



MEASURING THE EFFECTIVENESS OF THE INDIGENOUS-BASED EXPERIENTIAL LEARNING MODEL ON PRE-SERVICE SCIENCE TEACHERS' CREATIVE THINKING SKILLS

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ABSTRACT

Indigenous-based Experiential Learning (IbEL) model has been developed to promote pre-service science teachers' creative thinking skills. This model emphasizes a more holistic, community-based education grounded in Indigenous knowledge and cultural practices. This study aims to evaluate the effectiveness of the IbEL model in enhancing the pre-service science teachers' creative thinking skills. The study involved 29 participants who were randomly selected from a larger population. The participants were assessed using a pretest and posttest design to determine the changes in their creative thinking skills after being taught using the IbEL model. The study utilized a standardized evaluation instrument to measure creative thinking skills, including Fluency, Flexibility, Originality, Elaboration, Risk-Taking, Complexity, Curiosity, and Imagination. The data analysis method used was Rasch analysis with stacking and racking techniques. Using pretest and posttest evaluations, the researchers found a significant increase in creative thinking skills, with the Observation course showing a higher increase. The study highlights the importance of creativity in teaching and learning and how enhancing creative thinking skills can improve student achievement. The IbEL model encourages students to appreciate local knowledge and experience, context, and situation in learning, and direct experience, leading to more culturally sensitive research outcomes. The study contributes to the development of better learning models to enhance pre-service science teachers' creative thinking skills.

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Keywords: indigenous-based experiential learning; pre-service science teachers; creative thinking skills

INTRODUCTION

Creative thinking skills are becoming increasingly crucial in the era of globalization and the fourth industrial revolution, particularly for science teachers. Teachers are responsible for cultivating students' creative thinking skills, including the ability to solve problems, generate novel ideas, and explore alternative perspectives. The

current work landscape is becoming increasingly complex, requiring workers to quickly adapt and confront emerging changes (Bayer & Finley, 2022). Creative thinking skills can help students navigate these challenges, enabling them to produce innovative solutions to complex problems in the future (Dianita & Tiarani, 2023). In science, creative thinking skills are fundamental in addressing intricate problems. By developing creative thinking skills, students can generate innovative ideas, formulate new theories, and explore novel

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concepts in science (Kerans et al., 2024). Science teachers are pivotal in nurturing students' creative thinking skills (Fauzi & Wuryandani). Consequently, developing creative thinking skills is imperative for preparing students for a future that is progressively complex and dynamic.

Creative thinking skills are essential in science education, and teachers face several challenges (Syafuliaet al., 2025). One of the biggest challenges is teachers' tendency to focus more on providing measurable information and knowledge than on developing creative thinking skills (Valtonen et al., 2017; Ernawati et al., 2022). Many teachers still consider the main goal of science education to be conveying information about concepts and theories rather than developing creative thinking skills to help students address complex real-world problems. This results in students lacking creative thinking skills and being less prepared to handle situations outside the classroom (Morrison, 2022). One obstacle to promoting creative thinking in science education is a limited understanding of creative thinking and its implementation in this field (Nada & Sari, 2022). Some teachers may prefer traditional teaching methods, such as lectures and assignments with clear goals, rather than more exploratory and innovative approaches. As a result, these teachers may struggle to encourage students to think creatively and outside the box. Educational institutions must provide support and resources to develop programs that emphasize creative thinking skills, as a lack of support can negatively affect students' motivation and readiness to learn (Shih & Tsai, 2021). However, teachers may face constraints such as limited time, funding, or administrative support when attempting to develop such programs.

Problem-Based Learning (PBL) is a teaching approach that involves students in solving actual problems related to science topics (Kusumadani et al., 2024). Students must develop critical and creative thinking skills to address these problems. The ultimate goal of PBL is to make students more skilled in problem-solving and more independent in learning (Tarhan & Acar-Sesen, 2013; Maknun, 2020). However, the disadvantages of PBL are that it takes considerable time to solve a single problem and requires close teacher supervision. It also takes considerable time to complete one project and requires adequate facilities and resources. However, PBL allows students to learn through practical experience in creating science projects (Sugiharti et al., 2019). Students will be involved in the planning, execution, and completion of the project. PBL strengthens collaboration, communication, and problem-solving skills (Morrison, 2022).

