Chapter 2

Ethnoscience in Science Education

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Abstract

This study aims to examine the theoretical and pedagogical dimensions of ethnoscience integration in science education. Designed as a qualitative review, the research analyzed national and international sources published between 2015 and 2025, systematically evaluating the current challenges in science teaching and the potential solutions offered by ethnoscience. Findings indicate that science education is often perceived as abstract and disconnected from everyday life, negatively affecting students' scientific process skills and learning retention.

Ethnoscience emerges as a powerful pedagogical approach, enabling students to relate their cultural experiences to scientific concepts, thereby making learning more meaningful, durable, and functional. Incorporating local knowledge systems into science curricula not only contributes to the preservation of cultural heritage but also enhances students' scientific literacy, critical thinking, and creative problem-solving skills. However, teacher competencies, limited instructional materials, and curriculum rigidity represent significant barriers to the widespread implementation of this approach. The study highlights the theoretical foundations of ethnoscience-based science education while offering recommendations for educational policies and teacher training.

Introduction

Science education is a multifaceted discipline that occupies a central position within contemporary education systems. Its primary objective is twofold: first, to furnish individuals with academic knowledge, and second, to assist them in acquiring higher-order skills such as problem solving, critical thinking, decision making and lifelong learning. The evolving social and technological landscape of the 21st century necessitates a transformation

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in science education, moving beyond the confines of mere knowledge transmission and instead fostering individuals to become active contributors to their respective communities and societies. Nevertheless, a substantial body of research indicates that science lessons are predominantly perceived by students as abstract, disconnected from daily life, and challenging (Tsai et al., 2020). This phenomenon has been shown to engender adverse attitudes among students towards science lessons, thereby impeding the development of their scientific process skills and jeopardising the sustainability of their learning (Wahyuni, 2015; Kind & Osborne, 2017).

The prevailing view is that, for science education to become effective and meaningful, it must be supported by cultural and contextual elements that are directly related to students' lives. In this context, one of the approaches that has come to the fore in educational sciences in recent years is ethnoscience. The concept refers to the systematic study of traditional knowledge systems produced by individuals within their cultural environment. It also represents an interdisciplinary field that bridges local knowledge and universal science (Sturtevant, 1964; Sudarmin, 2014). When applied to the field of education, ethnoscience enables students to relate their own cultural experiences and local knowledge to science concepts, thereby rendering the learning process more meaningful, lasting, and functional (Fasasi, 2017; Hadi et al., 2019).

A significant contribution of ethnoscience-based science education is the integration of abstract scientific content with students' familiar everyday life experiences. This pedagogical approach facilitates not only the acquisition of scientific concepts but also their reinterpretation within the students' personal life contexts. Indeed, studies demonstrate that ethnoscience integration enhances students' scientific literacy levels, fosters their critical and creative thinking skills, and contributes to the development of positive attitudes towards science lessons (Nadhifatuzzahro & Suliyanah, 2019; Zidny & Sjöström, 2020). Moreover, the incorporation of local knowledge systems within course content fulfills a significant pedagogical function in terms of safeguarding cultural heritage and ensuring its transmission to future generations (Rahmatih, Maulyda & Syazali, 2020).

When evaluated specifically in the context of Turkey, the curriculum-based objectives of science education include students understanding their environment, internalising local values, and relating these to universal knowledge (MEB, 2018). However, in practice, the fact that lesson content is mostly text-based and relies on rote learning makes it difficult for students to understand science concepts in the context of everyday life. At this juncture, the ethnoscience approach emerges as a compelling alternative

that fosters cultural continuity, facilitates contextual learning, and enhances students' science learning processes.

The present study is an examination of the integration of ethnoscience in science education. Its aim is to address the theoretical framework and pedagogical practices in the field from a holistic perspective. The present study will discuss the effects of ethnoscience-based science teaching on students' academic achievements, scientific process skills, and cultural awareness. It will also offer recommendations regarding the applicability of this approach in education. The objective of this study is to establish a theoretical and practical framework that will contribute to current trends in science education at both the national and international levels.

