



Ethnoscience as Pedagogy of Patriotism: Cultivating National Identity and Scientific Literacy through Indigenous Knowledge in Ethiopian Secondary Schools

Belay Sitotaw Goshu¹, Muhammad Ridwan²

¹Department of Physics, Dire Dawa University, Dire Dawa, Ethiopia

²Universitas Islam Negeri Sumataera Utara, Indonesia

Abstract:

Ethiopia's rich indigenous knowledge systems remain largely underutilized in formal education despite policy commitments to their integration. This theoretical article addresses the gap between policy aspiration and classroom implementation in secondary science education. The article advances the argument that ethnoscience the reconstruction of indigenous scientific knowledge within formal frameworks can function as a "pedagogy of patriotism" that simultaneously cultivates scientific literacy, cultural pride, and national identity among Ethiopian secondary school students. Drawing on a comprehensive review of ethnoscience literature and empirical studies from the Ethiopian context, this conceptual article synthesizes theoretical frameworks from science education, indigenous knowledge studies, and citizenship education to develop an integrative model for ethnoscience-based pedagogy. The analysis reveals that Ethiopia possesses diverse indigenous knowledge systems with demonstrable scientific validity, including the Borana astronomical calendar, Gedeo agroforestry practices, Guji Oromo blacksmithing metallurgy, and Gamo peacemaking institutions. Empirical evidence demonstrates that indigenous knowledge integration enhances student academic achievement in science and contributes to civic engagement, national identity, and patriotism. Pedagogical models including Ethno-STEM, project-based learning, and context-based instruction offer effective frameworks for implementation. Ethnoscience pedagogy represents a decolonizing educational strategy that addresses Ethiopia's imperative to develop scientific literacy while cultivating patriotic citizens grounded in their cultural heritage. The integrative framework operates at cognitive, affective, and civic levels to transform science education into nation-building practice. Ethiopia should mandate indigenous knowledge integration across science curricula, invest in teacher education and resource development, establish ethical documentation guidelines, and support rigorous research on ethnoscience pedagogy effectiveness.

Keywords: *ethnoscience; indigenous knowledge; patriotism, science education; Ethiopia*

I. Introduction

1.1 Background and Context

Across Africa, post-colonial scholars have increasingly called for educational systems that move beyond the wholesale importation of Western epistemic frameworks toward curricula that reflect local realities, cultural contexts, and indigenous knowledge systems. Ethiopia, with its unique history and its rich tapestry of over 80 ethnic groups, presents a particularly compelling case for examining how education can simultaneously cultivate scientific competence and national identity.

Recent policy developments signal a growing governmental recognition of indigenous knowledge's value. The Ethiopian Ministry of Education has announced the establishment of a

national framework designed to consolidate Ethiopia's vast indigenous knowledge into a central repository for developmental and policy input (Africa-Press, 2025). State Minister of Education Kora Tushne stated that the newly established system will integrate scattered indigenous insights into the education system, academic research, and policy formulation (Ethiopian News Agency, 2025). Concurrently, the new Curriculum Framework for General Education and the revised Curriculum of Teacher Education have placed due emphasis on the integration and utilization of indigenous practices and knowledge systems (Herut, 2025).

1.2 Problem Statement

Despite these policy commitments, a significant gap persists between aspiration and implementation. Gunjebo et al. (2025) examined integrating indigenous knowledge into primary and middle school science curricula in Addis Ababa and found that "Indigenous knowledge-related elements are rarely incorporated into the school curriculum materials" (p. 418). Similarly, Tegegne et al. (2025) found that although teachers and students in the Tigray region hold positive attitudes toward indigenous knowledge, "there are no specific IK components integrated into the classroom" (p. 4310). This implementation gap is particularly acute in secondary school science education, where the pressure to meet standardized examination requirements often crowds out culturally responsive pedagogy.

1.3 Research Aim and Significance

This article advances the argument that ethnoscience defined as the process of reconstructing indigenous science knowledge within formal scientific frameworks (ERIC, 2024)—offers a powerful pedagogical bridge between Ethiopia's rich cultural heritage and the imperative to develop scientific literacy among secondary school students. The central thesis is that ethnoscience-based pedagogy can function as "pedagogy of patriotism": a deliberate instructional approach that simultaneously cultivates scientific competence, cultural pride, and national identity. By grounding science education in the lived realities and ancestral wisdom of Ethiopian communities, this approach positions students as inheritors of a profound intellectual legacy and as active contributors to the nation's future.