Game-based learning allows students to learn science through interactive and fun games. Students will be involved in solving science problems through games, which can increase motivation and engagement in learning. GBL can also improve students' social and teamwork skills (Sugiharti et al., 2019). GBL's weakness is its reliance on technology, which requires significant investment in costs and infrastructure. Collaborative learning allows students to learn together in groups. Students will discuss and collaborate to achieve learning goals (Morrison, 2022). Collaborative learning also strengthens students' social and communication skills. However, a weakness of collaborative learning is the lack of teacher supervision, which allows students to take over responsibility for learning. Inquiry-based learning (IBL) allows students to learn through exploration and self-discovery. Students will be involved in finding answers to questions that arise in learning. IBL can also improve students' critical and creative thinking skills. However, the weakness of IBL is that it takes considerable time to find answers to questions and requires strict teacher guidance (Aidoo et al., 2016).

The Indigenous-based Experiential Learning (IbEL) model integrates indigenous learning methods with experiential learning activities to create a culturally relevant and holistic learning experience (Satria et al., 2024). IbEL promotes students' creative thinking skills by engaging them in hands-on activities that allow them to explore the material more meaningfully. One of the key advantages of IbEL is its focus on cultural relevance. By incorporating Indigenous knowledge and culture into the learning process, students are exposed to diverse perspectives and learning approaches that can help broaden their understanding of the world (El Yazidi & Rizal, 2024). This approach can be particularly beneficial for Indigenous students who may feel disconnected from the educational system if their culture and ways of knowing are not represented in the curriculum (Riley & Johansen, 2019; Walter & Suina, 2019). Another advantage of IbEL is its emphasis on experiential learning. This type of learning involves hands-on activities that allow students to actively engage with the material (Ajani, 2023). By doing so, students can explore the material more meaningfully, which can lead to deeper understanding and retention of information. Experiential learning activities can also be more engaging and enjoyable for students, thereby increasing their motivation and interest in the subject matter (Ford et al., 2016). Environmental issue-based learning encourages students to understand the material and develop high-level thinking skills

such as interpretation, analysis, evaluation, and inference in solving environmental problems (Satria et al., 2024).

IbEL adopts a comprehensive approach to education that acknowledges the limitations of classroom learning and emphasizes a well-rounded education that encompasses both academic and practical skills. By integrating traditional storytelling, outdoor education, and cultural immersion, IbEL enables students to understand themselves better, their culture, and their place in the world. This unique approach to education also promotes creative thinking skills by incorporating cultural relevance, experiential learning, and holistic learning into the educational experience. As a result, students who engage in IbEL can benefit from a deeper understanding of the material, enhanced motivation and interest in the subject, and better preparation for their future pursuits. Based on the background, this study aims to measure the effectiveness of the indigenous-based experiential learning model in improving pre-service science teachers' creative thinking skills.

METHODS

This research used a quantitative approach to compare changes in pre-service science teachers' creative thinking skills before and after instruction using the Indigenous-based Experiential Learning (IbEL) model. The study was conducted with 29 students enrolled in the research methodology and observation course. Par-

ticipants were randomly selected to ensure the study results represented the population. Before the course started, a pretest assessed the participants' creative thinking skills. After the course, a posttest was given to measure progress and evaluate the effect of the IbEL model on the development of creative thinking skills.

This study used a standardized evaluation instrument to measure Creative thinking skills, including Fluency, Flexibility, Originality, Elaboration, Risk-Taking, Complexity, Curiosity, and Imagination. The instrument was developed with three rating scales. Its validity was ensured through a validation process involving language, science education, evaluation, and practitioners. The instrument was then pilot-tested on 15 senior science education students who had completed a relevant course. The reliability coefficient of 0.89 indicates that the instrument consistently measures creative thinking skills. Additionally, experts assessed participants' creative thinking skills through oral and written assessments, thereby enhancing the data's validity. Using a standardized evaluation instrument and a rigorous validation process enhances the reliability and accuracy of the study results.

Creative thinking is commonly described in terms of several aspects that represent how individuals generate, develop, and express ideas. The following table summarizes the main aspects of creative thinking along with their respective sub-aspects of competence.

