

Development and Validation of a Local Wisdom-Based Ecoliteracy Instrument for Indonesian University Students

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Abstract: Ecoliteracy integrates ecological and sustainability principles into education, emphasizing the interconnection between humans and the environment while incorporating local wisdom and traditional knowledge. This approach provides a comprehensive perspective that bridges environmental education with cultural and ethical dimensions. The present study aimed to develop and validate an ecoliteracy instrument based on local wisdom specifically for university students in Indonesia. A total of 326 students participated in this study. The instrument development followed three stages: (1) creation of dimensions and items with expert validation, (2) Exploratory Factor Analysis (EFA) and data reduction, and (3) internal consistency testing through Confirmatory Factor Analysis (CFA). The final instrument comprised 28 items across six dimensions: (1) Spiritual Values and Sacredness of Nature, (2) Traditional Sustainability Practices, (3) Togetherness and Community, (4) Folklore and Local Knowledge, (5) Environmental Ethics, and (6) Contextual Adaptation. The instrument demonstrated strong validity and reliability: KMO = 0.849, CFA confirmed a six-factor model with excellent fit (CFI = 0.956, SRMR = 0.031), and Cronbach's alpha ranged from 0.687 to 0.990 across dimensions. The instrument employs multiple-choice questions to assess ecological knowledge, awareness, attitudes, and sustainable behavior, providing a practical and culturally relevant tool. These results indicate that the developed instrument is a reliable, valid, and contextually appropriate tool for evaluating the implementation of ecoliteracy in higher education, contributing to both academic assessment and the promotion of environmentally responsible behavior among students.

Keywords: Ecoliteracy Assessment Instrument, Higher Education Sustainability Measurement, Local Wisdom-Based Scale Development

A. Introduction

The current global environmental crisis presents a strategic challenge for higher education to prepare graduates who are not only academically excellent but also have ethical awareness and commitment to ecological sustainability. In line with this need,

the measurement of student ecoliteracy in Indonesian universities is still largely carried out using instruments that refer to global frameworks. The indicators developed and applied have not been fully formulated to accommodate ecological cultural practices and customary norms that have evolved from local wisdom (Risqo M. Wahid et al., 2020; Supriatna, 2016). This condition emphasises the need to develop instruments that integrate a contextual approach, so that they can reflect the ecological reality as well as the socio-cultural dynamics of Indonesia. This approach is crucial so that the measurement of ecological literacy remains valid, relevant, and meaningful locally (Pilgrim et al., 2007; Pitman & Daniels, 2016). Without indicators that are designed and tested contextually, ecological literacy measurements risk experiencing construct bias, failing to encourage respondent participation, and being limited in their function as a basis for policy formulation, curriculum development, and the development of environmental education interventions in higher education (Pilgrim et al., 2007; Pitman & Daniels, 2016).

The concept of ecoliteracy was first introduced by David Orr, who defined it as the ability to understand the interconnectedness between human systems and the web of life on Earth, as well as an ethical foundation for education in addressing the environmental crisis in the Anthropocene era (Orr, 1991). Ecological literacy is not only related to knowledge about environmental issues, but also includes relational understanding, awareness of ecological limits, and moral responsibility for the planet's carrying capacity (Aguayo & Eames, 2017; Sharma, 2023). This thinking emphasises that ecoliteracy needs to be measured as a competency that combines conceptual understanding with ethical-ecological sensitivity. The concept of ecoliteracy was later expanded by Fritjof Capra, who viewed this ability as the ability to 'read relationships' in life systems through systems thinking, namely understanding patterns, feedback, interconnections, and principles of sustainability in living systems (Capra, 2007). According to Capra, ecology is the science of interconnectedness, not merely partial observation of environmental phenomena. These systems thinking approach is an important aspect in designing more comprehensive and meaningful ecoliteracy indicators (Arifiani et al., 2019).

The ecoliteracy development framework also refers to the indicators proposed by Goleman et al., (2012), which cover five domains: empathy towards living things and ecological systems, pro-environmental behaviour practices, visibility or awareness of human-environment relationships, real solutions in sustainable decision-making, and evaluation of facts to critically understand ecological impacts. This framework serves as a guide in formulating the domains of ecoliteracy measurement in higher education. However, because many indicators are universal in nature, contextualisation through Indonesian local wisdom is important to maintain the validity and relevance of the measurements (Pilgrim et al., 2007; Sarbaini et al., 2022).

