Science Education Research (Search) Journal
Volume 4, Nomor 2 : April 2026
E-ISSN: 3032-6435
https://e-jurnal.iainsorong.ac.id/index.php/jaser

Ethnoscience Course Program Oriented Towards Education for Sustainable Development (ESD): A Needs Assesment

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Abstract

Ethnoscience is one of the compulsory courses in the Science Education program. The implementation of Education for Sustainable Development (ESD) should be integrated into the ethnoscience course to enhance the awareness of prospective science teachers regarding the environment and sustainability. This study aims to analyze the implementation of the ethnoscience course program at a Teacher Training Institution (LPTK) in Riau Province. A case study methodology was employed, involving the analysis of ethnoscience course documents, observation and interviews with lecturers. The data were analyzed using qualitative descriptive methods based on the Miles-Huberman framework. The course implementation plan has met the established standards, and the majority of the learning outcomes align with the qualifications set by the Indonesian National Qualification Framework (KKNI). The ethnoscience course uses a research approach that examines the reconstruction of indigenous knowledge into scientific knowledge, though it has yet to emphasize sustainability literacy. Lecturers face challenges in accommodating the depth of content derived from student projects. Stakeholders should consider policies for collaborative teaching,like citizen science project in ethnoscience to support the optimization of achieving the course's expected competencies.

Article History:
Received 18 April 2026;
Accepted 24 April 2026;
Published 30 April 2026.

Keywords:
Ethnoscience;
Science Education;
ESD;
Needs Assessment.

How to Cite:
Aldeva, Hidayat, T., Riandi, R., & Sriyati, S. (2026). Ethnoscience Course Program Oriented Towards Education for Sustainable Development (ESD): A Needs Assesment. SEARCH: Science Education Research Journal, 4(2), 116–126. https://doi.org/10.47945/search.v4i2.2813

INTRODUCTION

The global community is currently working toward achieving the Sustainable Development Goals (SDGs), which are targeted for completion by 2030. The SDGs provide solutions for countries worldwide to develop human resources capable of competing in the 21st century. Teacher Education Institutions (LPTKs) play a crucial role in producing qualified educators (Fadilah et al., 2022). The quality of education is highly determined by the quality of its educators (Darling-Hammond, 2021). Over the past two decades, many developed countries have implemented new standards, monitoring systems, and course requirements to strengthen the quality of teacher preparation (Cochran-Smith, 2021). Graduates are expected to possess professional, pedagogical, social, and personal competencies (Kemenkumham, 2008; Maulana et al., 2023). The demand for 21st-century competencies, coupled with the rapid advancement of science and technology, urges the alignment of the curriculum with the needs of the field. 21st-century skills are essential today,

as they significantly impact the future career success of prospective teachers (Valtonen et al., 2021). The integration of 21st-century skills into curricula, teaching methodologies, and the use of information and communication technologies (ICT) is an ongoing area of development (González-Salamanca et al., 2020). According to the 21st Century Education framework, learners are required to develop Social and Cultural Awareness (SCA) (WEF, 2015). SCA is the ability to understand and respond to social and cultural phenomena, also known as cultural literacy (García Ochoa et al., 2016). Cultural literacy helps foster a critical cultural perspective among students (Flavell et al., 2013) and strengthens the understanding of the concepts learned in class (Rahmawati et al., 2019; Snively & Corsiglia, 2001; Uge et al., 2019). Therefore, teacher education curricula must be designed to produce graduates who possess the competencies required by the education system today.