Table 1. Matrix of Creative Thinking in the Psychomotor Domain (Write/Paper)

Creative Thinking Aspect/Sub Aspect	Competence
Fluency Definition: Performing smoothly, accurately, and with ease	A1: Express ideas fluently A2: Refer to appropriate references A3: Express/put ideas into words appropriately A4: Write down ideas in clear words or sentences A5: Convey ideas quickly and consistently
Flexibility Definition: Changing and adapting to different circumstances	B1: Respond to the stimulus given B2: Change views according to needs and conditions B3: Adapt spontaneously B4: Modify
Originality Definition: Generating new ideas	C1: Generate some unique or unusual ideas C2: Show the novelty of relevant ideas C3: Create ideas according to the results of their thinking

Elaborative Definition: Describing or explaining something in detail with careful preparation and completion	D1: Develop ideas in detail
Risk-Taking Definition: Doing something that involves the possibility of failure	E1: Dare to try new things E2: Dare to fail
Complexity Definition: Difficult to understand or explain because there are many different parts	F1: Organize many heterogeneous/multiple parts
Curiosity Definition: Being curious in learning, showing interest	G1: Get curious G2: Have a strong desire to learn
Imagination Definition: Thinking of every possibility	H1: Be open to imagination

Based on Table 1, creative thinking competence can be identified through several interconnected aspects, ranging from the ability to generate ideas fluently to the willingness to explore new possibilities through imagination and curiosity.

Creative thinking is an important cognitive ability that enables individuals to generate ideas, solve problems, and respond to situations in inno-

vative ways. It involves several interconnected aspects that reflect how individuals produce ideas, explore possibilities, and develop their thoughts. Each aspect represents a specific competence that supports the overall development of creative thinking skills. The aspects of creative thinking and their corresponding competencies are presented in the following table.

Table 2. Psychomotor Domain Creative Thinking Matrix (Oral/Presentation)

Creative Thinking Aspect/Sub Aspect	Competence
Fluency	A6: Provide several relevant responses
Flexibility	B5: Convey various directions and categories of thoughts related to questions
Originality	C4: Come up with unusual or novel responses
Elaborative	D2: Provide additional detail or specificity in an idea or response
Risk-Taking	E3: Dare to take risks in expressing previously unknown ideas that might fail or be criticized
Complexity	F2: Convey detailed ideas in depth
Curiosity	G3: Get curious about ideas, problems, and situations
Imagination	H2: Visualize and symbolize the unknown

Table 2 states that creative thinking can be understood through several key competencies that encourage individuals to generate diverse ideas, explore new perspectives, and develop their ideas in deeper, more innovative ways.

The data collected through questionnaires during the courses were ordinal, and logarithmic transformations were applied to ensure equal-interval measurements on the logit scale. The researchers found the Rasch model to be a suitable

tool for measuring latent traits to assess creative thinking skills among science students. The model enabled the researchers to distinguish differences in the effectiveness of the IbEL model between the pre- and post-pandemic eras by varying

the logit values of individuals and items, providing individual-centered statistical information. Wright's map was used to visualize the situation before and after the test, which gave an overview of the training's effectiveness.

Table 3. Instrument's Psychometric Attributes

Psychometric Attribute	Research Methodology	Observation
Raw variance explained by measures	72.4	70.5
Unexplained variance	<15%	<15%
Cronbach's alpha	0.98	0.98
Person reliability	0.97	0.98
Person separation	4.92	6.25
Item reliability	0.98	0.96
Item separation	4.92	4.79

Table 3 presents the outcomes of the psychometric attribute analysis of the measuring instruments. Both research methods employed can adequately explain the raw variance of the measuring tool, with percentages of 72.4% and 70.5%. Additionally, the unexplained variance is low, less than 15%, for both research methods. Moreover, Table 3 displays high Cronbach's alpha and person reliability values: 0.98 and 0.97 for the first method, and 0.98 and 0.98 for the second method. These outcomes imply that the measuring instrument used in this research reliably measures the observed science objects. Table 3 also illustrates that the person separation value for both research methods is above 4, indicating that the measuring tool can differentiate between participants with low, medium, and high abilities in the measured science objects.

Regarding item reliability and separation, the analysis results show excellent values for the first method (0.98 and 4.92). Still, the item reliabi-

lity value is slightly lower for the second method (0.96), and the item separation is slightly lower than for the first method (4.79). Consequently, Table 3 provides evidence that the measuring tool used in this research has excellent psychometric quality in measuring the observed and measured science objects. Therefore, the research results can be trusted and used to draw scientific conclusions or recommendations.

RESULTS AND DISCUSSION

The Indigenous-based Experiential Learning (IbEL) research model employed a staple analysis to measure the difference in creative thinking skills before and after learning in the Research Methodology courses. The analysis used two data sets, a pretest and a posttest, and applied the Rasch model to obtain the person logit value (LVP) to indicate performance on creative thinking skills.