Indonesia possesses a wealth of local wisdom that expresses ecological relations in practical, ethical, and social terms. Many communities maintain environmental sustainability through customary norms, restrictions on resource use, collective practices such as mutual assistance, and moral narratives that emphasise human-nature harmony as a shared value (Butler, 2017; Misnah et al., 2020; Supriatna, 2016). These culturally based ecological values can enrich indicators of knowledge, engagement, and pro-environmental behaviour, thereby strengthening ecoliteracy measurements to be more representative of Indonesian students' experiences (Misnah et al., 2020; Sharma, 2023). Therefore, the development of ecoliteracy instruments based on local wisdom is not only socially and culturally relevant, but also methodologically important to ensure the validity of constructs and the accuracy of indicators in higher education assessment. Local wisdom in this study is used as a basis for adjusting indicators and context, while the theories of Orr, Capra, and Goleman remain the conceptual foundation for construct development and psychometric instrument validation (Aguayo & Eames, 2017; Ardoin et al., 2020; Arifiani et al., 2019; Goleman et al., 2013; Pilgrim et al., 2007). Based on the need to close the instrument gap, ensure suitability to the cultural context and behavioural learning environment of Indonesian students, and provide culturally valid and psychometrically tested instruments, this study aims to develop and validate a locally based ecoliteracy instrument for Indonesian students. This instrument aims to produce a contextual measuring tool capable of assessing the knowledge, systems thinking, eco-ethical awareness, and sustainable behaviour of students in Indonesian higher education institutions.

B. Methods

General Background

The development of an ecoliteracy instrument based on local wisdom follows a structured process involving multiple stages: (1) development of dimensions, item construction, and expert validation; (2) Exploratory Factor Analysis (EFA), content validity, and data reduction; and (3) internal consistency testing through Confirmatory Factor Analysis (CFA) (Rahman, 2019; Suparman et al., 2024; Tambling et al., 2022). This instrument is designed to measure university students' understanding, awareness, and behavior regarding ecological concepts and sustainability, focusing on the integration of local wisdom values. The goal is to help educators design more relevant and effective learning strategies based on these cultural insights.

Participants

The study involved 326 biology education students from various universities across Indonesia. With a sample size of 150 or more, the study met the requirements for factor

analysis. The participant pool consisted of 70% females (n = 228) and 30% males (n = 98). They were selected from major islands in Indonesia: 40% from Sulawesi (n = 130), 30% from Java (n = 98), 20% from Sumatra (n = 65), and 10% from Kalimantan (n = 33). All participants had studied ecology in their coursework and provided informed consent.

Instrument and Procedures

The instrument used in this study included 30 multiple-choice items designed to measure ecoliteracy across six dimensions: (1) Spiritual Values and Sacredness of Nature, (2) Traditional Sustainability Practices, (3) Solidarity and Community, (4) Folklore and Local Knowledge, (5) Environmental Ethics, and (6) Contextual Adaptation. Each dimension was carefully constructed with items reflecting the corresponding concepts. Multiple-choice questions were selected for their structured nature and ease of statistical analysis. For instance, the dimension of "Folklore and Local Knowledge" includes items like analyzing the environmental message in the legend of Mount Rinjani, while "Traditional Sustainability Practices" includes questions on the application of the sasi principle in modern resource management. The instrument was validated by experts in education and ecology to ensure alignment with the measurement objectives. After expert feedback, revisions were made for clarity and relevance. For example, the question "How do local communities preserve forests for sustainability?" was revised to "How can the concept of forests as ancestral heritage, protected by indigenous communities in Sulawesi, be analyzed to enrich ecoliteracy learning?"

Data Collection and Analysis

Data were collected digitally, enabling participation from students across Indonesia. Descriptive analysis was initially performed to evaluate the validity of the items. The data was then tested for adequacy using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity. EFA was conducted to filter out unclear items and ensure they contributed significantly to the constructs. Items with a factor loading below 0.3 were removed. After EFA, Confirmatory Factor Analysis (CFA) was employed to validate the measurement model, with fit indices like SRMR, CFI, and others used to assess model fit. Cronbach's Alpha and Average Variance Extracted (AVE) were also used to measure internal consistency and convergent validity, ensuring the instrument's reliability.