Method

The present study is designed as a qualitative review research examining the integration of ethnoscience in science education from theoretical and pedagogical perspectives. The research involved a comprehensive review of both domestic and international literature on the subject, with a particular focus on articles, theses, reports, and book chapters published between 2015 and 2025.

The data collection process was undertaken using academic databases such as Google Scholar, ERIC, Scopus, and TÜBİTAK ULAKBİM. A comprehensive literature review was conducted using the keywords 'science education', 'ethnobotany', 'local knowledge', 'culture-based learning', 'contextual teaching' and 'scientific process skills'.

The sources utilised in the study underwent evaluation through content analysis, and were categorised under thematic headings such as current problems in science education, theoretical foundations of ethnoscience, its role in education, and its integration into science lessons. The findings were synthesised, with due consideration given to both the similarities and differences that were identified in the literature, and trends in the field were identified.

In this respect, the research aims to establish a theoretical framework and systematically present the contributions and application examples of ethnoscience-based science education.

Science and Science Education

Science is a discipline that fundamentally addresses natural phenomena from a systematic, structured perspective in line with scientific methodology

(Intika et al., 2020). The aforementioned discipline demands a specific degree of order and methodological integrity in the process of comprehending and elucidating the natural world. Puspasari et al. (2019) propose a definition of science as a set of principles, theories, concepts, and laws that emerge as a result of various scientific perspectives and process skills. Within this framework, science is presented as a holistic field that encompasses not only the accumulation of knowledge but also the methods of obtaining and structuring this knowledge.

Conversely, science education is regarded as a process that extends beyond the mere dissemination of knowledge about the natural environment, offering experiential learning opportunities that are directly connected to individuals' daily lives (Pratama et al., 2022). The approach under discussion aims to ground learning in a concrete and functional basis, moving it away from the abstract.

Concomitantly, the domain of science education comprises fundamental principles and methodologies that are designed to cultivate individuals' capacity to comprehend scientific content, to interpret this content with a critical perspective, and to create meaningful syntheses by integrating diverse pieces of information. In this process, epistemological beliefs – that is, individuals' fundamental assumptions about the source, validity, limits, and acquisition of knowledge – play an important role (Hofer & Pintrich, 1997). These beliefs have been shown to directly impact the nature of the relationship between learners and knowledge, and consequently the effectiveness of the learning process.

Tsai et al. (2020) posit that, heretofore, science education has been regarded by students as a challenging field that is disconnected from everyday life. This negative perception has been shown to have a detrimental effect on the learning process, resulting in a series of difficulties for the teacher and learner. It is evident that within the domain of educational challenges, there are notable deficiencies that persistently emerge. Among these are fundamental inadequacies, including students' deficient capacity for creative thinking, inadequately developed critical analysis skills, and suboptimal levels of scientific literacy.

Wahyuni (2015) asserts that contemporary science teaching practices are predominantly characterised by passive reading activities and the memorisation of information. However, the very essence of science is predicated on a process of discovery and understanding, as opposed to a mere transmission of information (Maksić & Spasenovic, 2018). In this context, effective science education should not be confined to the transmission of

theoretical content; it should also aspire to the development of procedural skills and higher-order cognitive abilities (Kind & Osborne, 2017).

Consequently, the design and implementation of science teaching should be structured in a manner that will instil scientific thinking and working habits in students and provide them with meaningful and contextual experiences (Latifah et al., 2020). This approach is designed to ensure that learning is more permanent and functional.

A further fundamental problem encountered in the domain of science education is that learning materials are not sufficiently related to daily life. Research indicates that the predominant use of text-based lesson content, presented in a context that is divorced from real-life scenarios, poses significant challenges for students in comprehending the subject matter (Dewi et al., 2019). Nevertheless, the fundamental objective of science education is to furnish students with the capacity to observe natural phenomena and analyse the consequences of human-nature interactions. In order to achieve this objective, it is imperative that students cultivate their problem-solving and evidence-based reasoning skills.

The science education programme proposed by the Ministry of National Education (2018) adopts a comprehensive approach based on the multifaceted development of students. The programme is predicated on an educational philosophy that is attentive to individual differences and permits flexible applications. Within this paradigm, the role of science education is predicated on the dual pillars of fostering students' academic acumen and nurturing their social and emotional well-being.