Table 4. Logit Value Person (LVP) at Pretest and Posttest (N=29)

	LVP Pretest mean (range)	LVP Posttest mean (range)	Difference	p*
LVP measuring research methodology course	4.01 -1.59 to 8.89	6.96 1.59 to 12.83	2.95	<0.01
LVP measuring observation course	1.42 4.52 to -2.84	-1.42 2.02 to -6.07	2.84	<0.01

Table 4 presents the results of this analysis. For the Research Methodology course, the LVP Pretest mean was 4.01, while the LVP Posttest mean was 6.96, indicating a significant increase in creative thinking skills of 2.95. The p-value was less than 0.01, confirming the difference's

statistical significance. The LVP range for the Research Methodology course varied from -1.59 to 8.89 for the pretest and 1.59 to 12.83 for the posttest. These results demonstrate the effectiveness of the IbEL model in improving pre-service science teachers' creative thinking skills.

The Indigenous-based Experiential Learning (IbEL) research model conducted a staple analysis to measure the difference in creative thinking skills before and after training in the Research Methodology and Science Observation and Measurement courses. The analysis used pretest and posttest evaluations as the data sets. Table 4 indicates a significant increase in creative thinking skills for both courses. For example, the Science Observation and Measurement course had a pretest LVP mean of 1.42 and a posttest

LVP mean of -1.42, showing an increase of 2.84 in creative thinking skills. The p-value range was less than 0.01, signifying that the increase was statistically significant. On the other hand, the Research Methodology course had a pretest LVP mean of 4.01 and a posttest LVP mean of 6.96, indicating an increase of 2.95 in creative thinking skills. The p-value range was also less than 0.01, demonstrating that the increase was statistically significant.

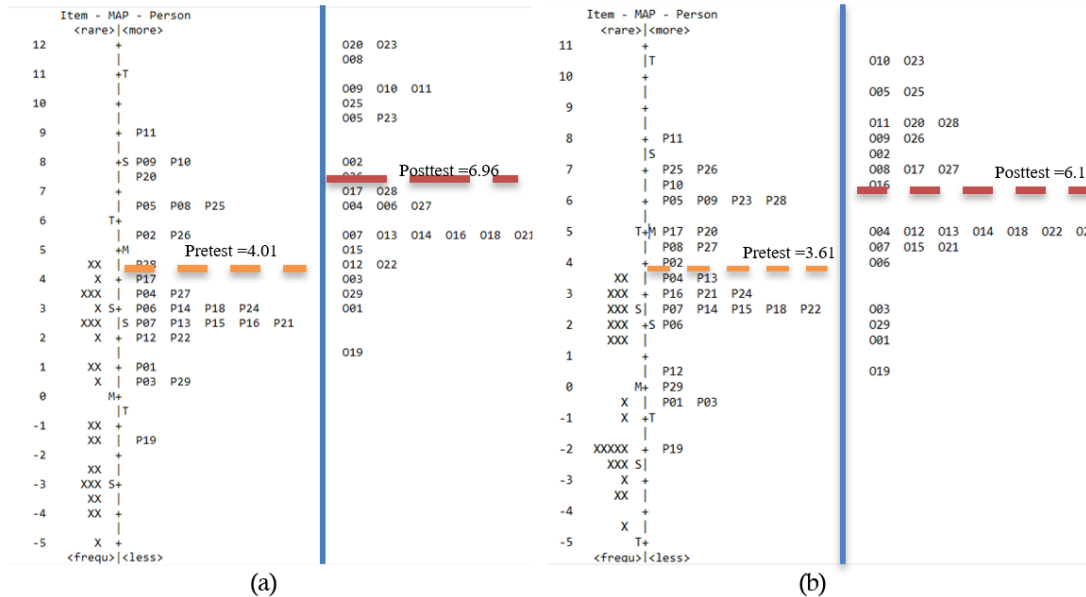


Figure 1. Wright Map of Pre-service Science Teachers' Creative Thinking Skills: (a) the research methodology and observation course; (b) measurement of research subjects

Figure 1 presents a holistic picture of the situation regarding creative thinking skills, revealing that the training significantly improved them in both courses. The analysis also identified student number 20 as having the largest increase in creative thinking skills, from 7.42 to 12.83, indicating a significant improvement. In summary, this research suggests that the IbEL model effectively enhances creative thinking skills in the Research Methodology and Observation courses. Overall, the experiential learning approach used in the IbEL model was successful in helping students develop their creative thinking skills. The table displays each student's code number, pretest and posttest scores, and relative position within the score distribution. It can be observed that most students experienced an increase in scores from the pretest to the posttest, as evidenced by their shift towards the right in the table. However, some students experienced a decrease in scores, as indicated by their shift toward the left in the table.