C. Results and Discussion

Results

The development of the items was based on the six dimensions of the Ecoliteracy Instrument Based on Local Wisdom, which consists of a multiple-choice test designed to measure the following aspects: (1) Spiritual Values and Sacredness of Nature, (2) Traditional Sustainability Practices, (3) Solidarity and Community, (4) Folklore and Local Knowledge, (5) Environmental Ethics, and (6) Contextual Adaptation. The items were created and validated by experts to ensure alignment between the dimensions and the items. During the expert validation process, several aspects required revisions, including item narratives, ecological content, the use of biological terminology, operational clarity in sentence structure, and the proper nomenclature of organisms. Revised items included 3, 9, 13, 15, 16, 19, 20, 22, 25, 29, and 30. These revised items were subsequently revalidated by experts to ensure their quality. The validated items were then used in the content validity testing and data reduction stages. The results indicate that there are 30 questions distributed across the six dimensions of the ecoliteracy instrument based on local wisdom. The average validation score from the expert validation process was 91.5%. Examples of the developed items based on the six dimensions of ecoliteracy rooted in local wisdom are shown in Table 1.

Table 1. Dimensions of Ecoliteracy Instrument Based on Local Wisdom and Example Items

Dimension	Sample Question Item	No. Item
Spiritual Values and Sacredness of Nature (sVaSon)	How can the concept of forest as an ancestral heritage that must be protected by Indigenous peoples in Sulawesi be analyzed to enrich ecoliteracy learning? a. By ignoring the cultural values of Indigenous people and only teaching modern concepts about nature conservation. b. Emphasizing that indigenous peoples have no knowledge of the importance of forest conservation, they must fully adopt high-tech approaches to environmental management. c. Integrating the spiritual and cultural values of indigenous peoples who consider forests an integral part of their lives encourages students to adopt traditional ways of preserving nature. d. By teaching students that forests are natural resources that must be exploited for economic interests without considering the cultural values of indigenous peoples. e. By relying on approaches that ignore indigenous peoples and emphasize modern government policies for forest conservation.	4
Traditional Sustainability Practices (TSP)	The <i>sasi</i> system in Maluku, which prohibits the exploitation of certain resources during certain periods, aims to ensure sustainability. How	16

Dimension	Sample Question Item	No. Item
Solidarity and Community (SaC)	<p>can the principle of sasi be analyzed for application in the broader context of environmental conservation?</p> <p>a. By emphasizing that free exploitation without a time limit is more economically beneficial and quicker to improve environmental conditions.</p> <p>b. By ignoring the sasi policy and relying solely on a global approach without considering the local context in natural resource management.</p> <p>c. By applying the principle of limiting exploitation in accordance with natural cycles to maintain ecosystem balance and ensure the sustainability of natural resources.</p> <p>d. By replacing the Sasi system with government policies that only focus on the use of high technology without considering local cultural values.</p> <p>e. This is done by allowing indefinite exploitation if it is done in a planned manner and supervised by the central government.</p>	18
	<p>The tradition of <i>mangkasarak</i> (gotong royong) in Sulawesi is a collective practice that involves communities in maintaining and managing common lands. How can the mangkasarak tradition be analyzed to improve sustainable natural resource management?</p> <p>a. Assuming that gotong royong is not effective in land management, it is better to rely on advanced technology and individualized management.</p> <p>b. By replacing the <i>mangkasarak</i> tradition with modern approaches that do not involve local communities in natural resource management.</p> <p>c. By integrating the principles of cooperation and shared responsibility in land management, to strengthen ecosystem resilience and community welfare.</p> <p>d. By ignoring local cultural values in natural resource management and focusing only on short-term economic benefits.</p> <p>e. By encouraging communities to carry out agricultural activities individually, without involving cooperation or cooperation.</p>	
Folk Tales and Local Knowledge (FTaLK)	<p>The legend of Mount Rinjani and Segara Anak Lake teaches the importance of maintaining the balance of nature to avoid disaster. How can the moral message in this legend be analyzed to increase environmental awareness among modern society?</p> <p>a. By assuming that the legend is just an empty story that is irrelevant in everyday life.</p> <p>b. By integrating the message of this legend to teach that nature is an entity that must be respected and safeguarded, as well as avoiding over-exploitation.</p> <p>c. By replacing the moral message of the legend with economic policies that prioritize the exploitation of nature for short-term profits.</p> <p>d. By ignoring the values taught in the legend and replacing them with technical approaches that are entirely science-based.</p>	26

