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Actualizing Ethnoscience in Physics Education: A New Pathway to Foster Academic Creativity through Local Traditions

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Abstract

Strengthening academic creativity is an urgent need in 21st-century physics education, a field increasingly shaped by complex challenges and global shifts. However, the conclusions drawn in this study remain bounded by its specific context, as the analysis focuses solely on a limited set of learning activities and participant groups. This study aims to actualize ethnoscience as a contextual approach that can enhance student creativity through the integration of local cultural values into physics learning. Using a combined framework of Systematic Literature Review (SLR) and field surveys, this study analyzed 10 relevant articles and collected quantitative data from 50 high school students. Descriptive and inferential analysis results show that positive perceptions of ethnoscience-based learning (r = 0.472) and appreciation of local culture (r = 0.352) are significantly related to high levels of student academic creativity. In addition, linear regression results reveal that these two variables together explain 31.3% of the variance in student creativity. These findings indicate that physics learning based on local wisdom is not only culturally relevant but also shows promising indications of supporting creative, reflective, and contextual thinking. Nevertheless, these conclusions remain constrained by the study's correlational design and the specific characteristics of the participant group, limiting the extent to which they can be generalized. Therefore, future educational strategies need to consider ethnoscience as a core approach in the design of culture-based curricula.

Keywords: *Ethnoscience, Academic Creativity, Physics Learning, Local Wisdom, Contextual Education*

Introduction

The development of creative thinking skills has become a key focus of 21st-century education, as these skills play an important role in problem solving, innovation, and adapting to an increasingly dynamic world. In the context of physics learning, this demand is often hampered by conventional teaching patterns that emphasize memorization of formulas and algorithmic solutions, thereby limiting the space for exploration of ideas and divergent thinking (Novita et al., 2025). As a result, students may master mathematical procedures but fail to develop the creativity that would enable them to apply physics concepts authentically and innovatively in real life. To bridge this gap, a pedagogical approach is needed that not only strengthens scientific understanding but also fosters flexibility of thought, imagination, and critical skills rooted in meaningful experiences (Fitri, 2023).

One approach that has significant potential to achieve this balance is through the actualization of ethnoscience, an approach that integrates local knowledge systems, cultural practices, and traditional wisdom into science learning. In this context, academic creativity refers to learners'

abilities to demonstrate fluency, originality, flexibility, and elaboration in generating and developing scientific ideas dimensions that serve as the operational framework for evaluating creative performance in educational settings. Ethnoscience presents abstract physics concepts in the context of traditions that are familiar to students' lives, such as folk games, handicrafts, or community customs in interacting with nature. This kind of contextualization not only makes learning more meaningful, but also encourages students to think creatively about the connection between culture and science. In this case, local wisdom functions as a "cultural laboratory" where students learn to observe scientific phenomena while interpreting the social and ecological values around them.

Empirical findings further reinforce this view. Pieter & Risamasu, (2024) demonstrate that physics materials incorporating ethnoscience content can strengthen scientific process skills and stimulate students' creative engagement in contextual problem-solving. Likewise, (Agustina et al., 2022) report that learning media enriched with local-wisdom elements improve students' thermodynamics mastery and support innovative perspectives in interpreting problems. Nevertheless, existing studies tend to examine discrete competencies or narrow learning indicators, resulting in limited insights into how ethnoscience-based instruction contributes to the broader dimensions of academic creativity. This gap positions the present study as a necessary effort to explore ethnoscience's role in fostering more comprehensive creative capacities within physics education.

In addition to empirical research, Bibliometric studies also map global trends in the integration of ethnoscience within science education. (Ariani & Hariyadi, 2024) noted a marked rise in publications from 2016 to 2024, particularly those emphasizing creativity, problem-solving, and higher-order thinking skills as key outcomes of ethnoscience-based learning. Through a bibliometric analysis focusing on physics and local wisdom (Alhusni et al., 2025) identified creativity and contextual learning as dominant research clusters, although scholarly contributions remain concentrated in Southeast Asia, especially Indonesia. Meanwhile, (Ali et al., 2025), in n their review of ethnoscience research from 2020–2025, highlighted that creative and critical thinking are recurring thematic concerns, yet cross-cultural and interregional comparative work is still limited. These patterns collectively underscore the need for studies that not only address creativity as a central construct but also examine it within specific instructional contexts—an orientation that aligns directly with the objectives of the present research. These findings collectively point to two important things: first, scientific recognition of the potential of ethnoscience in developing creativity is growing; second, the need to expand empirical evidence through contextual research in various regions remains urgent.