1.4 Research Questions

The article addresses the following questions:

- a. What theoretical frameworks explain the relationship between ethnoscience pedagogy, scientific literacy, and patriotic identity formation?
- b. What is the current state of indigenous knowledge integration in Ethiopian secondary science education?
- c. What indigenous knowledge systems in Ethiopia hold demonstrable scientific and pedagogical value?
- d. What pedagogical models can effectively translate ethnoscience principles into classroom practice?
- e. How does ethnoscience pedagogy cultivate national identity and patriotism?
- f. What are the pathways and challenges for implementing ethnoscience-based science education in Ethiopian secondary schools?

1.5 Article Structure

The remainder of the article proceeds through five additional sections: a theoretical framework; an empirical diagnosis of the current Ethiopian educational landscape; a documentation of Ethiopia's indigenous scientific knowledge; a pedagogical model for implementation; an analysis of the patriotism-national identity connection; and finally, a discussion of implementation pathways, challenges, and conclusions.

II. Review of Literatures

2.1 Defining Ethnoscience: From Reconstruction to Pedagogy

Ethnoscience is not merely the inclusion of cultural artifacts in science lessons; rather, it is "a process of reconstructing indigenous science knowledge with scientific science" (ERIC, 2024). This reconstruction involves identifying the scientific principles embedded within traditional practices and articulating them in ways that align with formal scientific concepts.

The pedagogical value of ethnoscience lies in its capacity to create meaningful learning because it highlights local culture which can provide new knowledge about science to students. By connecting scientific concepts to students' cultural backgrounds, ethnoscience makes education more relevant and engaging and has been shown to be effective in improving student learning outcomes, scientific literacy, critical thinking, and other 21st-century skills (Wulandari et al., 2024). Ethnoscience learning is an activity that connects local wisdom or culture with science concepts (Wulandari et al., 2024).

Importantly, ethnoscience does not position indigenous knowledge as inferior to or separate from Western science. Rather, indigenous knowledge should be used as a foundation to follow the scientific inquiry process and acquire valid scientific concepts, thereby positioning it as a means to acquire scientific process skills (Tegegne et al., 2025).

2.2 Scientific Literacy as an Educational Goal

Drawing on contemporary science education literature, scientific literacy is defined not as the mere acquisition of factual knowledge but as the capacity to understand scientific concepts, engage in scientific inquiry, and apply scientific reasoning to real-world problems. The challenge facing science education in Ethiopia, and across much of the Global South is that traditional approaches often lack contextual relevance, especially in areas rich in local wisdom. Ethnoscience addresses this challenge by providing contexts that are immediately meaningful to students (Wulandari et al., 2024).

Research has demonstrated the effectiveness of indigenous knowledge integration in enhancing scientific achievement. A quasi-experimental study by Tegegne (2025) on eighth-grade students in Injibara, Ethiopia, found that the experimental group significantly outperformed the control group when indigenous knowledge was integrated into biology instruction, suggesting that integrating indigenous knowledge into biology instruction enhances students' academic performance and fosters more effective teaching and learning outcomes (Tegegne, 2025, p. 815).

2.3 Theorizing National Identity and Patriotism in Educational Contexts

National identity is understood as a very special type of collective identity that offers a sense of belonging and personal dignity to an individual. In educational contexts, the cultivation of national identity involves helping students develop a thorough grasp of national ideals, citizens' rights and obligations, and how citizens love their nation (Mulyani et al., 2023).

In the Ethiopian context, national identity formation is complicated by the nation's ethnic diversity. As one study notes, Ethiopia's multifaceted identity, characterized by a rich array of languages, traditions, and customs, holds immense potential but also presents challenges. The goal of education, therefore, is not to erase ethnic identities but to cultivate what scholars describe as a "unity in diversity" framework in which diversity is seen as a shared strength to achieve common goals (Gela & Agegnehu, 2025).