The inclusion of ethnoscience in higher education curricula serves as an actualization of 21st-century skill demands for future science educators. The ethnoscience course is particularly relevant given the characteristics of Indonesian society, which is rich in ethnic and cultural diversity. Local culture, known as local wisdom, represents the identity of the local communities and is still preserved due to its inherent values of wisdom and practicality. Various forms of culture, including arts, architecture, clothing, cuisine, and traditions, reflect Indonesia's motto "Bhinneka Tunggal Ika" (Unity in Diversity). Local wisdom is a valuable resource for learning and innovation. It can be used as a basis for knowledge to innovate teaching methods. Additionally, local wisdom functions as a conservation tool for preserving values and natural resources. The integration of local cultural values into ethnoscience teaching is a way to preserve Indonesia’s local wisdom (Oktavianti & Ratnasari, 2018). This highlights the urgency of ethnoscience education in strengthening the quality of future educators' human resources.

Ethnoscience education must be developed to meet the expectations of the study program's learning outcomes and address the needs of prospective teachers. Innovative teaching is crucial in preparing educators to teach science subjects in schools. Science educators are expected to offer a deep understanding of scientific concepts and process skills (Starkey, 2020; Tanak, 2020). Science is a fundamental subject in primary and secondary education, playing a critical role in shaping students' understanding of natural phenomena and the processes that occur around them. Students are trained to develop critical, analytical thinking skills and problem-solving abilities (Chowdhury, 2018; DeBoer, 2019). The ethnoscience course program is expected to contribute to the achievement of the established graduate competencies. This program also equips students with various problem-solving skills related to local wisdom issues. Every course program follows a learning design agreed upon by the academic team. As time progresses, new demands arise to accommodate the needs of the field. Therefore, evaluating the program is essential to make improvements that ensure the course remains structured and systematic, ultimately enhancing the quality of classroom learning.

Ethnoscience is a compulsory course in the Science Education program. Ethnoscience is the study of the knowledge and scientific practices held by local communities (Ilhami & Yasnel, 2022; Sudarmin, 2014). In the context of science education, ethnoscience is vital as it

examines alternative perspectives on how local communities, especially the Malay community, understand their environment. The ethnoscience course in the Science Education program is designed to introduce students to the concepts and principles of ethnoscience, local knowledge, and how to integrate this knowledge into science education in schools. The goal of this course is to provide students with an understanding of the concepts and principles of ethnoscience and analyze the relationship between indigenous knowledge and modern science. This approach encourages prospective teachers to integrate local wisdom into their science teaching practices. Research on the exploration of Malay local wisdom reveals its potential as a resource for science learning, including local wisdom such as "*Lubuk Larangan*" to enhance environmental literacy (Ilhami, 2019; Ilhami & Riandi, 2018), the "*Malomang*" tradition to reinforce food chemistry concepts (Ardana et al., 2023), the "*Mauwo*" tradition for water conservation (Ilhami et al., 2020), "*Hutan Larangan*" for forest preservation (Matsna et al., 2023), and "*Manongkah Kerang*" for marine biodiversity conservation (Ilhami et al., 2021).

Ethnoscience is closely related to the SDGs. Ethnoscience learning plays a significant role in supporting the development of inclusive and sustainable educational quality. The primary characteristic of ethnoscience, which focuses on integrating scientific knowledge with local wisdom, aligns with SDG Goal 4. Ethnoscience studies encompass numerous best practices from traditional communities that are in line with sustainability principles. Therefore, the Ethnoscience course provides prospective educators with the opportunity to understand local potential, appreciate cultural diversity, and develop critical thinking skills necessary to face global challenges.

Previous research has mainly focused on analyzing students' abilities, teaching modules, and learning evaluations. Research by Laksono et al. (2023) on analyzing the ability of prospective chemistry teachers to integrate ethnoscience in contextual learning. Research findings on the analysis of environmental chemistry teaching modules (Al Idrus, 2025) and ethnoscience-based food chemistry (Sumarni & Supanti, 2021) in higher education. Dewi Lengkana & Jalmo (2021) developed an ethnoscience-based learning design using multiple representations. Hayon & Wariani (2025) analyzed assessment instruments based on ethnoscience. The gap in these studies lies in the exploration of the ethnoscience curriculum with a focus on sustainability literacy. The novelty of this research lies in the in-depth analysis of the ethnoscience curriculum in higher education as an initial foundation for the development of ethnoscience learning oriented towards SDGs. This highlights the urgent need to holistically analyze ethnoscience courses as an effort to develop sustainability values.