However, a number of conceptual and methodological gaps remain apparent. This study aims to fill part of that gap by examining how ethnoscience-based learning contributes to multiple dimensions of academic creativity within the context of physics education. Many studies that highlight increased creativity have not described in detail the mechanisms of how ethnoscience works, whether through analogical reasoning, culture-based problem creation, or direct and participatory learning experiences(Hikmawati et al., 2021). In addition, indicators of creative thinking are often operationalized inconsistently, with some measuring only fluency and originality, while others use a broader framework without clear standards. Most studies are also still short-term and focus on limited local contexts, not yet touching on cross-cultural domains or long-term curriculum integration. On the other hand, bibliometric analysis shows that international collaboration in ethnoscience research is still low, so the global potential of this approach to enrich academic creativity has not been fully explored.

Based on this context, this study attempts to actualize ethnoscience in physics education as a new way to foster academic creativity based on local traditions. The focus is not merely to

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emphasize the relevance of culture in learning, but to explore how traditional experiences, symbols, and practices can become pedagogical mediums that enliven students' creative thinking processes. By involving students as active subjects in connecting scientific phenomena and cultural heritage, this study is expected to make a real contribution to the design of more humanistic, contextual, and innovative physics learning. In addition, the results of this study are expected to strengthen the empirical basis for the development of a culturally responsive curriculum and enrich the discourse on science education that is rooted in local identity while being globally oriented.

Accordingly, this review addresses the following research questions:

1. RQ1. What are the publication trends and thematic clusters in the literature on ethnoscience integration in physics education related to creative thinking skills?
2. RQ2. How does the incorporation of local traditions through ethnoscience contribute to the development of students' creative thinking in physics learning?
3. RQ3. What pedagogical strategies and mechanisms have been reported as effective in fostering creative thinking through ethnoscience based approaches?
4. RQ4. What research gaps exist in terms of contexts, assessment methods, and theoretical frameworks, and how can future studies advance the integration of ethnoscience for creativity enhancement in physics education?

Method

Research Design

This study employed a hybrid research framework combining a Systematic Literature Review (SLR) approach with a field survey. In line with established SLR guidelines (Kitchenham & Charters, 2007; Page et al., 2021), the methodology was structured into distinct planning, conducting, and reporting stages. The standard SLR phases were adapted to guide the design and execution of a quantitative survey, providing a rigorous and transparent procedure. The integration of an SLR with a survey is academically warranted because the SLR synthesizes theoretical and empirical developments, enabling the survey instrument to be informed by validated constructs, while the survey extends the SLR findings by generating context-specific quantitative evidence that cannot be captured through literature synthesis alone. This adaptation ensured that the survey was grounded in insights from recent literature on ethnoscience and creative thinking in physics education (Snyder, 2019), thereby establishing a strong conceptual foundation for the study. Below, each stage of the methodology is described, followed by details on quality assessment and data analysis.

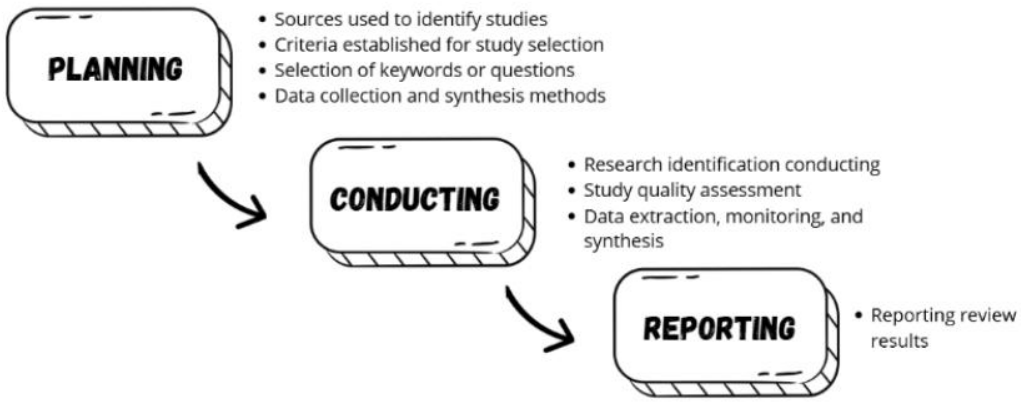


Figure 1. The systematic literature review method

Planning Stage (Search Strategy Adaptation)