Research on Citizenship Education in Ethiopia has found that indigenous knowledge integrated into Citizenship Education is contributing to civic engagements in peace, respect, and unity in diversity, national identity and sense of patriotism (Gela & Agegnehu, 2025; Goshu and Ridwan, 2024a). It enhances school-based activities which cultivate essential skills like empathy, agency, and social awareness in students for developing leadership, accountability, and democratic participation.

a. Ethnoscience as Pedagogy of Patriotism: Theoretical Foundations and Empirical Evidence

The conceptualization of ethnoscience as a pedagogy of patriotism rests on the premise that education serves not only to transmit scientific knowledge but also to cultivate the affective and civic dispositions essential for national identity and patriotic commitment. This dual mandate is particularly salient in post-colonial contexts where educational systems have historically marginalized indigenous knowledge in favor of Western epistemic frameworks, thereby undermining students' cultural pride and sense of national belonging (Gela & Agegnehu, 2025). Ethnoscience pedagogy addresses this gap by positioning indigenous knowledge not as folklore but as a scientifically valid knowledge system that can simultaneously foster scientific literacy and patriotic identity (Tegegne et al., 2025).

The theoretical foundation of this pedagogical approach draws on the understanding that patriotism is not an innate sentiment but a disposition that must be deliberately cultivated through educational practice. National consciousness develops through systematic educational influence on the learner's personality (Mulyani et al., 2023). Ethnoscience-based learning serves this purpose by creating meaningful connections between scientific concepts and students' cultural heritage, thereby validating students' identities while developing their scientific competencies (Wulandari et al., 2024). Ethnopedagogy, as a related framework, serves as an educational approach capable of reshaping societal dynamics by preserving cultural values, thereby reinforcing a multicultural national identity (Gela & Agegnehu, 2025).

Empirical evidence substantiates the efficacy of this approach. Ardianti et al. (2023) conducted a quasi-experimental study implementing an ethnoscience-based smart module in three Indonesian primary schools, finding that students' patriotism scores increased from an average of 50 to 80, with a normalized gain of 0.60, indicating a medium category improvement. The study concluded that "implementing an ethnoscience-based smart module can improve students' patriotism in elementary schools" (Ardianti et al., 2023, p. 7). Similarly, research on ethnoscience-based guided inquiry learning found that this approach effectively enhances students' scientific literacy and critical thinking skills while simultaneously fostering cultural awareness and national pride (Wulandari et al., 2024). Lestari et al. (2025) demonstrated that integrating local wisdom into Ethno-STEM project-based learning significantly improved students' conceptual understanding and engagement, with students reporting increased appreciation for their cultural heritage and stronger identification with national values.

The mechanism through which ethnoscience cultivates patriotism operates at multiple levels. At the cognitive level, ethnoscience enhances scientific literacy by grounding abstract concepts in familiar cultural contexts, making science more accessible and meaningful (Tegegne, 2025). At the affective level, it validates and celebrates indigenous knowledge, thereby cultivating cultural pride and self-efficacy (Gela & Agegnehu, 2025). At the civic level, it connects local knowledge to national development and showcases the scientific sophistication of diverse communities, fostering a sense of belonging to a nation with a rich intellectual heritage (Africa-Press, 2025). Research examining Ethiopian students' national identity formation through

traditional knowledge systems found that "nurturing patriotism and national pride requires educational approaches that engage students with their distinct knowledge systems and cultural traditions" (Beka & Ayele, 2026, p. 15). This study revealed that students exposed to curriculum content incorporating indigenous knowledge demonstrated stronger identification with Ethiopian national identity and greater appreciation for cultural diversity.

The integration of ethnoscience into science education thus represents a decolonizing pedagogical strategy that simultaneously addresses the imperative to develop scientific literacy and the imperative to cultivate patriotic citizens (Gela & Agegnehu, 2025). By demonstrating that scientific knowledge is not exclusively Western but is also embedded within indigenous traditions, ethnoscience pedagogy challenges epistemic hierarchies while building the cultural confidence essential for active citizenship and national development (Tegegne et al., 2025). Research on the infusion of indigenous knowledge into Ethiopian curricula confirms that this approach "contributes to civic engagements in peace, respect, unity in diversity, national identity and sense of patriotism" (Gela & Agegnehu, 2025, p. 12). As Ethiopia implements its national framework for centralizing indigenous knowledge, ethnoscience pedagogy offers a theoretically grounded and empirically supported pathway for cultivating a generation of scientifically literate and patriotically committed citizens (Africa-Press, 2025).

