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Exploring problem-solving competence in Indonesian language learning: An EFA study using ecological image stimuli

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ABSTRACT

The necessity of problem-solving skills has become a core competency that university students must possess, particularly through the appropriate and accurate use of the Indonesian language. This study aims to construct a theoretical framework of problem-solving abilities by analyzing the composition of opinion texts in Indonesian language learning. The research employs Polya's theoretical approach, integrated with recent studies, and utilizes a quantitative methodology through Exploratory Factor Analysis (EFA). This method is used to examine the validity of the theoretical construction of problem-solving skills within the context of writing opinion texts in Indonesian language learning. The problem-solving theory derived from opinion-based learning was developed to produce a valid measurement instrument. The study began with the development of indicators drawn from various studies on problem-solving competencies. The resulting instrument consists of 19 items administered to students from both science and social studies tracks. A total of 298 first-semester students from Central Java participated in this study. The test reliability estimation yields a standardized alpha of 0.71. The findings include: (1) the adequacy of the sample was confirmed with a KMO-MSA value > 0.5, specifically 0.71, and a significance level of 0.001 on the Bartlett's test; (2) all items were found to measure problem-solving skills, indicated by anti-image correlation values > 0.5; and (3) the study identified four dimensions of problem-solving skills based on opinion text analysis: initial problem identification, problem resolution, taking tangible action, and evaluation of implemented solutions solution reflection.

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INTRODUCTION

In today's educational context, there is a growing emphasis on the development of critical thinking and problem-solving abilities as key competencies for navigating global challenges. Critical thinking is conceptualized as a core component of communicative competence, whereby students are expected to articulate ideas both orally and in writing in a structured, coherent, and argumentatively sound manner, grounded in the information they receive. This competency is internalized through both curricular and extracurricular engagements, such as classroom instruction, assessment tasks, and teacher-led discussions. The imperative to cultivate such skills is further heightened by emerging issues, particularly the increasing reliance on artificial intelligence (AI) in completing higher-order tasks—particularly those situated at the sixth level of Bloom's taxonomy (create). A critical stance is required to ensure that AI functions as a cognitive scaffold rather than a distractor in students' meaning-making processes.

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As a core subject in the curriculum, Bahasa Indonesia holds a strategic position in the development of higher-order thinking skills, including critical thinking and problem-solving (King et al., 1998; Suwandi et al., 2021). Like other subjects, Bahasa Indonesia comprises a range of competencies designed to develop learners' attitudes, knowledge, and skills. However, these competencies have largely remained within a linguistic framework, positioning the subject more as a domain of linguistic knowledge than as a medium for cultivating language use and communicative attitudes. There is a pressing need to implement pedagogical approaches, learning resources, media, and assessment tools that support the integration of language proficiency with critical thinking (Fisher, 2011). Creative instructional design can guide students in solving real-world problems beyond the classroom, thereby helping to meet the global demand for high-quality education more effectively.

Although the national curriculum emphasizes the development of critical thinking competencies, classroom implementation—particularly in Bahasa Indonesia instruction—remains largely focused on rote memorization and literal comprehension. Numerous instructional materials that could potentially be used by teachers to stimulate contextual thinking in students. In practice, however, many teachers believe that classroom-based changes will not lead to significant shifts in students' cognitive orientations. One area where this is particularly evident is in the teaching of opinion writing, which continues to be approached in a predominantly textual manner (Olson, 1992; Shi & Iordanou, 2025). In addressing educational challenges, curriculum demands, and future societal needs, critical thinking should not be treated as memorized content acquired solely through cognitive means. Consequently, the proportion of knowledge-based material is being reduced to place greater emphasis on the development of psychomotor and affective domains. These dimensions, however, cannot be cultivated through sudden or incidental instructional changes. Consistent and measurable habituation is required to ensure that indicators of thinking skills are achieved optimally, one of which is through the use of appropriate instructional stimuli.