Dimension	Sample Question Item	No. Item
	e. By assuming that the legend serves as mere entertainment and has no impact on sustainable environmental management.	
Environmental Ethics Dimension (EED)	Traditional prohibitions (awig-awig) in Lombok play an important role in preserving coral reefs. Based on these principles, which of the following approaches would be most appropriate for implementing awig-awig in the context of coral reef protection?	10
	a. Judging that using modern technology without involving local communities is more effective than using customary prohibitions to protect coral reefs.	
	b. Judging that involving local communities in awig-awig enforcement is a more effective way of safeguarding coral reefs, as they have in-depth local knowledge and a sense of ownership of these natural resources.	
	c. Judged that involving the central government without involving indigenous communities is a more effective approach to protecting coral reefs in Lombok.	
	d. Judging that the customary ban should be replaced with policies that focus more on the expansion of the tourism industry to boost the local economy, despite the risk of damaging coral reefs.	
	e. Judging that coral reef protection only needs to be done by the private sector and government, without involving customary policies and local communities.	
Contextual Adaptation (CnA)	Lessons on climate change can be linked to customary forest management in local communities. How can customary forest management implemented by local communities be analyzed to reduce the impact of climate change?	12
	By ignoring customary forest management and replacing it with a completely industry-based approach to forest management to generate greater economic returns.	
	a. By integrating customary forest management based on local traditions, such as intercropping systems and prohibitions on forest encroachment, which can reduce carbon emissions and increase resilience to climate change.	
	b. By teaching that climate change has no effect on customary forest management and ignoring existing local knowledge in preserving forests.	
	c. By utilizing customary forest management to accelerate the conversion of forests into agricultural land without regard to its impact on climate change.	
	d. By relying entirely on modern technology to manage forests without involving local communities or considering their indigenous knowledge and traditions.	

The results of the descriptive statistical analysis, as presented in Table 2, show that the standard deviation (SD) for all items falls within an acceptable range, with no item exceeding 2.5 SD from the mean. The Pearson correlation test revealed a positive and

significant relationship between individual item scores and total scores, with a p-value < 0.05. The average item scores (Mean) ranged from 0.307 to 0.589, with standard deviations (SD) ranging from 0.462 to 0.501. The Pearson product-moment correlation coefficient (r) ranged from 0.208 to 0.670, with all correlation values meeting the significance threshold (p < 0.05). These findings suggest that the relationship between each item's score and the total score varies from "moderately strong" to "very strong." Thus, it can be concluded that all items in the instrument are suitable for use in conducting Exploratory Factor Analysis (EFA).

Table 2. Results of Descriptive Statistical Analysis

Item	Mean	SD	r	Item	Mean	SD	r
1	0.577	0.495	0.433***	16	0.362	0.481	0.664***
2	0.454	0.499	0.395***	17	0.509	0.501	0.467***
3	0.436	0.497	0.652***	18	0.319	0.467	0.670***
4	0.356	0.479	0.647***	19	0.365	0.482	0.640***
5	0.437	0.497	0.624***	20	0.451	0.498	0.633***
6	0.313	0.464	0.681***	21	0.353	0.479	0.606***
7	0.442	0.497	0.659***	22	0.457	0.499	0.613***
8	0.491	0.501	0.433***	23	0.307	0.462	0.645***
9	0.340	0.475	0.351***	24	0.426	0.495	0.627***
10	0.310	0.463	0.427***	25	0.589	0.493	0.208***
11	0.393	0.489	0.325***	26	0.497	0.501	0.445***
12	0.362	0.481	0.413***	27	0.368	0.483	0.657***
13	0.328	0.470	0.425***	28	0.325	0.469	0.665***
14	0.433	0.496	0.645***	29	0.521	0.500	0.375***
15	0.319	0.467	0.394***	30	0.396	0.490	0.655***

The results of the Exploratory Factor Analysis (EFA), presented in Table 3, indicate that the Measure of Sampling Adequacy (MSA) from the Kaiser-Meyer-Olkin (KMO) test falls within the "good" category, with a value of 0.849. The data meet the requirements for EFA, as confirmed by the Bartlett's Test of Sphericity, which yielded a significance value of <0.001. The EFA identified six dimensions of ecoliteracy based on local wisdom. Two items (1 and 25) were excluded due to factor loadings below 0.3, resulting in a final total of 28 items.