In the planning stage, a structured literature search was conducted to inform the survey design. The review focused on publications from 2020 to 2025 that address ethnoscience integration in physics education and the development of students' creative thinking skills. The inclusion criteria encompassed empirical or review studies published in peer-reviewed journals, written in English or Indonesian, and explicitly examining ethnoscience-based instructional practices or creativity-related outcomes in physics learning. Studies were excluded if they lacked methodological clarity, did not involve physics-education contexts, or discussed local wisdom without linking it to instructional or cognitive outcomes. Multiple databases and indexe (Scopus, Google Scholar, DOAJ (Directory of Open Access Journals), ReasearchGet, ScienceDirect, Publish or Peries, and GARUDA (Garba Rujukan Digital) were queried using keywords such as *"ethnoscience in physics education"*, *"local wisdom"*, and *"creative thinking"*. The initial search yielded 63 articles. After screening titles, abstracts, and full texts for relevance to ethnoscience-based physics learning and students' creative thinking, 10 key studies were selected to define the research variables and guide questionnaire development. These selected articles provided content for the survey instrument, ensuring alignment with existing research. The draft questionnaire was then reviewed by experts to validate its content, an approach that mirrors SLR planning practices by grounding the data collection tool in established literature.

Conducting Stage (Screening, Selection, and Data Collection)

In the conducting stage, the field survey was implemented with a targeted sample of 50 senior high school students. Participants completed the finalized questionnaire, which employed a 5-point Likert scale to assess perceptions, interest, and creative-thinking experiences in ethnoscience-based physics learning. The items were grounded in established dimensions of academic creativity—fluency, originality, flexibility, and elaboration. Included examples such as generating multiple solutions using local wisdom (fluency), proposing unconventional problem-solving approaches (originality), and adapting ideas from ethnoscience across contexts (flexibility and elaboration). The data collection followed a standardized procedure to maintain consistency, minimize potential biases, and ensure the validity of responses. During this stage, careful attention was paid to administering the survey under uniform conditions for all participants. (Note that in the SLR context, "screening and selection" typically refer to selecting

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literature; here, those principles were analogously applied to selecting a coherent participant sample and ensuring quality control in data gathering).

Reporting Stage (Data Extraction and Analysis)

In the reporting stage, the emphasis was on processing the collected data and presenting the findings systematically. Data extraction in this context entailed compiling the survey responses and preparing them for analysis. The quantitative data were entered into statistical software (IBM SPSS) for analysis. This included checking the questionnaire's reliability (e.g. internal consistency measures) and performing descriptive statistics to summarize respondents' profiles and key variables. Furthermore, simple inferential tests (such as correlation analysis and linear regression) were conducted to examine relationships between ethnoscience-based teaching factors and indicators of student creativity. The results of these analyses were organized into tables and figures as appropriate. In addition, any qualitative feedback from open-ended survey questions was collated and succinctly summarized. This reporting process was modeled after SLR guidelines for transparent and systematic presentation of results, ensuring that the study's findings are conveyed clearly and supported by the data.

Quality Assessment

The quality of the research instrument was ensured through a two-phase process: expert

The quality of the research instrument was ensured through a two-phase process: expert content validation during the planning stage and statistical reliability testing using Cronbach's alpha post-data collection. The results confirmed high internal consistency across questionnaire items, with a Cronbach's alpha value of 0.87, indicating strong measurement reliability. These steps aligned with standard SLR practices for appraising data quality and enhancing research credibility.

Data Analysis

Quantitative data were analyzed descriptively and inferentially using SPSS. Descriptive statistics summarized key trends in student responses. Inferential analysis tested correlations between perceptions of ethnoscience and creativity scores, while linear regression was used to assess predictive relationships. Open-ended responses were analyzed thematically to support quantitative findings. This mixed analytical approach allowed for a comprehensive understanding of how ethnoscience-based learning may foster academic creativity in physics education.