2.4 The Integrative Framework: Ethnoscience as a Bridge

This section synthesizes the foregoing concepts into an integrated theoretical framework. The framework posits that ethnoscience pedagogy operates on three interconnected levels:

Cognitive Level

By contextualizing scientific concepts within familiar cultural practices, ethnoscience enhances comprehension, retention, and the development of scientific process skills. Research by Tegegne (2025) provides empirical support for this claim, demonstrating that students exposed to indigenous knowledge-integrated instruction achieved significantly higher scores on ecology and biodiversity assessments.

Affective Level

By validating and celebrating indigenous knowledge, ethnoscience cultivates cultural pride, self-efficacy, and emotional attachment to cultural heritage. Studies from other contexts have found that ethnoscience-based learning contributes positively to students' attitudes toward science, conceptual understanding, and scientific reasoning skills (Wulandari et al., 2024).

Civic Level

By connecting local knowledge to national development and by showcasing the scientific sophistication of Ethiopia's diverse communities, ethnoscience fosters national identity and patriotic commitment. Mulyani et al. (2023) found that ethnoscience-based smart modules can improve students' patriotism, while Gela and Agegnehu (2025) demonstrated that indigenous knowledge integration in Ethiopian education contributes to national identity and sense of patriotism.

2.5 Ethiopia's Indigenous Knowledge Systems: A Repository of Scientific Wisdom

a. The Scope and Distribution of Indigenous Knowledge in Ethiopia

Ethiopia possesses an extraordinary wealth of indigenous knowledge spanning multiple domains: agriculture, astronomy, medicine, ecology, metallurgy, mathematics, and conflict resolution. Research indicates that this knowledge is concentrated in the Oromia, SNNPR, and

Amhara regions, with oral transmission dominating as the primary mode of knowledge preservation (Tegegne et al., 2025).

However, as the Ministry of Education has acknowledged, "much of it has remained untapped due to a lack of organized, national-level documentation" (Africa-Press, 2025). Rapid modernization has increasingly sidelined traditional practices, and there is a declining interest among younger generations to engage with indigenous knowledge systems (Tegegne et al., 2025). This underscores the urgency of documenting, preserving, and integrating this knowledge into formal education.

b. Astronomy and Timekeeping: The Borana Calendar

The Borana people's calendar represents one of Africa's most sophisticated indigenous astronomical systems. Based on observations of the moon and stars, researchers date it back to 300BC and it incorporates a form of astrology and weather forecasting (PreventionWeb, 2011). The Borana calendar is a lunar-stellar calendar that relies on astronomical observations of the moon in conjunction with seven particular stars or constellations (Wikipedia, 2010). Biressa (2018) describes it as "an accurate complex astronomical calendar of ancient Cushites" that has been supported by a broad range of disciplines, including anthropological, astronomical, and physical studies.

The Borana gada system is based on a system of social organization and transfer of power (each gada lasts for eight years) between five patri-classes (Bhandari, 2013). Indigenous astronomical knowledge based seasonal weather forecasting has been documented among Borana Oromo pastoralists of Southern Ethiopia.

For science education, the Borana calendar offers rich opportunities to teach astronomy, seasonal cycles, and the relationship between celestial observation and practical livelihood. It also provides a compelling counter-narrative to the assumption that sophisticated astronomical knowledge is exclusively Western.

c. Ecology and Sustainable Agriculture: Gedeo Agroforestry

The Gedeo people of southern Ethiopia practice an indigenous agroforestry system that has sustained their communities for centuries. The Gedeo cultural landscape with its agroforestry system based on indigenous crops mainly enset and coffee represents a culture of sustainable traditional land use, while protecting the environment. The Gedeo communities are still largely guided by indigenous knowledge and traditional institutions including the Songo, or Council of elders, as well as the Ballee system that regulates interaction with nature.

Research on indigenous knowledge of forest management among the Gedeo found that they have effectively managed their forest resources due to the supervision of indigenous Gadaa institutions, their effective land use and management, and their worldview and belief system towards natural resources (JStage, 2025). The Gedeo agroforestry system has been in practice based on Indigenous knowledge, helping people overcome livelihood challenges, adapt to various land topographies, and mitigate the effects of global climate change (ScienceDirect, 2025).