One prominent university in Riau Province offers a Science Education program. This program has a vision to develop a Science Education curriculum based on Islamic values, Science, Technology, Engineering, Art, and Mathematics (Islamic-STEAM), integrated with ethnoscience (TIPA, 2024). There is a strong emphasis on developing learning models based on Islam, STEM, and local wisdom. This vision accommodates students' skills in the fields of science, Islam, and culture. To achieve this vision, the program aims to produce graduates who are able to: master theoretical concepts of science and specific science teaching skills for schools; conduct research in the field of science education at schools; manage laboratory

activities; generate innovations and publications in science education based on Islamic STEM and ethnoscience; and contribute to community service in science education based on Islamic STEM and ethnoscience (TIPA, 2024). Ethnoscience education is a distinctive feature of this program. Preliminary research in the Science Education program at one of the LPTKs in Riau shows that the ethnoscience course has been offered since the establishment of the program in 2017. This indicates the urgency of evaluating the ethnoscience course program to enhance the quality of graduates in line with the curriculum demands and current field needs. The purpose of this study is to analyze the ethnoscience course program within the Science Education program at an LPTK in Riau.

RESEARCH METHODS

The research utilizes a qualitative approach with a case study design. A case study is an empirical inquiry that investigates contemporary phenomena and seeks to understand strategies to address research questions such as "how" or "why" (Yin, 2018). This study specifically examines the implementation of the ethnoscience course by analyzing course documents (syllabi), observing the course in practice, and conducting interviews with lecturers. The research was conducted during the fourth semester of the 2023/2024 academic year at a Teacher Education Institution (LPTK) in Riau.

The study includes three participants: the lecturers teaching the ethnoscience course and the head of the study program. These participants were selected purposefully to provide insights into different perspectives on the implementation and challenges of the ethnoscience course. Although the sample size is limited to three individuals, this selection is justified based on the in-depth and exploratory nature of the case study. Given the qualitative design and the specific context of the study, these three subjects were deemed sufficient to provide rich, detailed data on the course's implementation.

To ensure the validity of the data, triangulation was employed. This involved using multiple data sources: document analysis (syllabi), participant observations, and interviews with lecturers. The consistency of the data across these sources was compared to strengthen the credibility and reliability of the findings. By cross-referencing the data obtained from these different methods, potential biases and inconsistencies were identified and addressed. Data analysis followed the descriptive qualitative approach outlined by Miles and Huberman (2014). The analysis process consisted of several stages: data collection, data reduction, data display, and drawing conclusions. First, interview data were gathered regarding the implementation of the ethnoscience course. Next, the data were reduced by identifying key themes, which were then presented in a systematic narrative form. Finally, conclusions were drawn based on the patterns and relationships observed in the data, which were continuously refined through the triangulation process.

RESULTS AND DISCUSSION

1. Analysis of Course Planning

The ethnoscience course in the Science Education Department is a mandatory course for all students in the Tadris IPA program. This course provides students with the ability to

analyze the concepts of science (biology, physics, chemistry, and IPBA) through the lens of local wisdom as a source of learning and its implementation in science education. Students acquire knowledge by constructing ethnoscience concepts through references and field research, presented individually or in groups during classroom discussions with response lectures. The evaluation is based on independent tasks, structured assignments, mid-term and final exams.

The design of the ethnoscience course uses a research-based approach with a focus on studying the values of local wisdom integrated into the learning process or ethnopedagogy. Ethnopedagogy is a learning approach that emphasizes embedding local wisdom values. This ethnopedagogical-based learning involves transforming indigenous knowledge, which comprises beliefs passed down through generations, often intertwined with myths, into scientific knowledge. The scope includes fields like science, agriculture, ecology, medicine, and even flora and fauna. The emergence of ethnoscience is linked to knowledge discovered through trial and error, without the ability to translate findings into scientific knowledge. Ethnoscience typically begins at the local and regional levels, representing knowledge that emerges from trial and error (Novitasari et al., 2017).