Results

As a conceptual basis for research on the actualization of ethnoscience in physics learning, mapping the focus of learning outcomes from various previous studies is an important step. A review of these research results not only shows the direction and trends in the development of learning based on local traditions, but also provides an overview of how the ethnoscience approach contributes to strengthening students' interest, motivation, and academic creativity. This information serves as a strategic basis for formulating pedagogical recommendations and developing physics learning designs that are more relevant, contextual, and in line with the cultural characteristics of the students' environment.

Table 1. List of Findings from Literature Review

No.	Authors	Title	Years	Results
01	(Melinia & Yusup, 2024)	Development of Physics Module Based on Ethnoscience with the Local Wisdom of House Limas	2024	This study shows that integrating the local wisdom of Rumah Limas Palembang into physics learning can provide a

		Palembang to Improve Thinking Ability		valid, practical, and effective ethnoscience approach to foster students' academic creativity. The developed module received very high expert ratings in terms of content and language suitability, positive practical responses from students, and was proven to improve creative thinking skills through a moderate N-gain score. These findings confirm that utilizing local traditions as a context for physics learning can enrich the learning experience while also serving as a strategic pathway to strengthen student creativity within a culture-based education framework.
02	(Ardi et al., 2024)	Analysis of Students' Design Thinking in Creating 3D Creative Works Utilizing Mobile Technology within the Framework of Local Wisdom	2024	This study shows that integrating local wisdom with mobile technology in 3D learning projects significantly improves students' design thinking and creativity competencies. The group that used a local culture-based approach demonstrated higher abilities in dealing with uncertainty, collaborating, and applying a human-centered approach compared to the control group. Qualitative findings also show that the context of local wisdom makes the learning process more meaningful and encourages students' emotional attachment to their cultural identity. Overall, this study confirms that learning that combines technology with local traditions can enrich the learning experience and be an effective way to strengthen students' creative and innovative thinking skills—in line with the spirit of

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				actualizing ethnoscience in physics learning.
03	(Agusta & Pratiwi, 2020)	Learning Material Development Containing Critical Thinking and Creative Thinking Skills Based on Local Wisdom	2020	This study developed elementary school thematic teaching materials that integrate local wisdom as an effort to foster students' critical, creative, and logical thinking skills. After undergoing expert validation and field testing, the teaching materials were declared feasible and effective, as demonstrated by a significant improvement in the learning outcomes of the experimental class compared to the control class. Experts assessed the content, media, and language in the textbooks as highly suitable for supporting higher-order thinking skills. Overall, these findings show that learning that incorporates elements of local wisdom is not only culturally rich but also capable of strengthening students' creative thinking skills—empirical evidence that reinforces the relevance of ethnoscience in enhancing academic creativity.
04	(Putri, 2025)	Enhancing Creative Thinking in High School Physics through Project-Based Learning Integrating Local Wisdom and STEAM for Quality Education	2025	A literature review published in 2025 shows that the application of Project-Based Learning (PjBL) combined with local wisdom and the STEAM approach in physics learning can deepen conceptual understanding while developing 21st-century skills. Various studies reviewed show that student involvement in contextual projects based on local culture not only improves their mastery of physics material, but also strengthens their problem-solving, creativity, and collaboration

				skills. The integration of cultural elements has also been shown to foster students' interest in cultural preservation and make learning more relevant because it is linked to their identity and experiences. Overall, the study confirms the great potential of PjBL–STEAM-based physics learning with a touch of local wisdom as an effective strategy for fostering academic creativity within a culture-based educational framework.
05	(Fitri, 2023)	Development of an Ethnoscience-Based Physic E-Module to Improve Students' Critical Thingking Skills	2023	This study developed an ethnoscience-based physics e-module that integrates local cultural knowledge to improve high school students' critical thinking skills. Through expert validation and practitioner assessment, the e-module was found to be highly valid in terms of content, presentation, language, and graphics, and was considered very practical for use in the classroom. A trial involving 72 students showed that the group that learned using the ethnoscience e-module achieved a significant improvement in critical thinking skills compared to the control class, as evidenced by statistical test results where the t-value (3.66) exceeded the t-table (1.99). These findings confirm that the integration of local wisdom in digital modules can enrich the context of physics learning while strengthening students' higher-order thinking skills, supporting the relevance of ethnoscience as a strategy for fostering creativity and analytical skills in learning.