Gela and Agegnehu (2025) conducted an ontological analysis of the infusion of Gedeo's indigenous knowledge into Ethiopian curricular programs, recognizing that indigenous knowledge in education is a vehicle to inclusive development and understanding between cultures in Ethiopia. For science curricula, Gedeo agroforestry provides an ideal context for

teaching ecology, biodiversity, sustainability, and the relationship between human activity and environmental health.

d. Metallurgy and Chemistry: Guji Oromo Blacksmithing

An ethnographic study of blacksmithing in Guji Oromo by Mengesha and Mekbib (2024) revealed that "blacksmiths with no or little schooling have a remarkable conception of the fundamentals of metals and metallic bonding, malleability and ductility as a measure of metal qualities, rusting as threats to the existence of metals and how to prevent, metallic crystal and micro crystal rearrangement and thermal conductivity of metals" (p. e37855). The study found that blacksmiths employ three mechanisms to identify metal quality: "textual, mechanical, and sparking tests" (Mengesha & Mekbib, 2024; Goshu and Ridwan, 2026).

Moreover, the setting and underlying ways of knowing were found to be so constructivist because novices are allowed to explore and learn their way with minimal involvement from the experienced ones (Mengesha & Mekbib, 2024). This pedagogical approach aligns remarkably well with contemporary science education's emphasis on inquiry-based and experiential learning. In conclusion, the findings revealed that the blacksmithing practice in Guji has utilizable chemistry contents and concepts that could enhance learning of chemistry by creating familiar context (Mengesha & Mekbib, 2024).

e. Traditional Medicine and Biology: Tigray Practices

Research in the Tigray region by Tegegne et al. (2025) documented "plenty of indigenous knowledge and practices related to mathematics (e.g., measurement, ratio and proportion, number sense) and science fields (e.g., medication practices in health, anti-termites in agriculture, fermentation practices in biology, and chemical reactions in chemistry)" (p. 4308; Woldeamanual, et al. 2026). These practices offer concrete contexts for teaching biology (medicinal plant use, fermentation), chemistry (chemical reactions in traditional processes), and mathematics (measurement and proportion in traditional contexts).

f. Conflict Resolution and Social Cohesion: Gamo Peacemaking

While not directly a natural science domain, the Gamo people's traditional peacemaking processes provide crucial contexts for teaching social dimensions of science, including the relationship between environmental resource management and conflict, the role of traditional institutions in sustainable resource governance, and the integration of scientific and social knowledge in community resilience.

The Gamo people, located in the Southern Nations, Nationalities, and Peoples' Region of Ethiopia, possess a sophisticated and time-honored system of conflict resolution that has sustained social cohesion for generations. Central to this system is the Dubbusha (also spelled Dubusha) institution, a traditional governance and peacemaking assembly that serves as the cornerstone of Gamo cultural identity. As Milkias et al. (2024) explain, Dubbusha literally means "meeting" the coming together of people to discuss any issue, whether at the family level or the community level. At the community level, the meeting place is a designated physical location, traditionally positioned on elevated ground to ensure visibility and to facilitate the ritual oath process (Milkias et al., 2024). The institution is guided by orally transmitted mythology, which dictates that when the Gamo people quarrel, divine rule and regulation are sent to the people to restore peace and respect (Milkias et al., 2024).

The Gamo employ multiple interconnected conflict resolution processes. Research by Lako Pulea (2020) documented that Gamo elders utilize traditional peacemaking processes such

as the tuuge, iginththo, and gomppa processes at their traditional institution called Dubbusha. These processes have been shown to be accessible, efficient, and effective in managing conflicts arising from competition over natural resources (land for farming and grazing, water for irrigation and fishing), value and faith-based disagreements, criminal activities, and poverty-related pressures (Lako Pulea, 2020). The Gomy system serves as a reinforcing mechanism for Dubbusha and Cima conflict resolution methods, clearly articulating what constitutes transgression and sanction among the Gamo people (Endalamaw, 2020). Endalamaw (2020) found that Gomy significantly contributes to the promotion of peace and security by handling conflicts before the occurrence of loss of life and material destruction.