Prabowo (2015) offers a definition of science learning as a process in which students interpret natural events in their environment through experience. The objective of this process is to facilitate the development of students' cognitive, psychomotor and social skills through practical and meaningful experiences. Nevertheless, Insani (2016) highlights that challenges such as the dearth of efficacious learning strategies and inadequate learning resources persist at diverse levels of education. The challenges faced by students pursuing science education in undergraduate programmes specialising in basic science courses merit particular attention. It is evident that difficulties encountered in the face of contextual problems have a detrimental effect on the efficiency of learning processes. At this juncture, the integration of contextual learning methodologies within the domain of science education, alongside the presentation of educational materials in correlation to real-life scenarios, emerge as pivotal strategies that have the potential to render learning more enduring and significant.

Ethnoscience (Ethnology)

The historical and epistemological origins of the concept of ethnology represent an interdisciplinary field of research dating back to the period between 1960 and 1965. A thorough investigation into the etymological structure of the concept indicates that it comprises a multidisciplinary synthesis of the terms 'ethno' (culture/people) and 'science'. The prefix 'ethno' is a common component denoting the systematic study of cultural groups, as evidenced by its presence in the social science disciplines of ethnography and ethnology. This concept, pioneered by Sturtevant (1964), aims not only to document the traditional knowledge of cultural groups but also to examine, through a methodological approach, the ways in which these groups understand, classify, and organise knowledge about the natural and social world. In this context, ethnoscience can be defined as a unique research paradigm that reveals the intersections of cultural cognitive structures with scientific methodology and bridges local knowledge systems with universal science.

Ethnobotany is distinguished by its provision of a more systematic academic framework in comparison with local and traditional knowledge concepts. Nevertheless, it remains an interdisciplinary field of discussion due to its conceptual boundaries (Zidny & Eilks, 2022). Conversely, the educational value of traditional knowledge systems is being concretely recognised through curriculum integration in many cultural geographies, from Africa to North America, and from Oceania to Europe (Aikenhead & Michell, cited in Desmarchelier, 2020). This global trend signifies a mounting academic consensus on the pedagogical potential of local knowledge.

The Role of Ethnoscience in Education

When examined within the context of educational sciences, ethnology is seen to have a multi-layered and dynamic function (Smith, 2017). When the definitions of Sudarmin (2014) and Fasasi (2017) are considered from an integrative perspective, it is understood that ethnoscience plays an important role in both the preservation and transmission of cultural heritage and in facilitating the interpretation of scientific knowledge in relation to local contexts. The emphasis made by Hadi et al. (2019) and Usmeldi & Amini (2020) reveals that this approach deepens the learning process by enabling students to establish organic connections between their own cultural codes and science concepts. This pedagogical approach facilitates the integration of abstract scientific content with the students' daily life experiences and cultural context, thereby ensuring more enduring, transferable and applicable learning outcomes.

Pedagogical practices informed by ethnicity have been shown to enhance teaching processes by incorporating a cultural perspective, thus leading to the diversification of learning experiences. Empirical findings by Wati et al. (2021) demonstrate that this method facilitates the establishment of causal relationships between local practices and universal scientific principles, rendering the learning process more intuitive and accessible. Comprehensive research conducted by Kasi et al. (2020) reveals that this process supports the development of self-awareness, cultural belonging, creative thinking, and critical analysis skills in students. Furthermore, the natural integration of cultural values into the educational process has been demonstrated to positively affect students' intrinsic motivation towards the subject, their academic self-concept, and their learning responsibilities.An ethnoscience-focused approach presents itself as an innovative educational model that systematically integrates academic curricula with social and cultural codes in learning and teaching processes. This model facilitates the establishment of organic connections between the quotidian practices of students and the academic disciplines to which they are applied, thereby ensuring that abstract theoretical concepts are imbued with meaning within concrete cultural contexts (Fahrozy et al., 2022).

The fundamental function of ethnoscience-based education is twofold. Firstly, it guides students in discovering the scientific foundations of the cultural environment in which they live. Secondly, it facilitates the acquisition of multidimensional gains at the individual and societal levels through this discovery. As posited by Akmal et al. (2021), the following gains can be enumerated: the preservation and development of local culture, the amalgamation of traditional production techniques with contemporary science, the cultivation of ethical awareness in accordance with the social value system, and ultimately, the assurance of the intergenerational transmission of cultural identity.