The instructional media currently employed in classrooms often fail to adequately stimulate students to think critically, analytically, and reflectively. Opinion writing—as a potential product of critical thought—has yet to be optimized as a medium for engaging students in deep thinking. This is partly due to the limited complexity and lack of relevance in the problems presented, often perceived as monotonous. The stimuli used in instruction frequently do not encourage students to actively engage in problem-solving, including identifying relevant stakeholders involved in the issue at hand. Teachers often rely on pre-packaged materials and textbook-based opinion texts, which can constrain students' thinking and limit opportunities for original idea generation (Errington & Bubna-Litic, 2015). Moreover, textbook-based texts often prompt students to seek answers from the internet, AI-powered search engines, or to rely on subjective opinions, rather than engaging in independent reasoning. Therefore, more concrete and contextually grounded stimuli are needed to bridge students' thinking toward structured, systematic, and methodological reasoning. In response to this need, the present study employs ecological image-based stimuli as a means of encouraging students to actively participate in problem-solving processes

Environment-themed images have the potential to stimulate deep emotional and cognitive responses, thereby enhancing students' engagement in problem-oriented thinking within language learning contexts. When used as cognitive stimuli, such images help students approach problem-solving in a more concrete and structured manner. It is anticipated that these visual prompts will lead to more focused, measurable, and clearly defined problem formulations. This study employs ecological imagery as a stimulus, recognizing that environmental issues remain complex and multifaceted challenges that require sustained critical thought to address effectively.

Research examining how students interpret and respond to problematic situations through visual media remains very limited, particularly within the local context. Albaburrahim and Amin (2024) qualitatively internalized ecological values in the Indonesian language through analysis in learning contexts (Albaburrahim & Amin, 2024). Similarly, Samsiyah (2024) explored the teaching

of the Indonesian language as a means to enhance ecological intelligence (Samsiyah, 2024). Other studies have qualitatively examined ecological content in literary works, such as Hartati et al. (2023) investigation of the short story *Desir* by Gladhys Elliona. Additional research includes content analysis of ecological elements in elementary school literacy materials on the Ministry of Education and Culture's website (Jefiza et al., 2025), and a content analysis study examining ecological intelligence in Indonesian electronic school textbooks (Saputri et al., 2025).

Those studies indicate that the integration of ecological values into Indonesian language instruction has been carried out through analyses of textbooks and literacy materials, targeting elementary and secondary school students and also non-native speakers of Indonesian. Although ecological content, such as environmental knowledge, affective concern, and environmentally friendly behavior, has been identified, the findings indicate that the cognitive aspect remains more dominant than the affective and applicative aspects. This highlights the need to strengthen the internalization of ecological values and concrete actions within Indonesian language learning materials, to foster comprehensive environmental awareness and concern among students.

Based on the aforementioned review, there is currently no recent study that clearly demonstrates the integration of ecological values into Indonesian language teaching. This gap is particularly evident in the exploration of how ecological elements are constructed within project-based learning models in the Indonesian language classroom. The lack of attention to this area suggests a need for further investigation into the pedagogical potential of incorporating ecological awareness into language learning practices. Most existing research tends to focus on identifying and analyzing ecological issues within literary works. These studies often examine how nature, environment, and ecological concerns are represented in texts, rather than how such values can be embedded in instructional strategies. As a result, the application of ecological perspectives in practical teaching settings remains limited, highlighting the importance of expanding research toward more integrative and experiential learning approaches.

A quantitative approach, such as Exploratory Factor Analysis (EFA), is needed to empirically explore the dimensions of problem-solving based on students' perceptions. This study examines the construction of problem-solving in language learning through opinion texts stimulated by ecological images. The EFA approach is employed to uncover the underlying structure of a set of variables, aiming to constructively examine and identify the dimensions of problem-solving, particularly in opinion writing. This study is expected to provide deeper insights into the cognitive factors involved in problem-solving through language, while also offering new directions for a more relevant and transformative design of Indonesian language instruction.

METHOD

This study is a quantitative investigation employing factor analysis in the form of Exploratory Factor Analysis (EFA). It aims to examine the construct validity of a skills-based instrument designed to measure opinion writing ability using ecological image stimuli among early-semester university students in Purwokerto.