A particularly notable ritual is the practice of "wet grass" (ertib sar in Amharic), a traditional non-violent conflict resolution ritual practiced in select Gamo communities. This ritual, currently being investigated through a rigorous qualitative ethnographic study, functions as both a powerful symbolic rite and a practical tool to de-escalate conflicts and achieve durable reconciliation (Endalamaw, 2020). The findings of such research are expected to inform policy by developing a framework for integrating culturally grounded indigenous mechanisms into broader peace and development initiatives (Endalamaw, 2020).

The effectiveness of Gamo peacemaking has gained national recognition. Gamo elders have been acknowledged as "Peace Ambassadors of the Year" for their unique practices in addressing even the most serious offenses, including murder cases (Lako Pulea, 2020). Since 2018, the roles of Gamo elders in peacemaking have increased, driven by the accessibility and effectiveness of traditional conflict management institutions, the weakness of governmental institutions in providing peace and justice in some areas, and the role of media in promoting elders' contributions (Milkias et al., 2024). Both governmental and traditional institutions increasingly work together during crises, though their relationship sometimes reflects competition and tension (Milkias et al., 2024).

From a pedagogical perspective, the Gamo peacemaking system offers rich opportunities for interdisciplinary science education. Students can explore how competition over environmental resources (land, water) drives conflict and how indigenous institutions provide sustainable governance solutions—connecting ecology, resource management, and social studies. The Dubbusha institution demonstrates how traditional knowledge systems integrate spiritual beliefs, social norms, and practical governance, illustrating the interdependence of cultural and ecological sustainability. Furthermore, comparative analysis of indigenous and formal legal systems fosters critical thinking about knowledge pluralism and the role of local wisdom in addressing contemporary challenges. Milkias et al. (2024) examined the role of customary dispute resolution in prompting peacebuilding in the Ethiopian federation through the case of the Dubusha institution of the Gamo people, demonstrating that "indigenous conflict resolution methods apply throughout Ethiopia" (p. 8) and that traditional institutions "play a significant role in enforcing customary law" (p. 9). Integrating such content into science curricula cultivates not only scientific literacy but also civic awareness, social responsibility, and national identity by showcasing Ethiopia's indigenous governance wisdom as a source of national pride and unity.

g. Documenting and Validating Indigenous Knowledge for Educational Use

The Ethiopian Ministry of Education is currently conducting specialized training for higher education institutions focusing on methodologies for identifying and documenting traditional wisdom unique to their respective regions (Africa-Press, 2025). University coordinators are already seeing progress on the ground, with institutions like Debre Berhan

University and Haramaya University working to gather and digitize local wisdom (Africa-Press, 2025).

The process of validation identifying the scientific principles embedded within traditional practices without imposing external epistemic frameworks is critical. As Tegegne et al. (2025) note, researchers should conduct further studies, document indigenous knowledge in a consumable (understood and utilized in classroom instruction) manner, and communicate to the concerned practitioners (teachers and students) of the education system. Dire Dawa University has contributed to this effort through studies on ethnomedicine practices in the Afar region, West and East Hararghe zones, Somali region, and Dire Dawa administration. Some of these findings have been published in the Brazilian Journal of Science, including work by Woldeamanuel and Goshu (2026), who examined Ethiopian mothers' indigenous remedies, documenting the phytochemical profiles of medicinal plants such as *Vernonia amygdalina*, *Aloe vera*, *Allium cepa*, and *Eucalyptus globulus* widely used in traditional medicine (Woldeamanuel & Goshu, 2026). In addition, the astronomical calculations of the Ethiopian calendar, the Borana calendar, and the Hijra calendar have been studied and published. Goshu and Ridwan (2024) investigated Ethiopia's cultural foundations in astronomy, examining the Axumite stelae alignments, the Borena calendar, and the astronomical significance of Lalibela's rock-hewn churches, validating the Borena calendar as a precise lunar-stellar system demonstrating advanced celestial knowledge. More recently, Goshu and Ridwan (2025) mapped the contemporary distribution, scientific validity, and educational integration potential of Ethiopian Indigenous Astronomical Knowledge (EIAK), demonstrating that it constitutes "a scientifically valid, adaptive knowledge system with proven forecasting utility and significant educational value" (p. 211) (Goshu and Woldeamanuel, 2019).

III. Research methods

3.1 Pedagogical Approaches: Translating Ethnoscience into Classroom Practice

a. Principles of Ethnoscience Pedagogy

The core principles that should guide ethnoscience-based science instruction include:

Contextualization: Scientific concepts are taught within the cultural and environmental contexts familiar to students.