The course plan for ethnoscience is obtained through the study of the Semester Learning Plan (RPS) and teaching materials. The RPS is an essential document in higher education planning, helping students understand the structure and objectives of the course over a semester. It serves as a guide for students to follow the lectures, complete assignments, and achieve the specified learning objectives. The RPS ensures transparency in the learning process, providing students with the core material, strategies, and expected learning outcomes. According to SNDIKTI standards (2020), the RPS should contain nine components: identity, CPMK (Course Learning Outcomes), Sub-CPMK, study material, teaching methods, duration, assessment criteria, and references.

The analysis of the ethnoscience RPS, based on the established standards, shows that the RPS components align with SNDIKTI requirements as follows:

Table 1. Analysis of Components of the Ethnoscience RPS

RPS Component	Description
RPS Identity	Includes the course name, code, semester, credit hours, & the course instructor.
CPMK	Includes 4 CPMK: 1) Appreciating cultural diversity; 2) Applying logical, critical, systematic, and innovative thinking in ethnoscience; 3) Designing and using IPA learning resources based on IPTEKS and local wisdom; 4) Mastering local wisdom in a scientific or Islamic context.
Sub-CPMK	Breakdown of CPMK into specific sub-outcomes.
Study Material	1) The essence of ethnoscience; 2) Local wisdom and its scope; 3) Reconstruction of indigenous knowledge; 4) Malay Riau ethnoscience; 5) Ethnoscience-based learning.
Learning Method	Lectures, Question&Answer, guided inquiry, field visits.
Learning Time	2 SKS.
Learning Experience	Independent and structured learning.
Assessment Criteria	Participation, essays, and project products.
References	Core books and supporting references from textbooks and scientific articles.

One unique characteristic of the ethnoscience RPS is its integration of science and Islam. The integration model includes three aspects: Al-Nushus al-Syariyyah, At-Tahlil Imani, and An-Naqdul Imani. Al-Nushus al-Syariyyah links scientific material with relevant Quranic verses or Hadiths to strengthen understanding and demonstrate the alignment of science with religion. At-Tahlil al-Imani discusses the aspects of faith or Sharia embedded in scientific material, showing how science aligns with religious values. Al-Naqd al-Islami analyzes and critiques scientific theories that contradict religious beliefs, helping students develop critical thinking and reinforce their faith (Zarkasih et al., 2017). The ethnoscience RPS uses Quranic verses (Q.S. Al-Quraysh 1-4) as the foundation for aligning the study topics with Islam in the Al-Nushus al-Syariyyah aspect. In the At-Tahlil al-Imani aspect, the focus is on increasing faith in Allah. This component shows that the RPS aligns with the KKNI (National Qualification Framework), particularly in achieving the goal of enhancing religious piety. The integration of science and Islam plays a crucial role in educating future science teachers at Islamic higher education institutions (PTKI) (Karim & Bakar, 2023; Suprapto & Sumarni, 2022). This approach bridges the divide between knowledge and religion, creating a holistic understanding (Chanifudin & Nuriyati, 2020). Through this integration, future science teachers are equipped with the ability to merge Quranic verses about the natural world with scientific principles (Ramadanti, 2020). This competence helps teachers instill religious awareness in students through science learning.

