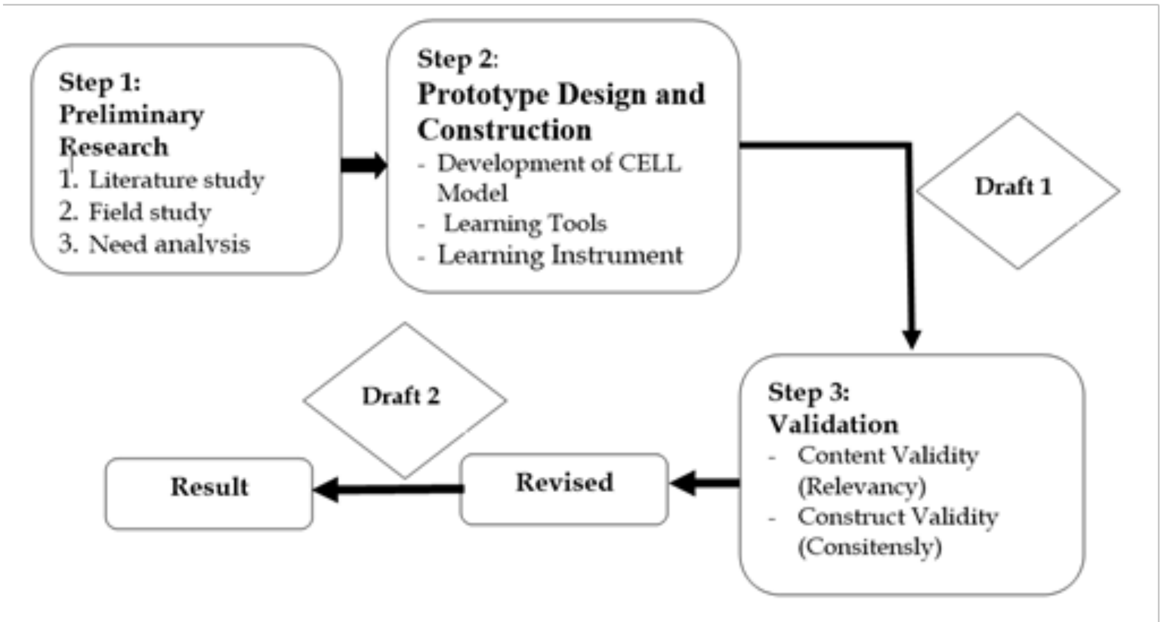

Figure 1. The steps of the research method.

The CELL learning model and its supporting tools have been validated by three experts in the fields of pedagogy, learning materials, and learning assessment. The validation data were then analyzed using Aiken's Validity Coefficient (V) with the following formula.

$$\mathbf{V = \sum S / [n(C-1)]}$$
$$\mathbf{S = R - Lo}$$

Description:

V = Aiken Index

S = Score given by the assessor minus the lowest score in the category

R = Score given by the assessor

Lo = Lowest assessment score
C = Highest assessment score
n = Number of validators (assessors).

The validation results were then analyzed descriptively and adjusted according to the model validation categorization criteria as shown in Table 1.

Table 1. CELL Model Validation Categorization Criteria and Learning Supporting Tools

Score intervals	Category	Description
$0.75 \leq V < 1.00$	Very valid	It can be utilized without any need for modification
$0.50 \leq V < 0.75$	Valid	Can be utilized with slight modification
$0.25 \leq V < 0.50$	Quite Valid	It is compatible with difference version
$0.00 \leq V < 0.25$	Invalid	It is inoperable and necessitates consultation

The validity of the developed product results meets the minimum standard criteria in the interval $0.50 \leq V < 0.75$ with the valid category. The reliability of the model validation instrument and supporting tools for the CELL learning model was determined by calculating the level of agreement between observers. Validation results are reliable if the reliability value ≥ 75% (Borich, 2017).