To identify the students who experienced the most significant increase in scores from the pretest to the posttest, one must examine the difference between their posttest and pretest scores—the more significant the difference, the greater the increase in score. From the provided LVP 2(b) map, it is evident that students with code numbers 10 (pretest) and 25 (posttest) had the greatest increase in creative thinking skills. In the pretest, student number 10 scored 7.25, while on the posttest, student number 25's ability increased to 12.83. Moreover, it is clear from the LVP figure 1(b) map that almost all students experienced an increase in their creative thinking skills after using the IbEL in the science objects observation and measurement course. This is evident from the number of students who exhibited an increase in their ability on the posttest compared to the pretest, particularly those with low scores. Therefore, based on the description provided, almost all students improved their creative thinking skills after using the IbEL model.

The Indigenous-based Experiential Learning (IbEL) model was analyzed using a racking analysis to determine its effectiveness in teaching science. The difficulty levels of questions (measured by the item's logit value or Logit Value Item (LVI)) were compared between the pretest and

posttest conditions. A decrease in the LVI score indicated an improvement in creative thinking skills. Table 5 presents the mean LVI results for the LVI measuring group and the observation and measurement of the Science objects group.

Table 5. logit Value item (LVP) at pretest and posttest (N=28)

	LVI Pretest mean (range)	LVI Posttest mean (range)	Difference	p*
LVI measuring research methodology course	1.47 -1.59 to 8.89	-1.62 1.59 to 12.83	3.09	<0.01
LVI measuring observation course	3.61 -2.15 to 8.02	6.13 0.65 to 10.39	2.52	<0.01

Based on Table 5, the mean LVI score in the LVI-measuring group was 1.47 in the pretest and -1.62 in the posttest, with a significant difference ($p < 0.01$) of 3.09 logit units. Similarly, in the Science objects group, the mean LVI score was 3.61 in the pretest and 6.13 in the posttest, with a significant difference ($p < 0.01$) of 2.52 logit units. Further analysis used Wright maps to compare LVIs in the pretest and posttest situations. The

Wright map revealed that most LVI items in the pretest decreased more than 2 logit scales in the posttest, indicating improved creative thinking skills through the Indigenous-based Experiential Learning (IbEL) model. In contrast, the mean LVI score for the research methodology course group ranged from -1.59 to 8.89 in the pretest and from 1.59 to 12.83 in the posttest.

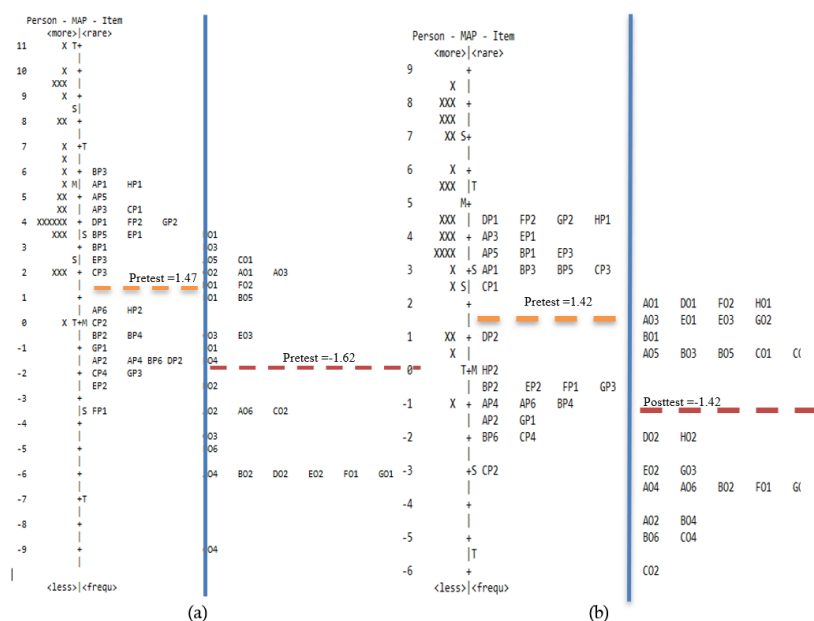


Figure 2. Wright map of LVI Item for pretest and posttest (a) the research methodology and observation course, and (b) measurement of science objects: racking of Creative Thinking Skills