Table 3. Results of Exploratory Factor Analysis (EFA)

Dimension	Item	Faktor Loadings
Spiritual Values and Sacredness of Nature (sVaSon)	Item_4	0.958
	Item_14	0.955
	Item_7	0.953
	Item_5	0.949
	Item_24	0.946
	Item_20	0.923
	Item_22	0.920

Dimension	Item	Faktor Loadings
Traditional Sustainability Practices (TSP)	Item_27	0.964
	Item_3	0.962
	Item_16	0.960
	Item_19	0.948
	Item_21	0.947
	Item_30	0.916
Solidarity and Community (SaC)	Item_6	0.949
	Item_28	0.941
	Item_23	0.929
	Item_18	0.929
	Item_2	0.434
Folk Tales and Local Knowledge (FTaLK)	Item_17	0.960
	Item_26	0.942
	Item_8	0.940
	Item_29	0.905
	Item_11	0.440
Environmental Ethics Dimension (EED)	Item_10	0.933
	Item_13	0.926
	Item_15	0.886
Contextual Adaptation (CnA)	Item_12	0.919
	Item_9	0.423

The factor analysis results indicate that most items within each dimension exhibit strong factor loading values, demonstrating their relevance and significant contribution to the measured construct. For the Spiritual Values and Sacredness of Nature (sVaSon) dimension, factor loadings ranged from 0.920 to 0.958, with Item_4 showing the highest value of 0.958, indicating that this item is highly representative of the dimension. Similarly, the Traditional Sustainability Practices (TSP) dimension showed factor loadings between 0.916 and 0.964, with Item_27 being the strongest at 0.964, reflecting a high degree of relevance between the item and the dimension. For the Solidarity and Community (SaC) dimension, most items had strong factor loadings, such as Item_6 (0.949); however, Item_2 had a lower factor loading (0.434). The Folklore and Local Knowledge (FTaLK) dimension followed a similar trend, with Item_17 showing the highest factor loading value of 0.960, while Item_11 had a lower value (0.440), suggesting weaker contributions to this dimension.

The Environmental Ethics (EED) and Contextual Adaptation (CnA) dimensions showed consistently good to excellent results. The EED dimension recorded factor loadings ranging from 0.886 to 0.933, with Item_10 having the highest factor loading of 0.933. In the CnA dimension, Item_12 had a high factor loading value of 0.919, while Item_9 had a relatively lower value of 0.423. Overall, the analysis demonstrates that most items effectively reflect the intended dimensions. However, items with lower factor loading values, such as Item_2, Item_11, and Item_9, should be revised or

reevaluated to ensure the instrument provides more accurate and valid measurements of ecoliteracy based on local wisdom. By adjusting these items, the quality of the instrument can be further enhanced to ensure optimal measurement.

The results of the Confirmatory Factor Analysis (CFA) with six dimensions of the Ecoliteracy Assessment Based on Local Wisdom (Figure 1) show an excellent statistical fit. The CFA indices were: CFI = 0.956 (good), NFI = 0.958 (good), TLI = 0.958 (good), GFI = 0.956 (good), and SRMR = 0.031 (good). These results indicate that the research model, which includes the six dimensions of the ecoliteracy assessment based on local wisdom, fits the data excellently. The Comparative Fit Index (CFI) value of 0.956 exceeds the recommended threshold of ≥ 0.90 , indicating the model's strong ability to explain the relationship between the empirical data and the hypothesized model. Additionally, the Normed Fit Index (NFI) value of 0.958 demonstrates high consistency between the observed data structure and the hypothesized model. Other fit indices, such as the Tucker-Lewis Index (TLI) with a value of 0.958, are also above the threshold of ≥ 0.90 , indicating the model's efficiency in measuring the hypothesized latent structure. Meanwhile, the Goodness of Fit Index (GFI) value of 0.956 reflects an excellent fit between the overall model and the observed data. Furthermore, the Standardized Root Mean Square Residual (SRMR) value of 0.031, which is below the threshold of 0.08, shows a minimal difference between the observed correlations and those predicted by the model, providing strong evidence of a good model fit. The CFA results for the Ecoliteracy Assessment Based on Local Wisdom can be reviewed in Figure 1.