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06	(Sumarni et al., 2020)	Students' innovative and creative thinking skill profile in designing chemical batik after experiencing ethnoscience integrated science technology engineering mathematic integrated ethnoscience (ethno-stem) learnings	2020	The results of the study show that Ethno-STEM learning—which combines chemistry concepts with cultural practices such as batik motif design—can foster innovative and creative characteristics in chemistry education students. Through a project designing batik motifs based on the structure of natural compounds, students produced various designs that were considered highly creative by batik experts, especially in terms of originality of ideas, visual appeal, and color selection. Some of the highest-rated motifs were inspired by compounds such as alpha-pinene, curcuminoids, and carotenoids. Overall, this study confirms that learning experiences that link science with local culture are effective in enhancing students' creative thinking profiles—a finding that supports the importance of an ethnoscience approach in fostering academic creativity.
07	(Hikmawati & Suastra, 2023)	Local wisdom-based learning to develop student's creativity in high school physics studies course	2023	Research findings on the application of local wisdom-based physics learning to develop student creativity in high school. This descriptive study shows that integrating the cultural context of Lombok into physics material increases student engagement and motivation, while stimulating creative thinking in problem solving. This study confirms that culture-based contextual learning provides a more meaningful learning experience and suggests expanding its implementation in other school contexts for further validation.

08	(Pieter & Risamasu, 2024)	Integrating ethnoscience in inquiry-creative learning: a new breakthrough in enhancing critical thinking	2024	This study explores the integration of ethnoscience with the inquiry-creative learning model for prospective science teachers. Using a mixed-method design, the experimental group that used this approach showed a significant improvement in critical thinking skills compared to the traditional class. Qualitative results confirm that cultural context increases student engagement, affirming the effectiveness of integrating local knowledge to support higher-order thinking skills.
09	(Mirsa et al., 2023)	The Description of Students' Creativity and Motivation in Physics: Introducing Madurese Local Wisdom "Karapan Sapi" as Ethnophysics Learning Media	2023	This study examines the effect of Karapan Sapi local wisdom-based physics learning on the creativity and motivation of high school students. A single case study with 37 participants showed that initial creativity scores were low (average 9.51) and more than 75% of students had low motivation to learn physics. The integration of local cultural contexts made learning more concrete and meaningful, which is expected to increase student creativity and motivation.
10	(Idul & Fajardo, 2023)	Ethnoscience-based physical science learning and its effects on students' critical thinking skills: A meta-analysis study	2023	Seven synthesized case studies show that ethnoscience-based science learning significantly improves students' critical thinking skills (overall effect ≈ 3.42). The integration of local cultural contexts not only improves higher-order thinking skills, but also encourages student engagement and motivation, while respecting their cultural identities. These findings confirm the effectiveness of the ethnoscience approach as a

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	relevant, inclusive science learning strategy oriented toward the development of critical thinking skills.

The results in Table 1 show that the survey method is the most widely used research approach, followed by experiments and R&D. The integration of ethnoscience is also a consistent focus throughout the articles, while creative thinking skills emerge as the most frequently measured outcome. All three reflect current trends in educational research that emphasize empirical data collection, contextualization of local culture, and the strengthening of 21st-century skills.

The emphasis on survey methods marks a methodological trend in modern education, as it allows for quantitative and systematic measurement of students' attitudes, knowledge, and skill improvement. Compared to limited approaches such as laboratory studies, surveys are considered more representative and applicable.

The dominance of the theme of ethnoscience confirms the direction of contextual pedagogy, which combines scientific concepts with cultural practices, making learning more relevant and meaningful. This approach is also believed to enhance students' critical thinking, creativity, and problem-solving skills in the global era. Referring to the 10 articles reviewed, the dominant learning outcomes include academic creativity, appreciation of local culture, and conceptual understanding, all of which are in line with the demands of 21st-century learning. Using a quantitative survey approach based on SLR, this study not only relies on literature review but also presents empirical evidence through data processing from surveys conducted and processed using SPSS, which confirms the contribution of ethnoscience to the development of students' academic creativity. These findings provide a strong basis for recommending ethnoscience as a contextual and pedagogically effective curriculum approach.