Pekan Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Materi Pembelajaran	Integrasi Islam – Sains			Pengalaman Belajar			Penilaian			Referensi
			Al-Nushus al-Syariyyah	At-Tahlil Imani	An-Naqdul Imani	Bantuk Pembelajaran; PenugasanMahasiswa;	Model/ Strategi/	Waktu	Indikator	Kriteria & Teknik	Bobot (%)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)	(10)	(11)	(12)
1, 2,	**Sub-CPMK 1**: Mampu memahami hakekat etnosains dan urgensinya	✓ Hakikat etnosains ✓ Urgensi etnosains untuk pembelajaran IPA ✓ Istilah etnosains (etnoekologi, etnomedisin,etnoteknologi,etnobotani)	Surat Al-Qurays 1-4 tentang kajian kearifan lokal sebagai ayat-ayat kauniyah	Meningkatkan keimanan kepada Allah Swt.		**Luring** Hadir tepat waktu Mengikuti perkuliahan secara luring	Ceramah Metode drill	2 x 100 Menit	Memahami hakikat etnosains Memahami urgensi etnosains dalam pembelajaran IPA Menjelaskan istilah dalam term dalam etnosains	Kriteria Partisipasi mahasiswa Rubrik penilaian Essay		[1,2]
						Belajar Terstruktur Mahasiswa diminta mengidentifikasi contoh etnosains		3 x 120 Menit	Ketepatan contoh etnosains	Rubrik Penilaian Essay		
						Belajar Mandiri Mahasiswa diminta Mengerjakan resume tentang urgensi pembelajaran IPA berbasis kearifan lokal		3 x 120 Menit	Ketepatan tentang urgensi pembelajaran IPA berbasis kearifan lokal	Penugasan (Produk)		

Figure 1. Excerpt of the Ethnoscience RPS (http://tiny.cc/rps-etnosains)

As supervisors in the course, lecturers play a crucial role in the learning process. LPTK lecturers not only facilitate the achievement of learning outcomes but also evaluate the effectiveness of the course program. Proper course planning is essential for lecturers to understand the targets to be achieved and the importance of delivering key topics. The development of the course plan includes relevant activities to support the achievement of the established competencies, and the plan is articulated in the RPS. The RPS acts as a learning guide for students over a semester in a specific course. It helps students achieve the learning objectives set by the program. To enhance the quality of the course, RPS development is conducted collaboratively by lecturers within the same academic field. Lecturers must consider student participation, the use of information and communication technology (ICT), the interrelation of materials, feedback, and follow-up activities in the development of the RPS. The creation and development of the RPS should be open, dialogical, and subject to

periodic revisions to align with developments in science, technology, and societal needs (Sitepu & Lestari, 2018).

2. Analysis of Ethnoscience Course Implementation

The ethnoscience course uses a research-based approach, assigning students in groups to explore scientific values in local wisdom. The evaluation of the learning process includes tests and portfolio assessments. The expected competencies for this course are that students develop innovative, logical, and critical thinking skills. In the course process, lecturers guide students in developing these skills through the systematic preparation of indigenous knowledge research, starting with planning, data collection, and reporting. However, assessments for these skills are not yet explicitly reflected.

This course also aims to develop student capacity in creating learning resources based on local wisdom. The final product of the course is a draft research report on local wisdom. The course has shown an innovative teaching strategy, but it still requires improvement. Students have been given the opportunity to explore local wisdom in their respective areas, but the solutions proposed have not yet been fully realized. Data collection is based on students' interest in exploring selected local wisdom. The activities include research planning, instrument preparation, data collection, data analysis, and conclusion drawing. Lecturers have facilitated students' critical thinking skills in the process of reconstructing community knowledge into scientific knowledge.