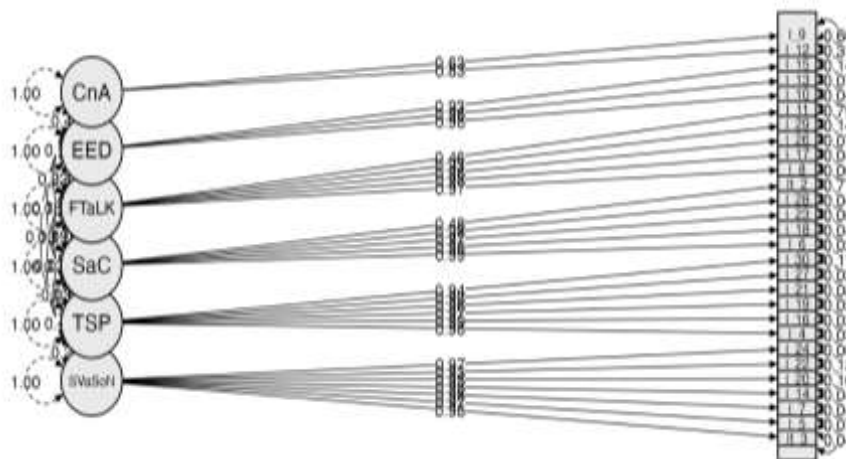


Figure 1 Results of Confirmatory Factor Analysis (CFA) for the Ecoliteracy Instrument Based on Local Wisdom

The final stage involved the analysis of internal consistency, as presented in Table 4. The researchers assessed the reliability of the developed instrument using Cronbach's alpha coefficient and Average Variance Extracted (AVE). The Cronbach's alpha values exceeded the criterion of >0.60 , while the AVE values met the threshold of >0.50 . These

results indicate that all dimensions and items demonstrate strong internal consistency, confirming that the instrument is reliable and suitable for application.

Table 4. Internal Consistency Analysis

Dimension	α	AVE
sVaSon	0.990	0.933
TSP	0.990	0.945
SaC	0.939	0.798
FTaLK	0.931	0.784
EED	0.970	0.916
CnA	0.687	0.544

Discussion

The primary finding of this study is a 28-item ecoliteracy instrument, systematically organized across six dimensions: (1) Spiritual Values and Sacredness of Nature, (2) Traditional Sustainability Practices, (3) Solidarity and Community, (4) Folk Tales and Local Knowledge, (5) Environmental Ethics, and (6) Contextual Adaptation. The instrument demonstrated strong validity and reliability, as evidenced by a Kaiser-Meyer-Olkin (KMO) value of 0.849, Confirmatory Factor Analysis (CFA) indicating excellent model fit (CFI = 0.956, SRMR = 0.031), and Cronbach's alpha values ranging from 0.687 to 0.990 across the dimensions. These results indicate that the instrument effectively measures students' ecoliteracy with accuracy and consistency, particularly within the context of learning grounded in local wisdom.

This study developed a specialized instrument to evaluate students' knowledge, awareness, and behavior regarding environmental issues, grounded in local wisdom. The primary aim of this research was to integrate traditional values within the framework of ecoliteracy, offering a more holistic approach compared to conventional environmental education methods. The findings align with previous research (Cruz & Abeledo, 2015; Fonua, 2018; Gunara et al., 2019), which emphasizes the importance of connecting traditional values with educational frameworks to cultivate a comprehensive understanding of sustainability. The developed instrument provides a concrete tool for assessing students' understanding and application of sustainability concepts rooted in local traditions. It further supports findings that suggest ecoliteracy can enhance younger generations' awareness of global sustainability issues (Lestari et al., 2023; Misiaszek, 2020; Nakagawa, 2017).

This study introduces a novel element by focusing on local values, often overlooked in global sustainability education frameworks. What distinguishes this instrument is its development of six key dimensions within three learning domains, which have not been extensively explored in an integrated manner in prior studies. Each dimension

holds significant relevance in the context of environmental education based on local wisdom, positioning this instrument as a valuable contribution to the field.

Knowledge Domain

This domain evaluates understanding and analysis of ecoliteracy concepts based on local wisdom.

Dimension 1: Spiritual Values and Sacredness of Nature (sVaSon)

This dimension explores the relationship between spiritual values and environmental preservation. It aims to assess students' understanding of how spiritual beliefs, such as reverence for nature in cultural or religious traditions, drive conservation efforts. Students are expected to recognize the link between spiritual beliefs and actions to protect ecosystems (Boersema et al., 2008; Counted et al., 2018; Sayem, 2021; Tanner & Mitchell, 2002). The evaluation also includes customary practices that regard nature as sacred, which often serve as mechanisms for environmental preservation (Omoyajowo et al., 2023; Sayem, 2021).