Figure 2 shows the changes in pretest and posttest scores for creative thinking skills, as assessed by the indicators Flexibility (B2), Originality (C3 and C4), and Curiosity (G1), after the implementation of the Indigenous-based Experiential Learning (IbEL) model in a research methodology course. The participant's ability to respond to the stimulus given (B1) decreased by

-1.75, while their ability to modify (B4) decreased by -0.98. On the other hand, their ability to change views according to needs and conditions (B2) decreased significantly by 5.34, indicating a significant change in their flexibility. Regarding originality, participants' ability to generate ideas based on their thinking (C3) decreased by 2.7. In contrast, their ability to develop unusual or novel res-

ponses that show originality (C4) decreased significantly by -5.33. For curiosity (G), participants' curiosity (G1) decreased significantly by 4.85, indicating a significant change in their curiosity. Finally, regarding fluency (A), participants' ability to refer to appropriate references (A2) decreased by -1.98. The data suggest that the Indigenous-based Experiential Learning (IbEL) model used in the methodology course significantly improved participants' creative thinking skills.

Figure 2 shows the changes in pretest and posttest scores for students' Creative thinking skills who received the Indigenous-based Experiential Learning (IbEL) treatment during the observation and measurement of Science objects. Specifically, the students showed the greatest improvement in their flexibility, as indicated by the significant decrease in scores for B4 and B6. These abilities involve modifying and conveying various directions and categories of thoughts related to questions and responses. The students also showed improvements in their originality, as indicated by lower scores on C1, C2, and C4. These abilities involve generating unique or unusual ideas and the novelty of relevant ideas. The students' Elaborative ability also showed a slight improvement, as indicated by the decrease in E2 score. This ability involves the willingness to take risks without fear of failure. Finally, in terms of curiosity, the students showed improvements in G2 and G3, which involve a strong desire to learn and curiosity about ideas, problems, and situations.

Regarding the indicator "Fluency," there was a slight improvement in A1's ability to generate ideas, as indicated by a 1.07-point increase. However, A2's ability to refer to appropriate references remained relatively unchanged, with a slight negative change of -0.18 points. For the indicator "Flexibility," B4's ability to modify improved significantly, with a change of -3.41 points, indicating greater capacity to adapt. B6's ability to convey various directions and categories of thoughts related to questions and responses also improved, with a change of -3.14 points. Regarding the indicator "Originality," C1's ability to generate unique or unusual ideas decreased slightly by 1.89 points. C2's ability to show the novelty of relevant ideas also decreased by 3.23 points. However, C4's ability to develop unusual or novel responses that show originality improved significantly, with a change of -3.14 points. For the indicator "Elaboration," E2's ability to not be afraid of failure showed a slight improvement, with a change of -1.94 points, indicating a greater willingness to take risks and experiment. The

indicator "Curiosity," G1's existing curiosity, was not measured in the data, but G2's strong desire to learn decreased by 3.14 points. G3's curiosity about ideas, problems, and situations slightly improved by 1.71 points. Overall, the data suggest that the application of the IbEL model had varying effects on different indicators of Creative thinking skills, with some showing significant improvement,

The study on the Indigenous-based Experiential Learning (IbEL) model analyzed the differences in creative thinking skills before and after training in the Research Methodology course for pre-service teachers. The study utilized pretest and posttest evaluations. Using the Rasch model, the researchers obtained person logit (LVP) scores that reflect participants' creative thinking skills.

The researchers used the staple analysis method and the Rasch model to obtain the person logit value (LVP) to measure improvements in participants' creative thinking skills (Deer & Faulkenberg, 2016; Dwijayani, 2019). The research indicates that the IbEL model effectively enhances creative thinking skills in Science Observation and Research Methodology courses. IbEL is a learning approach based on local experience and knowledge, which combines experiences related to social, cultural, and environmental aspects (Hare, 2012). Theoretical frameworks relevant to this study include experiential learning theory, which integrates theory and practice through direct experience, and contextual learning theory, which emphasizes the role of context and situation in learning. Creative thinking skills are crucial for achieving educational goals in teaching and learning contexts (Burnette et al., 2018; Myette, 2019). Creative thinking skills can positively impact students' performance, particularly in problem-solving and decision-making. Therefore, enhancing creative thinking skills can improve learning quality and student achievement. The study suggests that the increase in creative thinking skills in the Science Observation and Measurement course was greater than in the Research Methodology course, as evidenced by a larger difference between the posttest and pretest. In addition, the study showed that the Indigenous-based Experiential Learning (IbEL) model positively impacted the development of creative thinking skills in both the Science Observation and Measurement and Research Methodology courses. IbEL is a learning approach based on local experience and knowledge and combines experiences related to social, cultural, and environmental aspects (Kramarski & Michalsky, 2010; Davis et al., 2017).