RESULTS AND DISCUSSION

Results

This research resulted in a Collaborative Ethnoscientific Literacy Learning (CELL) learning model developed based on theoretical and empirical studies of Inquiry Based Learning, Ethnopedagogy and Integrated Teaching Strategy. The CELL model is expected to train students' ethnoscientific literacy competencies and collaboration skills. The characteristics of this learning model provide opportunities for students to construct scientific knowledge of local community wisdom through literacy strategies, integration with Indigeneous knowlede, communication and collaboration skills. The CELL learning model that has been developed has 6 syntaxes, namely: 1.) Observation of the local wisdom phenomenon; 2.) Integration of ethnoscience content; 3.) Collaborative investigation; 4.) Construction and analysis the result of experiment; 5.) Communication of new knowledge construction; and 6.) Reflection the ethnoscience learning experiences. The CELL learning model is presented in the figure 2.

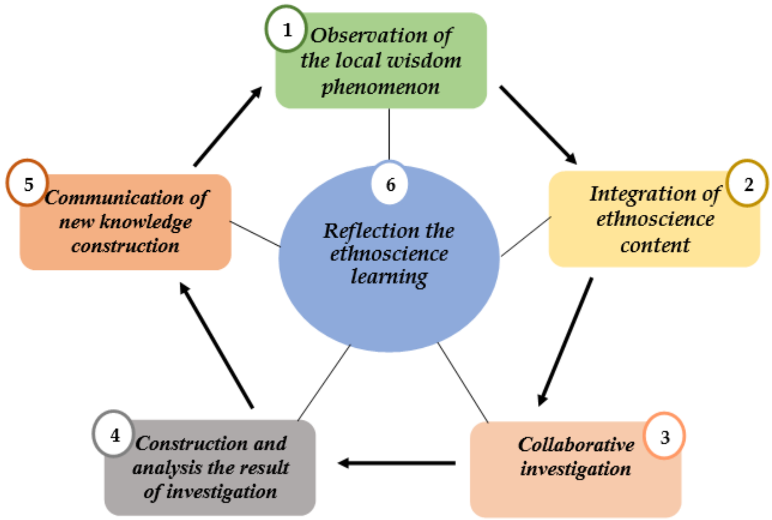

Figure 2. Syntax of the CELL Learning Model

The content validity of the CELL model contains five aspects/components validated by experts, including the need for developing the CELL model, state of the art knowledge, the chronology of the formation of the CELL model, the implementation of the CELL model, and the description of the CELL model. The validation data, conducted by three experts in their fields, were then analyzed using the Aiken's Validity Coefficient formula (Aiken, 1985) and the level of reliability was measured using the Percentage of Agreement statistical analysis (Borich, 2017). The results of the content validity measurements can be seen in Table 2.

Table 2. The Results of the Content Validity of CELL Model

No	Indicator	Validity		Reliability	
		V	Description	R	Description
1	Need for CELL model development	0.90	Very valid	96%	Reliable
2	State of the art knowledge	0.96	Very valid	95%	Reliable
3	Chronological sequence of the CELL model formation	0.81	Very valid	85%	Reliable
4	Implementation of the CELL Model	1.00	Very valid	100%	Reliable
5	Description of CELL Model	0.96	Very valid	95%	Reliable

V= Aiken's validity Score; R = Koefisien *Inter-observer agreement*

Construct validation was used to determine the feasibility of the CELL learning model by rationalizing the learning model, consistency of the theoretical basis, learning syntax, environment learning management, learning reaction principle, Instructional and Accompanying Impact, and evaluation. The results of the construct validation of the CELL model development can be seen in Table 3.

Table 3. Result of the Construct Validation and Reliability

No	Indicator	Validity		Reliability	
		V	Description	R	Description
1	Rationality of the CELL Model	0.97	Very valid	96%	Reliabel
2	Theoretical and empirical support of the CELL model	0.93	Very valid	92%	Reliabel
3	Syntax of the CELL model	0.99	Very valid	99%	Reliabel
4	Social Learning System	0.97	Very valid	96%	Reliabel
5	Reaction Principle in learning	0.92	Very valid	91%	Reliabel
6	Supporting system in learning	0.92	Very valid	94%	Reliabel
7	Instructional and Accompanying Impact	1.00	Very valid	100%	Reliabel
8	Learning Environment	0.96	Very valid	94%	Reliabel
9	Evaluation	0.83	Very valid	89%	Reliabel

V= Aiken's validity Score; R = Coefficient *Inter-observer agreement*

Learning tools supporting the implementation of the CELL model development were also validated. Validation content and construct were conducted to measure the suitability and consistency of the learning support tools to train students' ethnoscience literacy competencies and collaboration skills. The supporting tools for the CELL model development included lesson plans, student activity sheets, student textbooks, and ethnoscience literacy-oriented learning assessment sheets. Three validators assessed the validity of these supporting tools using validation instruments provided by the researchers. The findings of the content and construct validation results are presented in Table 4.