The most salient aspect of this approach is that it transcends mere knowledge transfer to cultivate students' sense of cultural belonging whilst concurrently fostering their universal scientific literacy skills. The integration of ethnological science applications into the educational curriculum has been demonstrated to contribute to the preservation of local values and the integration of students into the global scientific discourse. This integration is achieved by offering students the opportunity to reinterpret their own cultural heritage from a scientific perspective.

Ethno-science is a comprehensive field of research that serves as an interdisciplinary bridge between anthropology, educational sciences,

sociology, and natural sciences (Lestari & Fitriani, 2016). The objective of this discipline is to systematise traditional knowledge within societies and integrate it into the scientific knowledge production process. This process is intended to establish a productive dialogue between the local and the universal. The classification systems developed by Novitasari et al. (2017) demonstrate that the application domains of ethnoscience are diverse, encompassing areas such as agricultural biotechnology, traditional medicine practices, ecological restoration, and sustainable engineering solutions. This disciplinary diversity is indicative of the comprehensive nature of ethnoscience research and its profound interconnection with social life. Furthermore, it underscores the potential contributions of integrating traditional knowledge with modern science.

The ethnobiology-based learning approach is presented as an integrative pedagogical model that combines cultural continuity with education, thus offering students the opportunity to both preserve local values and develop universal scientific perspectives. In this respect, ethnobiology has become an indispensable component of contemporary educational understanding and has the potential to increase educational accessibility, particularly in culturally diverse societies.

Ethnology in Science Education

A fundamental aim of science education is to equip students with the necessary skills to develop a sense of responsibility towards the problems of the society in which they live, and to generate critical and creative solutions to these problems (Zidny, 2020). The integration of cultural elements into the educational process has been identified as a highly effective approach to achieving this aim. In this context, Nadhifatuzzahro and Suliyanah (2019) emphasise that culture must become an integral part of education in order to enrich learning environments and develop a discovery-based approach to education.

The integration of local wisdom within the educational process is manifested in an ethnoscience-based educational model within the Indonesian context (Kurniawan & S., 2020). Sapitri, Hadisaputra, and Junaidi (2020) posit that the successful implementation of this model is contingent upon the adaptation of teaching content and methods to the socio-cultural and geographical conditions of the region in which the students reside.

The term "ethno-science" is defined as an interdisciplinary field that serves to integrate traditional knowledge systems and the production of scientific knowledge (Ahmadi, Astutii, & Linuwih, 2019). In their 2019

study, Melyasari, Suyatno, and Widodo evaluate this process as a pedagogical tool that facilitates students' connection between local realities and scientific concepts. This approach has the potential to enhance the quality of education through the implementation of a culture-based learning model.

The efficacy of integrating ethnoscience into science education is contingent upon the capacity of educators to assimilate local cultural values into the pedagogical process (Rahmatih, Maulyda, & Syazali, 2020). Zidny and Sjöström (2020) posit that to enhance the efficacy of science education, curricula and pedagogical approaches must extend beyond the confines of theoretical knowledge, aligning instead with students' quotidian life experiences.

A plethora of studies have been conducted on ethnoscience in various educational settings, ranging from primary to higher levels. As asserted by Permatasari, Madlazim, and Widodo (2019), the focal point of these studies pertains to the dynamics of the relationship between science concepts and local culture, their repercussions on academic achievement, and the cultivation of scientific process skills. Ahmadi, Astuti, and Linuwih (2019) reveal that ethnoscience-based teaching materials have positive effects on learning outcomes.

Integrating the tradition of fish smoking into science education from an ethnological perspective has been demonstrated to be an effective method of developing students' scientific literacy levels (Sarini & Selamet, 2019) and supporting their critical thinking skills (Atmojo, Kurniawati, & Muhtarom, 2020).