Population and Sample

The respondent population consisted of second-semester students from universities in Purwokerto, namely Jenderal Soedirman University, Muhammadiyah University of Purwokerto, State Islamic University of Saizu Purwokerto, and Nahdlatul Ulama University of Purwokerto. A random sample of 215 students was selected to complete the provided skills test instrument. Purwokerto was chosen as the research site due to its role as an educational center in Central Java, with diverse student populations across several universities. The academic climate in these institutions supports project-based and interdisciplinary learning, making them suitable for testing ecological writing tasks. Additionally, local environmental issues relevant to the region provide authentic contexts for assessing students' ecological awareness and opinion-writing skills.

Instrument

The instrument was constructed based on theories of problem solving. In modern education, problem-solving is understood through various complementary theoretical approaches. This study draws on the theoretical frameworks (Flavell, 1979; Oradee, 2013; Santos-Trigo, 2024; Shokri & Mousavi, 2024; Snyder, L. G., & Snyder, M. J., 2008).

Problem-solving emphasizes the importance of students' active engagement in addressing real-world issues, which has been shown to enhance both their problem-solving abilities and self-regulation. Meanwhile, cognitive style theory suggests that an individual's tendency toward systematic or intuitive thinking influences the problem-solving strategies they employ. Collaborative theory highlights that joint problem-solving fosters the development of social and cognitive skills, while also enhancing learning effectiveness. In addition, cognitive load theory emphasizes the importance of managing mental workload during the learning process to optimize problem-solving performance. Finally, the problem-finding approach underscores the individual's ability to identify and formulate problems as a crucial initial step in the problem-solving process. By understanding these various theoretical constructs, educators can design more effective and adaptive instructional strategies to develop students' problem-solving skills.

Based on the constructed theoretical framework, this study developed eight open-ended items requiring students to formulate opinions on ecological issues presented through images. The instrument was administered via Google Forms and scored on a 1–4 scale to assess students' ability to construct opinions. The scoring rubric for students' responses is summarized in Table 1.

Table 1. Scoring Indicator

Indicator	Score 1 Very Low	Score 2 Low	Score 3 Good	Score 4 Very Good
Identifying problems in environmental issues	Fails to identify the problem; response is irrelevant	Identifies the problem in general terms but lacks specificity	Clearly and logically identifies the problem	Identifies the problem in a deep, contextual, and critical manner
Proposing solutions to problems	Does not provide a solution, or the solution is irrelevant	Provides a solution that is less appropriate or unrealistic	Provides a logical, relevant, and applicable solution	Provides an innovative, realistic solution supported by data or references
Selecting the best solution	Unable to compare or choose a solution	Selects a solution without a clear justification	Selects a solution by considering several factors	Selects the optimal solution through in-depth analysis and strong reasoning
Identifying risks associated with the solution	Unable to identify any risks	Identifies risks that are overly general or irrelevant	Logically and realistically identifies key risks	Critically analyzes various risks and suggests mitigation strategies
Identifying responsible stakeholders	Unable to identify relevant stakeholders	Identifies inappropriate or overly general stakeholders	Identifies several relevant stakeholders with logical reasoning	Clearly identifies relevant stakeholders along with their respective roles and responsibilities

Research Procedure

This study began with the development of a language skills assessment instrument focused on opinion writing. The instrument included ecological visual stimuli depicting issues such as flooding, waste, and environmental degradation. The research proceeded by converting students'

responses into scaled scores based on a rubric specifically constructed for this purpose. Subsequently, content validity was assessed using Aiken's V index (Table 2). The study employed the development of a performance-based assessment instrument in the form of an ecological project writing task. Participants were presented with contextual images depicting environmental phenomena as prompts for their responses. The assessment utilized a short-answer format, requiring participants to construct written responses based on the visual stimuli. The finalized instrument comprised 19 items designed to elicit ecological awareness through language production.