The results of the analysis of the ethnoscience course reveal both strengths and areas that require further refinement, particularly in relation to the concept of Education for Sustainable Development (ESD). The course is designed to integrate local wisdom into the teaching of science, allowing students to critically engage with concepts across disciplines such as biology, chemistry, and physics through the lens of indigenous knowledge. While the course demonstrates a clear alignment with the curriculum standards and emphasizes scientific inquiry, there is a noticeable gap in explicitly addressing sustainability literacy as a core component. This issue is particularly evident when comparing the course's implementation with recent studies on ESD in higher education. For example, research by González-Salamanca et al. (2020) emphasizes the necessity of integrating sustainability skills into teacher education programs, yet the ethnoscience course under study largely focuses on knowledge reconstruction without a systematic emphasis on environmental sustainability or social responsibility, core tenets of ESD (Ilhami et al., 2021). Furthermore, the integration of local wisdom into science education, while innovative, often lacks the critical linkage to sustainable practices that could reinforce the broader goals of SDGs, particularly Goal 4 (Quality Education) and Goal 13 (Climate Action). A comparison with other ethnoscience courses, such as those explored by Rahmawati et al. (2019), shows that while some programs effectively embed sustainability concepts into ethnoscience, this course falls short in making these links explicit. Therefore, it is recommended that future iterations of the course enhance the incorporation of sustainability literacy, ensuring that local wisdom not only informs scientific inquiry but also fosters a deeper understanding of sustainable practices. In conclusion, while the course contributes to critical thinking and local knowledge

preservation, a more intentional and explicit alignment with ESD principles would enhance its relevance and impact in shaping future educators capable of addressing global sustainability challenges.

While students are given the opportunity to gather data based on contextual issues, the research process remains divergent. Students have the freedom to choose their research topics, leading to a wide variety of research areas. Students analyze local wisdom in areas such as medicine, agriculture, food, environmental management, and more. Interviews with lecturers indicate that there are challenges in accommodating the depth of content in the analysis of local wisdom. In the research process, community knowledge is reconstructed into scientific knowledge in an integrated manner. The disciplines of biology, physics, and chemistry play a fundamental role in transforming local knowledge into scientific knowledge. Each of these disciplines offers unique lenses for understanding and analyzing local wisdom into a comprehensive scientific explanation. Biological studies provide insights into biodiversity, organism interactions, and ecological processes underlying indigenous knowledge of medicinal plants, farming practices, and resource management. Physics offers a framework for understanding the natural phenomena observed and manipulated by local communities. Chemistry plays a significant role in understanding the composition of materials used in local practices and technologies. Therefore, the application of collaborative learning is essential in implementing the ethnoscience course to effectively support the achievement of the expected course competencies.

CONCLUSION

The implementation of the ethnoscience course in the Science Education program has met the established standards. There are key areas that require attention for improvement, particularly in its alignment with ESD and its ability to address real-world sustainability challenges. The course successfully emphasizes the development of critical thinking, logical, systematic, and innovative skills in students, who engage with local wisdom and transform it into scientific knowledge. However, the course has not yet effectively focused on finding solutions to the research problems students choose, which limits its capacity to address practical sustainability issues. A fundamental component of ESD is the ability to connect educational content with real-world challenges, especially those related to environmental and social sustainability. This gap highlights the need for the course to more explicitly integrate sustainability literacy, ensuring that local wisdom is not only explored but also connected to sustainable practices and broader global challenges. The lack of explicit sustainability integration, lecturers also face challenges in accommodating the depth and complexity of the content derived from student projects. The course primarily focuses on the reconstruction of indigenous knowledge into scientific knowledge, yet it does not always provide sufficient depth in applying these insights to contemporary sustainability issues. To address this limitation, it is recommended that the course be restructured to include input from interdisciplinary experts who can provide a more holistic and comprehensive approach to integrating local knowledge with scientific inquiry. The inclusion of citizen science projects in the ethnoscience course could provide valuable opportunities for students to engage in

practical, real-world problem-solving. By involving students in citizen science initiatives, the course would encourage the application of knowledge to environmental challenges, reinforcing the link between ethnoscience and sustainability. While the ethnoscience course has successfully fostered critical thinking, it requires further refinement to more explicitly incorporate sustainability concepts, engage interdisciplinary expertise, and implement hands-on, real-world projects. By making these adjustments, the course could better contribute to the development of future educators equipped to address the pressing sustainability challenges of the 21st century and support the achievement of the SDGs.

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