Table 4. Result of Validity Content and Construct of Supporting Learning Tools of CELL Model

No	Indicator	Validity		Reliability	
		V	Description	R	Description
1	Syllabus	0.92	Very valid	90%	Reliable
2	Lesson Plan	0.90	Very valid	90%	Reliable
3	Student activity sheets	0.85	Very valid	88%	Reliable
4	Student textbooks	0.91	Very valid	95%	Reliable
5	Ethnoscience literacy-oriented learning assessment sheets	0.94	Very valid	91%	Reliable

Discussion

The CELL (Collaborative Ethnoscientific Literacy Learning) model is considered valid and consistent. This is based on the results of the CELL model validation activities carried out by three experts in their fields, including experts in pedagogy, science materials, and learning assessment. The results of the three validators' assessments are presented in table 1, 2 and 3. The content validation of the CELL learning model that has been developed are proven to be valid and can be applied in learning with slight revision. This CELL model fulfills 6 components included syntax, social systems, reaction principles, support systems, instructional impacts and accompanion impacts, as well as a supportive learning environment.

The CELL model is the result of integration with an ethnopedagogical approach. Ethnoscientific literacy can also be learned through an ethnopedagogical model developed to practice science learning integrated with local culture (Rahmawati et al., 2020). The CELL model was developed by integrating various dimensions of local wisdom (Nalau et al., 2018; Parmin & Fibriana, 2019; Dewi et al., 2021). It is hoped that enriching the scientific content with indigenous knowledge will further strengthen students' understanding of scientific literacy, both content-wise and contextually. The development of the CELL model focuses not only on students' cognitive and socio-emotional aspects but also on sensitive and wise behavior in maintaining the potential and preserving the nation's nature and culture. Therefore, the CELL model can be a variation of the learning model that prioritizes the goal of achieving Education for Sustainable Development (ESD).

The average content validity score of the CELL model was 0.92, with the criteria of being very valid and reliability level of 93.95%. The analysis of the needs for the CELL model was considered highly relevant to the demands of 21st-century education in the aspects of global awareness, citizenship literacy, and collaboration skills. Students can learn individually, partnerships, or in groups, studying various indigenous knowledge from their surroundings, religion, and lifestyle with a spirit of mutual respect in personal, work, and community contexts. Activities in phase 4, analyzing experimental data, train students to think in complex and interdisciplinary ways. Students have integrated knowledge content with culture, thus creating opportunities for differences in interpretation and conceptual debate between students and teachers (Sándor, 2019). Students at this stage can more easily understand the specific attributes of a concept, making the concept more concrete and serving as an effective way to recall information in the long term (Arends, 2012). Various multiple learning modalities such as read it, write it, do it, and talk it will further support the way science content is learned and train scientific literacy skills (Odegaard, 2015; Anderson, 2017).

The CELL model phase sequence begins with observation of the local wisdom phenomenon. In this initial learning stage, students are stimulated to be curious by presenting contextual phenomena around them through Local Wisdom Socialscience Issues (LWSI). Interesting phenomena need to be presented in provocative problem situations and are expected to arouse curiosity through question participation (Slavin, 2018). Students have strong intrinsic motivation so they can increasingly explore knowledge and information that is relevant in life (Rahmawati, Ridwan, Cahyana, et al., 2020). Next, students can listen, see, watch, and observe the local wisdom science phenomenon presented through images, videos or direct field observations. Students can convey arguments through Student worksheets and then can convey findings/problems from the phenomenon. Student activities in examining LWSI are part of presenting a natural knowledge system that can train the scientific process (prediction) and have practical applications (Khusainov, 2015; Zidny, 2021), train scientific communication and awareness of cultural identity (Hadi, 2020; Rahmawati, 2020).