Table 2. Distribution of Aiken's Validity Index

Item	V1	V2	V3	V4	V5	S1	S2	S3	S4	S5	∑S	n(C-1)	V
Item 1	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 2	4	5	3	5	4	3	4	2	4	3	16	20	0.80
Item 3	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 4	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 5	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 6	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 7	4	5	4	5	4	3	4	3	4	3	17	20	0.85
Item 8	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 9	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 10	4	5	4	5	4	3	4	3	4	3	17	20	0.85
Item 11	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 12	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 13	4	5	4	5	4	3	4	3	4	3	17	20	0.85
Item 14	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 15	4	5	4	5	4	3	4	3	4	3	17	20	0.85
Item 16	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 17	5	5	4	5	4	4	4	3	4	3	18	20	0.90
Item 18	4	5	4	5	4	3	4	3	4	3	17	20	0.85
Item 19	4	5	4	5	4	3	4	3	4	3	17	20	0.85

The distribution of polytomous data representing students' opinion writing ability scores was analyzed using the KMO and Bartlett's tests. The criterion for the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy is >0.6, indicating that the data are suitable for Exploratory Factor Analysis (EFA). Meanwhile, a significance value of < 0.05 in Bartlett's Test of Sphericity suggests the presence of correlations among variable patterns. Once the sample adequacy tests were met, extraction and rotation methods were selected. The study concluded with the naming of the extracted factors.

FINDINGS AND DISCUSSION

Item Reliability Using Cronbach's Alpha

To measure the internal consistency of the instrument, a reliability analysis was conducted using Cronbach's Alpha coefficient on 19 polytomously scaled items. The analysis yielded a Cronbach's Alpha value of 0.69, with a standardized alpha of 0.71 and Guttman's Lambda 6 (G6) value of 0.75, indicating that the instrument demonstrates an acceptable level of reliability for exploratory research purposes. The 95% confidence interval ranged from 0.64 to 0.74, supporting the stability of the reliability estimates.

An analysis of each item's contribution indicated that no single item, if removed, would significantly increase the overall alpha value. The alpha values after the deletion of individual items ranged from 0.67 to 0.69. This suggests that all items contribute relatively evenly to the internal consistency of the instrument.

Furthermore, the corrected item-total correlation analysis revealed that item B9 (r = 0.50) and item B18 (r = 0.48) had the highest correlations with the total score, while item B12 (r =

0.23) and item B15 (r = 0.24) showed the lowest correlations. Nevertheless, all correlation values remain within the acceptable range (r > 0.20), indicating that no items need to be eliminated at this stage.

The response distribution indicated that most participants tended to provide high scores (categories 4 and 5), suggesting a general inclination toward positive responses. No missing data were identified, reflecting a high quality of questionnaire completion. Overall, the results of the reliability analysis indicate that the instrument possesses adequate internal consistency and is suitable for further analysis, such as EFA.

Evaluation of Factor Analysis Assumptions

Before conducting Exploratory Factor Analysis (EFA), a data suitability test was first performed using the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. The results indicated that the overall KMO value was 0.71, which falls within the "middling" category according to Kaiser's (1974) classification. This value exceeds the minimum threshold of 0.60, suggesting that the data possesses adequate sample sufficiency for further analysis using EFA. Additionally, the Measure of Sampling Adequacy (MSA) values for each item ranged from 0.62 to 0.86, indicating that no items need to be eliminated based on this test, as all items meet the individual suitability threshold (> 0.50).

The results of Bartlett's Test of Sphericity also indicated that the correlation matrix among the variables was statistically significant ($\chi^2 = 2606$; df = 171; $p < 0.001$), suggesting that there is sufficient correlation among the items to proceed with Exploratory Factor Analysis (EFA). Based on these two tests, it can be concluded that the data meet the requirements for conducting EFA.

Exploratory Factor Analysis

Exploratory factor analysis using the principal axis factoring method and rotation yielded four main factors (MR1 to MR4), which collectively accounted for 37.9% of the total variance. (1) Factor 1 (MR1) comprises items B6, B7, B8, B9, B10, B11, B16, B17, and B19, with the highest loading observed on item B6 (0.584) and a sum of squared loadings (SS Loadings) of 2.155, accounting for 11.3% of the total variance. This indicates that the factor contributes the most significantly to the overall data structure. (2) Factor 2 (MR2) includes items B1, B2, B3, B4, and B10, with the highest loading on item B4 (1.011). This factor has a sum of squared loadings (SS Loadings) of 2.102, accounting for 11.1% of the total variance. (3) Factor 3 (MR3) consists of items B5, B15, B18, and a partial loading from B19. The highest loading is observed on item B18 (0.878), indicating a strong representation by this item. The sum of squared loadings (SS Loadings) for this factor is 1.790, accounting for 9.4% of the total variance. (4) Factor 4 (MR4) encompasses items B12, B13, and B14, with the highest loading observed on item B14 (0.786). The sum of squared loadings (SS Loadings) for this factor is 1.162, accounting for 6.1% of the total variance.