Univariate Analysis

Table 2. Univariate Statistics of Research Variables

Variable	Mean	S. Deviasi
Ethnoscience Perception	3.71	0.37
Appreciation of Culture	3.71	0.44
Academic Creativity	3.33	0.36

Based on Table 2, the average student perception of ethnoscience learning is 3.71, reflecting a positive inclination toward a local wisdom-based learning approach. Similarly, the mean score for student appreciation of local cultural values is 3.71, suggesting that integrating cultural context can foster students' emotional connection to physics content. The average academic creativity score is 3.33 with a standard deviation of 0.36. According to benchmarks in creativity assessment literature (e.g., Snyder, 2019; Runco & Jaeger, 2012), scores above the mid-point of the 5-point scale (i.e., >3.0) indicate a moderate-to-high level of creative engagement, which suggests that students demonstrate a meaningful capacity for fluency, originality, flexibility, and elaboration in their learning processes.

Bivariate Analysis

Table 3. Pearson Correlation between Research Variables

Variable	1. Ethnoscience Perception	2. Cultural Appreciation	3. Academic Creativity

Ethnoscience Perception	1.000	0.110	0.472
Appreciation of Culture		1.000	0.352
Academic Creativity			1.000

The results of Pearson's correlation analysis show a positive relationship between students' perceptions of ethnoscience and academic creativity (r = 0.472), as well as between cultural appreciation and academic creativity (r = 0.352). However, it is important to note that these correlations indicate associations rather than causal relationships. Therefore, while students with more positive perceptions and greater engagement with the local cultural context tend to exhibit higher levels of academic creativity, these findings do not establish that ethnoscience perception or cultural appreciation directly causes increases in creativity.

Simpel Linear Regression Analysis

Table 4. Results of Linear Regression of academic Creativty on Perceptions of Ethnoscience and Cultural Apprection

Predictir Variable	Koefisien (Beta)	Interpretasi
Ethnoscience Perception	0.417	Significant positive influence on creativity
Cultural Appreciation	0.247	Moderate positive influence
Intersep (Konstanta)	0.863	Basic creativity score without predictors

The linear regression model shows that students' perceptions of ethnoscience learning and their appreciation of local culture positively influence academic creativity. Ethnoscience perception has a standardized beta coefficient of 0.417 ($p < 0.001$), and cultural appreciation has a beta of 0.247 ($p = 0.003$), indicating statistically significant effects. The model's R^2 value of 0.313 suggests that the two predictors together explain 31.3% of the variance in students' academic creativity. These results highlight that integrating cultural context in physics learning can meaningfully support the development of students' creative capabilities, while also quantifying the strength and significance of each contributing factor.

Discussion

This section is also a major part of the research articles and is also usually the longest part of an article. Discussion of the research presented in this section are the result. The process of data analysis such as statistical calculations or other processes for the achievement of its research.

This study provides preliminary evidence on the potential benefits of contextualized physics learning, highlighting how integrating ethnoscience and local culture may support the development of students' creative skills within the observed sample. Through a combination of systematic literature review and quantitative survey, this study emphasizes that the integration of ethnoscience in physics education not only enriches teaching materials but also plays a significant role in fostering students' academic creativity. A review of 10 relevant articles from 2020 to 2025 shows an increasing trend in publications exploring local cultural values in science education. Three main thematic clusters that consistently emerge are creativity, critical thinking, and cultural appreciation. These three themes suggest more than just pedagogical trends; they highlight a pressing need for instructional designs that not only foster higher-order cognitive skills but also actively integrate local knowledge to produce students who can apply scientific

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understanding in contextually meaningful and globally relevant ways. This underscores the strategic value of ethnoscience-based approaches in bridging cultural relevance with the development of 21st-century competencies. These results are also in line with the findings of Pieter and Risamasu (2024) and Sartika et al. (2025), which emphasize the role of ethnoscience in improving students' conceptual understanding and creative engagement in physics learning.