In the second phase, students integrate the content of local wisdom knowledge with scientific concepts, so that students have a comprehensive and multidimensional understanding. In the table 2, the construct validation results in this second phase were 0.83 (very valid criteria) and a reliability level of 75%. This phase is an important step in training students' basic literacy skills in finding information and understanding scientific concepts from the local wisdom phenomena presented before they conduct investigations. This condition addresses empirical evidence from previous research, which shows that junior high school students' scientific literacy skills in explaining scientific phenomena are still low, has reached 37.30% in the coastal community ecosystem material (Shofatun, 2021). This is in accordance with the theory of whole language learning, which states that language and communication skills will be honed when literacy activities are included in all aspects of the curriculum through assignments, life problems, and various authentic contexts in learning (Slavin, 2018).

Improvements to the CELL model occurred in phase 3, namely Collaborative Investigation. The construct validity results for the third phase were 0.83 with valid criteria and a reliability level of 89%. Activities at this stage were carried out in groups. This stage aims to improve scientific literacy skills, especially the aspect of designing scientific investigations by reviewing or testing and or increasing the value of local wisdom knowledge through guidance from the Student Activity Sheet. Students' understanding of scientific concepts provides a foundation for evaluating and designing ethnoscience-based scientific investigations. Learning through this collaborative investigation is expected to provide benefits in increasing student engagement in learning, achieving sustainable acquisition, increasing motivation and interest of each individual (Peterscu, 2018; Järvenoja, 2020). More importantly, it aims to train good practical work in measuring scientific performance, designing experiments and collecting data both synchronously and asynchronously so that students' scientific literacy is sharpened. The phenomenon of ethnoscience is so unique and diverse that it's highly likely that not all of it can be experimented with as with general scientific concepts. Therefore, the term "investigation" provides broad and flexible scope for the application of the CELL model.

Based on table 3, the validity of the supporting tools of the CELL model, including the syllabus, lesson plan, studentbook, workbook, and ethnoscience literacy competency assessment, obtained an average value of 0.90 (valid category), with a reliability value of 91% (reliable category). The level of agreement was more than 75%. This can be concluded that the validity of the ethnoscience literacy competency items is valid with very good criteria. The validity of the content of the CELL model development contained in the model book also has very good criteria. This means that the CELL model design contained in the model book is categorized as very feasible and consistent.

Learning to train students' ethnoscience literacy and collaboration skills requires special design in science learning which can be done by: (1) Conducting joint discussion activities (dialogue) by providing feedback to each other on information obtained or presented about the values of local wisdom knowledge studies in the community

(Rahmawati, 2020; Dewi, 2021; Toleubekova & Zhumataeva, 2018), (2) integrating scientific investigations with literacy-based learning modalities such as reading, writing, doing and communicating activities (Hastuti, 2019; Novitasari et al., 2017; (Yuliana, 2021) (3) emphasizing a scientific approach through observing local wisdom phenomena, formulating questions, investigating, processing and presenting data (Parmin, 2019; Verawati & Wahyudi, 2024) (4) through collaborative learning activities using literacy-based strategies (Dewi, 2021) and (5) reflecting the value of direct experience related to issues that develop in the socio-cultural life of local communities (Alim, 2020; Zidny & Eilks, 2022). Based on the analysis of the content, language, and construct assessment results from the three validators, the research hypothesis has been proven to produce learning products in the form of learning models, student books, workbooks, student activity sheets, and ethnoscience literacy and collaboration skills test instruments in science subjects.

CONCLUSION

Fundamental Findings: The developed CELL learning model has been proven to be valid in terms of content and construct and is effective in training junior high school students' ethnoscience literacy competencies and collaboration skills. **Implications:** The CELL learning model is designed to train students' ethnoscience literacy competencies through Whole Language Learning Theory. Integrating ethnoscience content through reading literacy strategies will make it easier for students to receive, interpret, evaluate, and reflect on information. The application of the CELL model is also aligned with sociocognitive and constructivist theories. Collaborative learning will develop students' potential to contribute the real-world problems in society and the surrounding environment. This also further supports to education for sustainability. **Limitation:** Students have limitations in collaborative investigation in designing, determining research variables, and analyzing ethnoscience-based investigations. **Future Research:** The validity of the CELL learning model needs to be ensured for its effectiveness in classroom implementation using various topics and technology integration in learning.

ACKNOWLEDGEMENTS

The author would like to thank teacher, observer and the Muhammadiyah Elementary and Secondary Education Council of GKB Gresik, East Java, Indonesia, for providing support and facilities in conducting this research.

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