Several items exhibited cross-loadings (e.g., B10 and B19); however, the dominant loading values still indicated a primary association with a specific factor. Overall, the four-factor structure reflects relatively stable and interpretable conceptual dimensions, which can be further analyzed in relation to the theoretical constructs of the study. Based on the results of the Exploratory Factor Analysis (EFA), four main factors (MR1–MR4) were identified, with the details presented in Table 3.

Table 3. Exploratory Factor Analysis (EFA)

SS Loading	Varians Proportion	Explained Proportion
Factor 1 (MR1): 2.394	MR1: 12.6%	MR1 contributes 30.7% of the total explained variance
Factor 2 (MR2): 2.193	MR2: 11.5%	MR2 contributes 28.1% of the total explained variance
Factor 3 (MR3): 1.959	MR3: 10.3%	MR3 contributes 25.1% of the total explained variance
Factor 4 (MR4): 1.257	MR4: 6.6%	MR4 contributes 16.1% of the total explained variance

The SS Loadings indicate the contribution of each factor to the total variance. The four factors together explain a cumulative total of 41.1% of the overall variance. The Proportion Explained column represents the relative contribution of each factor to the explained variance. The Cumulative Proportion value shows that these four factors collectively account for 100% of the variance explained within the model.

The four factors extracted through Exploratory Factor Analysis (EFA) accounted for approximately 41.1% of the total variance in the instrument data. The first factor contributed the most to the data structure; however, overall, the four factors showed relatively balanced contributions to the explained variance. This indicates a moderately complex but interpretable multidimensional structure that is suitable for further analysis and interpretation.

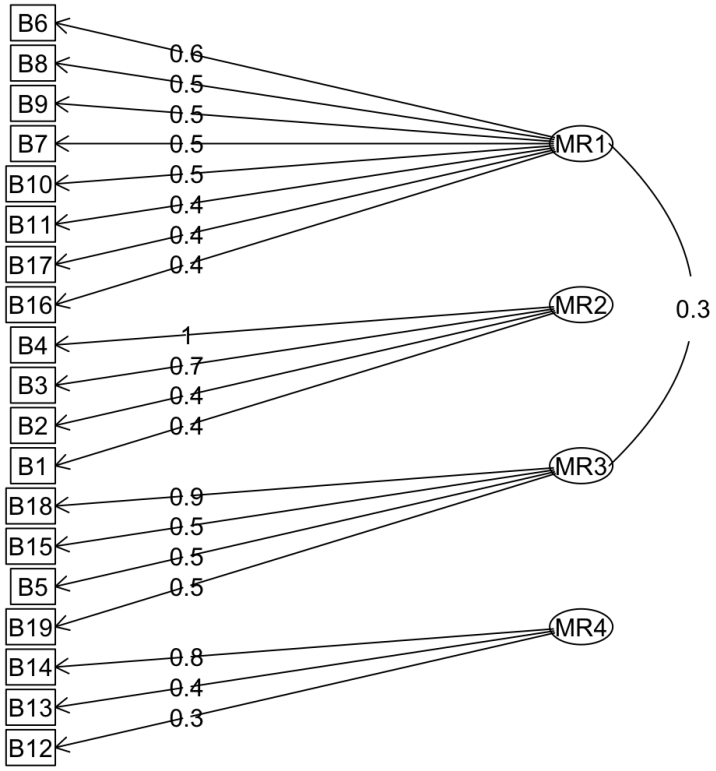

Figure 1. Screeplots

Figure 1 presents a visualization of the results from the Exploratory Factor Analysis (EFA), illustrating the relationships between indicators (items) and the latent factors that emerged. Based on the plot, four main factors (MR1–MR4) were identified, each grouping indicators with sufficiently significant loadings. For example, MR1 predominantly includes indicators B6, B8, B9, B7, B10, B11, B17, and B16, with loading values ranging from 0.4 to 0.6. This indicates that these indicators are substantially related and can be interpreted as a coherent latent construct.