One of the benefits of using the IbEL model is that it helps students to appreciate the local knowledge and experience of Indigenous communities. This can lead to a more culturally sensitive research approach, which is important for promoting a deeper understanding of local communities and their needs. The IbEL model also emphasizes the importance of context and situation in learning, which can help students develop a more holistic understanding of their subjects (Duru et al., 2015; Skinner et al., 2016). Another benefit of the IbEL model is that it encourages students to engage in direct experiences, which can lead to the development of creative thinking skills. By combining theory and practice through direct experience, the IbEL model enables students to apply their knowledge in real-world settings, helping them develop practical solutions to problems. Using the IbEL model in the Science Observation and Measurement and Research Methodology courses has effectively enhanced creative thinking skills (Duru et al., 2015; Leung et al., 2022). The model's emphasis on local knowledge and experience, context and situation in learning, and direct experience can help students develop a more creative and culturally sensitive approach to research, ultimately resulting in more meaningful and impactful research outcomes (Assefa & Mohammed, 2022).

Racking analysis was conducted to compare the difficulty levels of questions in the pretest and posttest. The difficulty level of the questions was measured using the Logit Value Item (LVI); a decrease in the LVI score indicated a decrease in the questions' difficulty. The analysis showed a significant decrease in LVI scores in both groups. The theory underlying these results is creativity theory. Creativity is the ability to generate new and useful ideas. Creativity is essential in learning as it can help students develop critical thinking skills, problem-solving abilities, and innovative solutions (Datta, 2018). This study demonstrates that using the Indigenous-based Experiential Learning (IbEL) model in teaching science can improve students' creative measurement skills, as indicated by a decrease in the difficulty level of test questions. Therefore, the results of this study can contribute to the development of better learning models to enhance students' creativity and thinking abilities (Valtonen et al., 2017; Ernawati et al., 2022).

The Indigenous-based Experiential Learning (IbEL) model used in the research methodology course significantly enhanced participants' creative thinking skills. The changes in pretest and posttest scores for creative thinking

skills were measured using the indicators Flexibility (B2), Originality (C3 and C4), and Curiosity (G1), which were assessed using the Logit Value Item (LVI). The analysis showed that the participant's ability to respond to the stimulus given (B1) and modify (B4) decreased slightly. In contrast, their ability to change views according to needs and conditions (B2), create unusual or novel responses that show originality (C4), and be curious (G1) decreased significantly. Additionally, their ability to refer to appropriate references (A2) decreased slightly. A conducive and optimally utilized environment greatly influences the development of students' creativity and creative thinking skills. Environmental-based learning expands knowledge and cognitive skills and forms social attitudes, concerns, and a sense of responsibility toward the surrounding environment (Abdullah et al., 2024).

The data suggest that the IbEL model used in the methodology course improved participants' creative thinking skills in some areas while decreasing them in others. The decrease in certain areas may be due to the emphasis in the IbEL model on other aspects of creative thinking, such as curiosity and flexibility. Overall, the data support the effectiveness of the IbEL model in enhancing creative thinking skills, but also highlight the need for further research to understand its full impact on different aspects of creative thinking. Based on the results, it can be inferred that the Indigenous-based Experiential Learning (IbEL) model used in the research methodology course significantly impacted the participants' creative thinking skills, particularly in flexibility, originality, and curiosity. For example, regarding flexibility, participants showed a significant decrease in their ability to change views in response to needs and conditions (B2). This could be because the IbEL model emphasized the importance of exploring and understanding local contexts, which may have challenged the participants' existing perspectives and required them to adapt to new ways of thinking (Aidoo et al., 2016).

The implementation of the Indigenous-based Experiential Learning (IbEL) model in a research methodology course significantly enhanced participants' creative thinking skills. This is evident in the Logit Value Item (LVI) scores, which measure the difficulty of the test items. The LVI scores indicated that participants' ability to develop unusual or novel responses (C4) decreased significantly, possibly because the IbEL model emphasizes incorporating Indigenous knowledge and practices. This could have limited the participants' ability to think outside their cultural

norms and conventions. Similarly, participants' curiosity (G1) decreased significantly, which could be attributed to the IbEL model's presentation of unfamiliar concepts and methods that required greater effort to understand and engage with. However, the results also showed that the IbEL model helped the participants become more flexible in their thinking. Their ability to respond to the stimulus given (Flexibility B2) decreased significantly, indicating a significant change in their flexibility. Their ability to modify (Flexibility B4) also decreased, but less than their ability to change views according to needs and conditions (Flexibility B2).