Dimension 2: Traditional Sustainability Practices (TSP)

This dimension assesses students' ability to understand and evaluate traditional practices such as local agricultural systems or natural resource management in supporting sustainability (Limpo et al., 2022). The evaluation focuses on the effectiveness of these practices in the modern era and their impact on ecosystems and long-term sustainability (Gunara et al., 2019).

Dimension 3: Solidarity and Community (SaC)

This dimension evaluates students' understanding of the role of communities in environmental preservation through cooperation, solidarity, and collective action. The assessment includes analyzing the effectiveness of community-based projects, such as recycling programs or forest restoration initiatives that involve public participation (Aguayo & Eames, 2017). Students are expected to evaluate the success of these projects in promoting sustainable environmental preservation.

Awareness Domain

This domain emphasizes the evaluation of the relevance and effectiveness of local values and practices:

Dimension 4: Folk Tales and Local Knowledge (FTaLK)

Folk tales often embed values supporting environmental conservation, serving as mediums for understanding relevant messages for environmental management. This indicator assesses students' ability to explore the relevance of folk tales as educational tools or strategies for environmental preservation (Johannes, 1989; Osemeobo, 1994). The evaluation focuses on how well folk tales contribute to raising awareness and supporting sustainable environmental management.

Dimension 5: Environmental Ethics Dimension (EED)

This dimension evaluates students' understanding of environmental ethics principles adopted from local cultures in supporting environmental preservation. The assessment focuses on students' ability to analyze environmental policies grounded in local ethical values, such as prohibitions on cutting down trees in specific areas (Gunara et al., 2019). The evaluation examines the effectiveness of such policies in maintaining ecosystem balance and promoting sustainability.

Behavior Domain

This domain pertains to the application of values and practices into real actions:

Dimension 6: Contextual Adaptation (CnA)

This dimension assesses students' ability to connect global issues, such as climate change, with local practices that contribute to mitigation or adaptation efforts. The evaluation focuses on the sustainability of local practices in addressing challenges of modernization and environmental change (Goleman et al., 2012; Murti et al., 2025). The analysis centers on how these local practices can endure or evolve to support sustainability amidst changing times.

Correlations Among Dimensions in the CFA Model

The correlations among dimensions in the CFA model illustrate the logical and theoretical relationships between the six measured dimensions: CnA, EED, FTaLK, SaC, TSP, and sVaSon. These relationships are represented by dashed lines connecting the primary dimension circles in the model. For example, the correlation between CnA and EED suggests that the ability to adapt to local contexts is closely related to awareness of environmental ethics. These dimensions are mutually supportive, as local adaptations are often implemented by considering ethical principles in preserving ecosystems.

The relationship between SaC and TSP indicates that traditional sustainability practices are strongly influenced by collaboration within communities. Traditions like *sasi* in Maluku, which regulates the collective exploitation of natural resources, exemplify how solidarity forms the core of traditional sustainability. A strong correlation is also observed between TSP and sVaSon, indicating that traditional sustainability practices are often guided by spiritual values and the sacredness of nature, such as the Tri Hita Karana philosophy in Bali's *subak* system. This relationship underscores that traditional sustainability incorporates spiritual dimensions, not merely technical ones.

The FTaLK dimension shows a significant correlation with EED, demonstrating that folklore and local knowledge play an important role in shaping environmental ethics awareness. Messages embedded in folklore, such as prohibitions against overexploitation, provide a strong ethical foundation for environmentally friendly behavior. Similarly, the correlation between CnA and sVaSon reinforces that adaptation to environmental changes is often guided by spiritual values that respect ecosystem balance. Overall, these interdimensional correlations reflect mutually supportive relationships, illustrating how these dimensions collectively shape ecoliteracy based on local wisdom.

Relevance, Validation, and Potential Applications of the Ecoliteracy Instrument

The ecoliteracy instrument based on local wisdom is highly relevant in the Indonesian context, where traditional values and local wisdom significantly influence societal life. By integrating spiritual values, traditional sustainability practices, and folklore, the instrument captures the relationship between local communities and their environment (Goleman et al., 2013; Johannes, 1989; Omoyajowo et al., 2023; Tanner & Mitchell, 2002). This relevance makes the instrument an effective tool for universities in Indonesia to support ecological education rooted in local cultural contexts. The instrument underwent Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), demonstrating that all items are valid and consistent, accurately measuring the dimensions of ecoliteracy, including students' knowledge, awareness, and behavior related to environmental sustainability.