Factor MR2 appears to be strongly influenced by indicator B4, with a loading of 1.0, and by indicators B3 and B2, which have loadings ranging from 0.4 to 0.7. MR3 shows considerable strength, with high loadings on indicators B1 and B18 (0.9 and 0.5, respectively), followed by B15, B5, and B19. Meanwhile, MR4 is more specific, characterized by indicator B14, which has the highest loading (0.8), followed by B13 and B12 with lower contributions (0.3–0.4). This distribution suggests that each factor successfully groups indicators that are theoretically and empirically correlated.

Overall, this model reflects a relatively stable factor structure, with a total of four main factors that collectively explain approximately 41% of the total variance in the data (as indicated by the previous calculations). The strength of the loadings on each indicator suggests that the

factor grouping is sufficiently reliable for further interpretation. The correlations between factors (such as the 0.3 correlation between MR1 and MR2) also indicate interrelationships between dimensions, which may reflect the complexity of the construct being analyzed, namely the problem-solving ability in student opinion writing with ecological image stimuli. Based on this theoretical construct, the study concludes the problem-solving construct as presented in Table 4.

Table 4. Factors and Indicators of Problem-Solving in Opinion Writing

Factors	Indicators	Items
Initial Problem Identification	a. Ability to analyze stakeholders, their roles, and stakeholder management b. Ability to examine the problem: definition, forms, and causes	B6, B8, B7, B8, B10, B11, B16, B17
Problem Solving	a. Ability to identify problems b. Ability to determine the priority scale of solutions	B1, B2, B3, B4
Taking Concrete Action	a. Ability to develop a structured problem-solving plan b. Ability to implement solutions	B5, B15, B18
Solution Follow-Up	a. Analyzing the relationship between the problem and the solution b. Reflecting on the solution	B12, B13, B14

In the writing project assigned to test participants, various competencies were demonstrated, reflecting a wide range of critical thinking and problem-solving abilities. One of the key indicators assessed was the ability to analyze stakeholders, including their roles and how they are managed within the context of an ecological issue (Reed, 2008; Villamor et al., 2014). This competency is crucial in opinion writing, as it enables participants to consider diverse perspectives and interests involved in the environmental problems they address. Through this lens, participants can structure their arguments more persuasively by acknowledging the complexity of real-world scenarios.

Furthermore, the ability to examine the problem—including its definition, forms, and underlying causes—was essential in assessing participants' depth of understanding. This skill was complemented by the ability to identify the core problems embedded within the environmental images presented (Olson, 1992; Ruddell, 2005). These indicators are foundational in opinion writing, as participants must first grasp and articulate the issue clearly before offering any personal stance or recommendation. In this way, their written opinions reflect not only language proficiency but also analytical reasoning.

Another important dimension observed was the ability to determine a priority scale of solutions and to develop a structured plan for addressing the problem. Participants who demonstrated this ability were able to organize their opinions logically, providing a sequence of actionable and realistic steps (Mualimin & Pamungkas, 2024; Reina & Clark, 2019). This reflects higher-order thinking in writing, where opinions are not only expressed but are also supported by coherent and strategic planning. Such structure is a hallmark of effective opinion writing, especially when discussing complex environmental issues.

Finally, the competencies to implement solutions, analyze the relationship between the problem and proposed solutions, and reflect on the effectiveness of those solutions were also measured (Adas & Bakir, 2013; Sudaryanto et al., 2020). These indicators suggest that the participants' opinion writing moved beyond surface-level commentary to a more evaluative and reflective stance. By integrating these skills, the writing showcased the participants' ability to engage in critical reflection, which is a vital aspect of ecological literacy. In the context of Indonesian language education, these results underscore the potential of project-based writing tasks to cultivate both linguistic and environmental awareness simultaneously.

Profiling Student Competencies in Constructing Ecologically-Informed Opinions

This study identifies four core competencies that students must possess to critically and systematically construct opinions based on ecological issues. These four competencies include:

initial problem identification, problem solving, taking concrete action, and solution follow-up. Each competency is accompanied by specific indicators that represent the required skills.