Empirically, data analysis using SPSS confirms that students with positive perceptions of ethnoscience-based learning tend to exhibit higher levels of academic creativity. The correlation between perceptions of ethnoscience and student creativity ($r = 0.472$), as well as cultural appreciation ($r = 0.352$), shows that engagement with the local cultural context has a positive impact on how students think and solve scientific problems. These findings are reinforced by the studies of Alhusni et al. (2025) and Ali et al. (2025), who in their bibliometric review stated that creativity is a consistent outcome in the ethnoscience approach. Traditions such as Nias Stone Jumping, used as an example in this study, serve as effective contextual media for representing physics concepts such as kinetic energy and potential energy. In culture-based learning processes, students do not merely memorize concepts but also construct new meanings from the interaction between physical phenomena and the local traditions they are familiar with.

The pedagogical strategies applied in this study adopted the principles of inquiry-based and participatory learning based on culture. The use of ethnoscience-based electronic modules, the exploration of cultural symbols in a scientific context, and the involvement of students in designing solutions based on local wisdom proved effective in stimulating creative thinking. The regression results show that perceptions of ethnoscience ($p < 0.05$; $\beta = 0.417$) and appreciation of culture ($p < 0.05$; $\beta = 0.247$) are significant predictors of students' creativity scores. It should be noted that these findings indicate predictive relationships rather than causal effects, meaning that higher perceptions or appreciation are associated with higher creativity scores, but causation cannot be inferred from this analysis. This means that learning that places culture as a pedagogical medium not only strengthens conceptual understanding but also shapes flexible, original, and reflective thinking. This approach also encourages students' affective engagement, creating a deeper connection between themselves and the material being studied, as well as stimulating intrinsic motivation that supports long-term creative thinking processes. This is supported by the findings of Pinar et al., (2025), which emphasize the importance of affective connections in the context of locally-based scientific learning.

This study has several limitations that suggest directions for future research. The systematic literature review did not follow PRISMA guidelines, the survey sample was small ($N = 50$), and the creativity instrument lacked construct validity testing. Additionally, previous studies often lack standardized creativity measures, focus mainly on Southeast Asia, and show limited cross-cultural collaboration, with most investigations being short-term. Future research should address these gaps by developing standardized creativity frameworks, conducting cross-cultural and longitudinal studies, and exploring pedagogical strategies such as cultural analogies, tradition-based problem design, and inter-community collaboration to enhance the effectiveness of ethnoscience-based physics learning.

Overall, the findings of this study provide a conceptual basis and strong empirical evidence that ethnoscience can be used as a learning strategy that is not only culturally contextual, but also effective in enhancing student creativity. By integrating local values into the learning process, physics education is no longer merely a means of transferring knowledge, but rather a vehicle for developing identity, imagination, and innovative thinking skills needed to respond to future challenges. Ethnoscience enables the emergence of a holistic learning approach that

integrates cognitive, affective, and social aspects in an authentic and relevant cultural context for students.

Conclusion

This study indicates that the integration of ethnoscience in physics education contributes to the development of students' academic creativity. Through an SLR-based approach and quantitative surveys, evidence was obtained that student involvement in the context of local culture can strengthen scientific concept understanding while building affective connections that encourage flexible thinking and innovation. The results of the analysis show that perceptions of ethnoscience and appreciation of culture significantly predict students' creativity levels. In addition, a culture-based participatory learning approach has been shown to stimulate creativity and scientific problem solving. However, the study is limited by a relatively small survey sample (N = 50) and the creativity instrument was not tested for construct validity, which may affect the generalizability and robustness of the findings. Moreover, the SLR did not employ PRISMA guidelines, which could reduce transparency in the literature selection process. These limitations suggest several directions for further research, including the development and validation of standardized instruments for assessing creativity, conducting cross-cultural and longitudinal studies, examining the long-term integration of ethnoscience into physics curricula, and exploring pedagogical mechanisms such as community-based projects, tradition-inspired problem design, and the use of cultural analogies to enhance both cognitive and affective outcomes. Thus, ethnoscience is recommended as a strategic approach in designing a physics curriculum that is not only responsive to the cognitive demands of the 21st century but also relevant to cultural identity and local values.

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