Several studies present differing perspectives on the local wisdom-based ecoliteracy approach. (Kelbessa, 2018) or example, argue that ecoliteracy focused on global sustainability principles is more effective in enhancing environmental understanding compared to local wisdom-based approaches, which are considered less applicable in formal educational contexts. (Sandoval-Rivera, 2020) also reveal that instruments incorporating traditional cultural elements often overlook the needs of modern curricula that prioritize science and technology, which are more relevant in today's environmental education. Furthermore, (Hilman & Sunaedi, 2017) demonstrate that using traditional indicators to assess ecoliteracy may introduce bias, as not all local

elements are relevant to the global environmental challenges faced by students. Emphasizes that ecoliteracy instruments relying on exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) often fail to capture non-verbal dimensions and firsthand experiences, which are essential in shaping deeper sustainable behavior.

This study emphasizes that a purely universal framework is insufficient to fully capture students' understanding in culturally and ecologically diverse nations like Indonesia. Local wisdom has been shaped through generations of community experience in sustaining natural systems manifested in spiritual worldviews that regard nature as sacred, customary norms that function as indirect environmental protection mechanisms, and social traditions that promote collective stewardship, such as cooperation and shared responsibility for natural resources. When these elements are excluded from ecoliteracy assessment, the results risk becoming overly narrow and failing to represent how students meaningfully interpret sustainability within their lived realities. Therefore, the instrument developed in this research does not oppose science- and technology-based environmental education. Rather, it is designed to complement those approaches by incorporating cultural indicators, making the measurement more relevant, more interpretive, and more reflective of students' learning experiences, which are shaped not only by academic theory but also by the sociocultural environments in which they develop. This position is further reinforced by the correlations among factors in the Confirmatory Factor Analysis model, demonstrating that spiritual values, traditional sustainability practices, environmental ethics, and community agency interact coherently in forming ecoliteracy as an integrated construct, not as isolated components.

Looking ahead, this instrument offers immediate practical value for Indonesian Higher Education institutions in constructing baseline ecoliteracy profiles, evaluating the effectiveness of sustainability-oriented coursework, and informing curriculum improvement that is aligned with local cultural contexts. Future research is strongly encouraged to extend validation across broader regional and cultural settings, examine whether instrument scores correspond with observable pro-environmental behavior in students' daily lives, and investigate relationships with psychological and behavioral factors that influence sustainability learning. Through iterative testing and ongoing refinement, this approach has the potential to support higher education in achieving a productive balance between scientific advancement and enduring cultural ecological knowledge, ensuring that students not only comprehend sustainability conceptually but are also able to apply it responsibly in real-world environmental decision-making.

D. Conclusion

The local wisdom-based ecoliteracy instrument was developed across six dimensions, comprising a total of 28 items: (1) Spiritual Values and Sacredness of Nature (7 items),

(2) Traditional Sustainability Practices (6 items), (3) Solidarity and Community (5 items), (4) Folk Tales and Local Knowledge (5 items), (5) Environmental Ethics (3 items), and (6) Contextual Adaptation (2 items). The instrument's validity and reliability were evaluated through Exploratory Factor Analysis (KMO = 0.849) and Confirmatory Factor Analysis (CFI = 0.956, SRMR = 0.031), with Cronbach's alpha values ranging from 0.687 to 0.990 across the dimensions. These results indicate that the instrument effectively measures ecoliteracy, particularly within the context of learning based on local wisdom.

This study provides practical contributions by offering a valid and reliable tool to assess university students' ecoliteracy in Indonesia. The instrument measures students' knowledge, awareness, and sustainable behavior, while also incorporating local cultural values that support sustainability practices. Accordingly, the instrument can be utilized by universities to establish baselines, monitor and evaluate the effectiveness of sustainability curricula, as well as support the development of learning strategies that are appropriate to the local context.

Furthermore, this research serves as a foundation for the development of educational models that integrate local wisdom into ecology and sustainability courses. Future studies may explore how students' conditions during assessment influence outcomes, examine the relationship between instrument scores and actual pro-environmental behavior, and adapt the instrument for other cultural contexts. Instrument adaptation can also be carried out in line with advancements in sustainability science, educational practices, and global environmental challenges. Overall, the instrument strengthens the assessment of ecoliteracy in higher education through an approach that is systematic, valid, and culturally relevant, while providing a clear framework for both research and sustainable educational practice.

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