Regarding originality, participants' ability to develop unusual or novel responses (Originality C4) decreased significantly. The IbEL model significantly impacted their ability to generate original ideas. For curiosity (Curiosity G), participants' curiosity (Curiosity G1) decreased significantly, which indicates a significant change in their curiosity. The IbEL model focused on specific topics and activities, which may have reduced participants' curiosity about other areas. Regarding fluency (Fluency A), the participant's ability to refer to appropriate references (Fluency A2) decreased, suggesting that the IbEL model significantly impacted their ability to gather information from appropriate sources. The results suggest that the IbEL model used in the methodology course significantly improved participants' creative thinking skills, as indicated by changes in LVI scores. The IbEL model seemed to help participants become more flexible in their thinking, generate more original ideas, and gather information from appropriate sources (Aksu & Koruklu, 2015; Johnson et al., 2016; Assefa, 2021).

Indigenous-based Experiential Learning (IbEL) is used to observe and measure science objects. The IbEL model emphasizes direct experience and reflection and is designed to create a more contextual and in-depth learning experience by integrating local culture and traditional knowledge into the curriculum. The data show that students who received the IbEL treatment showed the most remarkable improvement in their Flexibility, as indicated by the significant decreases in scores for B4 and B6. Flexibility involves modifying and conveying various directions and categories of thoughts related to questions and responses. The students also improved their Originality, as indicated by lower scores on C1, C2, and C4. Originality involves generating unique or unusual ideas and presenting relevant ideas in a novel way. The students' Elaborative ability also showed a slight improvement, as in-

dicated by the decrease in E2 score. Elaboration involves the willingness to take risks and not be afraid to fail. In terms of curiosity, the students showed improvements in G2 and G3, which involve a strong desire to learn and being curious about ideas, problems, and situations

Indigenous-based Experiential Learning (IbEL) is a pedagogical approach that integrates local culture and traditional knowledge into the curriculum. The approach emphasizes the importance of direct experiences and self-reflection in building students' knowledge and skills (Riley & Johansen, 2019). It is rooted in constructivism, which posits that students construct their understanding of the subject matter through their experiences and interactions with the environment (Abdullah et al., 2024). IbEL aims to provide students with a more contextual and profound learning experience by drawing on Indigenous peoples' knowledge, experiences, and values. The approach recognizes the diversity of ways of knowing and learning and values the learner's holistic development. The study's findings suggest that IbEL positively impacts students' Creative thinking skills. Creative thinking involves generating new ideas, connecting seemingly unrelated concepts, and thinking flexibly and critically. The improvements in Flexibility, Originality, Elaboration, and Curiosity observed in the students who received the IbEL treatment suggest that the approach effectively promotes these aspects of creative thinking (Dwijayani, 2019; Dewi et al., 2021). The data suggest that IbEL can enhance students' learning experiences by making the curriculum more engaging, meaningful, and relevant. The approach provides students with a way to connect with their cultural identity, heritage, and community and to develop a deeper appreciation for the knowledge and values of Indigenous people.

CONCLUSION

Creative thinking skills are essential for pre-service science teachers; however, conventional instructional approaches often provide limited opportunities for contextual, experiential, and culturally grounded learning. This study addressed the challenge of effectively enhancing pre-service science teachers' creative thinking skills through an innovative learning model rooted in Indigenous knowledge and experiential practice. The findings indicate a significant improvement in creative thinking skills following the implementation of the IbEL model. The results demonstrate that integrating contextual learning, direct experience, and Indigenous knowledge systems enhances students' abilities in fluency, flexibility, originality, elaboration,

risk-taking, complexity, curiosity, and imagination. By connecting theory with real-world practice and emphasizing community-based and culturally sensitive approaches, the IbEL model fosters a more holistic understanding of scientific concepts and promotes meaningful engagement in research processes. In conclusion, the study confirms that the Indigenous-based Experiential Learning (IbEL) model effectively enhances pre-service science teachers' creative thinking skills. The model provides a culturally responsive, experiential framework that supports the development of creativity while encouraging appreciation for local knowledge and contextual problem-solving.

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