First, the competency of initial problem identification reflects students' ability to understand the complexity of an ecological issue from the outset. This competency comprises two main indicators. First, students are expected to analyze the actors involved in the issue—both individuals and institutions—and to understand their roles and influence within the dynamics of the problem. Second, students must be able to critically examine the core of the issue, including its definition, forms, and underlying causes (Hayes & Flower, 1980; Lamberg, 1977; Zuber-Skerritt & Knight, 1986). These indicators highlight the essential role of critical and analytical thinking in the initial stages of opinion development.

Second, in the competency of problem solving, students are expected to accurately identify the problem and determine relevant and well-structured solutions. This competency consists of two indicators: the ability to systematically recognize the problem and the ability to establish a solution priority scale based on considerations of urgency and its impact on environmental sustainability (Hayes & Flower, 1986; White, 1994). Assessment of these indicators reflects the depth of students' strategic thinking and their decision-making skills.

Third, the competency of taking concrete action assesses the extent to which students are not only able to formulate solutions but also possess the capacity to implement them. This competency comprises the ability to develop a structured solution plan and the ability to carry out the proposed solution. Students are expected to design strategic and applicable steps, and to demonstrate active engagement in the implementation process, both individually and collectively (Reina & Clark, 2019; Yuxian, 2025). This reflects the integration of contextual thinking and action-oriented skills.

Fourth, the competency related to solution follow-up highlights the importance of evaluation and reflective thinking in assessing the impact and relevance of implemented solutions. The first aspect of this competency involves the ability to critically analyze the link between the identified problem and the chosen solution, allowing learners to determine the extent to which the intervention addressed the core issue effectively (Santos-Trigo, 2024; Zitha et al., 2023). The second aspect focuses on the capacity to reflect not only on the outcomes but also on the process of implementing the solution, encouraging learners to derive insights for future improvement and decision-making.

This reflective dimension adds novelty by framing ecological problem-solving as an iterative learning cycle rather than a one-time decision-making event. It positions students not merely as problem solvers, but as adaptive thinkers capable of evaluating their own reasoning and actions within dynamic environmental contexts (Lowyck & Pöysä, 2001; Lubezky et al., 2004). In doing so, this competency fosters a metacognitive approach that aligns with transformative education principles. Overall, these four interrelated competencies reflect a holistic model of problem-solving that integrates critical, analytical, and reflective thinking—skills that are essential for nurturing environmentally literate citizens in the 21st century.

In summary, this study offers a novel contribution by designing a performance-based writing assessment that integrates ecological literacy into Indonesian language education. Through eight measured competencies from stakeholder analysis to reflective solution evaluation, the instrument captures students' ability to think critically, structure arguments, and propose meaningful actions in response to environmental issues. The project-based opinion writing task not only assesses language proficiency but also fosters ecological awareness and problem-solving skills (Hambleton & Patsula, 1998; Sudaryanto et al., 2019). This approach aligns with the goals of 21st-century education, emphasizing interdisciplinary learning, critical literacy, and social responsibility. The findings underscore the potential of integrating ecological themes into language instruction as a pathway to develop both communicative competence and environmental consciousness in students.

CONCLUSION

This study developed an instrument consisting of 19 items related to the skill of writing opinions prompted by ecological images. Through the provided stimuli, the study explored the data using Exploratory Factor Analysis (EFA) to identify the number of factors that emerged. Four factors were found to measure students' problem-solving abilities in constructing opinion texts, namely: (1) ability to identify problems; (2) ability to solve problems; (3) ability to take concrete action; and (4) ability to reflect on solutions. Eight items assessed the ability to identify problems, including analyzing actors, roles, and team management, as well as defining the problem. The ability to solve problems was measured by four items, which included recognizing the problem and determining the solution priority scale. The ability to take concrete action was measured by four items, including creating a problem-solving structure and implementing the solution. The final factor, reflecting on solutions, consisted of four items related to recognizing the relationship between the problem and the solution and reflecting on the solutions created.

DISCLOSURE STATEMENT

The authors declare that they have no potential conflicts of interest to disclose.

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ETHICS APPROVAL

There is no ethics approval needed because the research participants in this study were anonymized, and all data collected during the study were used only for the purpose of research. The results of the study would not cause any harm to the research participants.

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