It has been observed that the ethnically-based learning approach not only develops students' scientific process skills but also strengthens their appreciation of local cultural heritage (Andayani, Purwoko, Jamaluddin, 2020). Khery and Erna (2019) posit that ethnobiology education fosters the establishment of a framework conducive to the optimisation of regional potential by local governments. As posited by Shofiyah (2020), the systematic integration of local wisdom into teaching materials has been demonstrated to be an efficacious strategy for the development of student abilities. Hayati and Ridho (2020) posit that the significance and efficacy of science education is contingent upon its integration with environmental contexts and social requirements.

Research undertaken by Sudarmin et al. (2020) demonstrates that ethnoscience-based learning exerts a favourable influence on students' competencies in relation to the scientific process. This approach aligns

with constructivist learning theory, which emphasises the construction of meaning, thereby enabling students to integrate scientific knowledge with their personal experiences.

Ethno-science-based science education is predicated on an integrative model that is designed to ensure cultural continuity whilst concomitantly developing scientific literacy. This model fosters a multifaceted educational experience by providing students with the opportunity to both safeguard local values and remain at the forefront of global scientific advancements.

The following examples illustrate concrete applications of ethno-science integration in science education.

Table 1. Table of Examples (Hamna & Ummah, 2025; Chibuye, 2015; Jančič & Hus, 2018)

Science Topic	**Traditional Practices**	**Ethnology Application**
Electricity / Magnetism	Use of locally specific small-scale generators or simple dynamos	Designing magnetic field experiments with local materials and examining electricity generation processes
Photosynthesis / Ecosystem	Plant species used in traditional agriculture and ecological cultivation methods	Observing photosynthesis processes through local plants and analysing agricultural ecosystem relationships
Force and Motion	Historic water mills or traditional spring-loaded door mechanisms	Relating simple machines to physical principles and experimentally demonstrating energy conversions
Chemical Reactions	Traditional soap making or production of natural root dyes	Modelling chemical reactions in local production processes in a laboratory environment and examining material properties
States of Matter	Traditional food preservation methods (drying, salting)	Researching heat transfer and phase changes through everyday life applications
Sound and Waves	Regional musical instruments and acoustic architectural elements	Discovering the properties of sound waves through cultural instruments
Genetics and Inheritance	Physiological characteristics of relatives in the region and causative factors of birth defects and diseases.	Observing gene transfer and mutations in situ in the relevant region.

Discussion, Conclusion, and Suggestions

This study comprehensively addresses the theoretical foundations, pedagogical contributions, and application possibilities of integrating ethnoscience into science education. The analyses conducted reveal that an ethnoscience-based understanding of science education has quite positive effects on students' academic achievement as well as their scientific process skills, critical thinking capacities, and cultural awareness (Sudarmin, 2014; Zidny & Sjöström, 2020). Ethnobiology has been demonstrated to facilitate meaningful and lasting learning experiences by concretising the abstract structure of science concepts through cultural contexts with which students are familiar (Hadi et al., 2019; Wati et al., 2021).

Research findings indicate that ethnoscience offers an alternative solution to overcoming the learning difficulties caused by traditional teaching methods (Kasi et al., 2020; Usmeldi & Amini, 2020). This approach is regarded as being particularly efficacious in modifying negative attitudes towards science lessons and establishing a correlation between science and everyday life. The sample applications presented in Table 1 provide a concrete framework for establishing an effective link between curriculum outcomes and local knowledge systems.

Nevertheless, there are some obstacles to the widespread adoption of ethnoscience-based science education. The necessity for in-service training for teachers in this domain, the paucity of suitable teaching materials, and the restricted adaptability of the curriculum represent the primary challenges in the implementation process (Rahmatih et al., 2020; Shofiyah, 2020).

In future studies, it is considered valid to examine in depth the effects of ethnoscience applications on students' long-term academic success, scientific attitudes, and cultural identity development using quantitative and qualitative methods. Moreover, comparative analyses of application examples in different geographical and cultural regions would be valid in terms of testing the universal validity of the model.

In conclusion, ethnoscience in science education has been demonstrated to emerge as a multifaceted pedagogical approach that engenders meaningful learning, supports cultural continuity, and develops 21st-century skills. It is asserted that the effective implementation of this approach necessitates a comprehensive transformation, encompassing educational policies and teacher competencies.

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