Reconstruction: Indigenous knowledge is not merely described but analyzed for its scientific content.

Inquiry: Students engage in investigation and discovery, mirroring the constructivist learning approaches found in traditional knowledge transmission (Mengesha & Mekbib, 2024).

Integration: Ethnoscience is not a separate subject but an approach integrated across the science curriculum.

3.2 Pedagogical Models for Ethnoscience Instruction

a. Ethno-STEM

Ethno-STEM integrates indigenous knowledge into Science, Technology, Engineering, and Mathematics education. This approach helps students appreciate their cultural heritage as they learn scientific concepts, making education more relevant and interesting to them (Wulandari et al., 2024). In the Ethiopian context, Ethno-STEM might involve studying traditional agricultural terracing (engineering and mathematics), indigenous building techniques (physics and engineering), or traditional water management systems (environmental science and technology).

b. Project-Based Learning with Ethnoscience (E-PjBL)

Project-based learning integrated with ethnoscience provides a science learning base intimately connected to students' cultural backgrounds (Wulandari et al., 2024). Students investigate a local problem or practice, such as traditional food preservation, medicinal plant use, or weather forecasting and develop project-based solutions or explanations that integrate scientific inquiry (Goshu and Ridan, 2024; Goshu and Woldeamanueal, 2019).

c. Context-Based Learning (EthCBL)

Context-based learning situates scientific concepts within authentic local contexts. For example, teaching chemistry through the context of traditional blacksmithing (Mengesha & Mekbib, 2024), teaching biology through traditional medicinal practices, or teaching physics through traditional building techniques.

d. Guided Inquiry

Guided inquiry approaches encourage students to ask questions and discover scientific principles within their community's practices. This approach aligns with the constructivist learning found in traditional apprenticeship models and has been shown to be effective in enhancing students' scientific literacy (Wulandari et al., 2024; Goshu and Woldeamanueal, 2019).

3.3 Curriculum Integration Strategies

a. Infusion across Subjects

Rather than creating separate ethnoscience modules, indigenous knowledge can be infused across existing science subjects. Biology can incorporate traditional ecological knowledge and medicinal plant use; chemistry can incorporate traditional metallurgy, food processing, and dyeing; physics can incorporate traditional building and irrigation; environmental science can incorporate indigenous conservation practices.

b. Thematic Units

Thematic units organized around indigenous knowledge systems can integrate multiple science disciplines. A unit on Gedeo agroforestry, for instance, could incorporate ecology (biodiversity, ecosystems), chemistry (soil chemistry, nutrient cycles), physics (water flow, energy transfer), and mathematics (measurement, data analysis).

c. Community Engagement

Effective ethnoscience pedagogy requires engagement with community knowledge holders. This might involve inviting elders to classrooms, organizing field visits to traditional practitioners, or establishing school-community partnerships for knowledge documentation and sharing.

3.4 Teacher Education and Professional Development

The success of ethnoscience pedagogy depends critically on teacher preparation. For instance, Tegegne et al. (2025) found that despite having "positive attitudes towards indigenous knowledge," teachers do not receive any training to facilitate its effective use (p. 4310). This calls for:

Pre-service teacher education that includes courses on ethnoscience pedagogy and indigenous knowledge systems

In-service professional development that provides teachers with practical strategies and resources

The development of teacher guides and resource materials that document local indigenous knowledge in educationally accessible formats

Gunjebo et al. (2025) recommend that "stakeholders, curriculum experts, educators, teachers, and other concerned bodies working in the education system particularly the Ministry of Education, and regional education bureaus should put their effort into maximizing the integration of indigenous knowledge elements, and related pedagogical practices into school curricula" (p. 426).

3.5 Assessment in Ethnoscience Pedagogy

Assessment in ethnoscience-based instruction must go beyond traditional testing to include:

- Performance-based assessment that evaluates students' ability to apply scientific concepts to local contexts

- Portfolio assessment that documents student projects and investigations

- Formative assessment that tracks the development of both scientific understanding and cultural awareness

IV. Result and Discussion

4.1 Cultivating Patriotism and National Identity through Ethnoscience

a. The Affective Dimension of Ethnoscience Pedagogy

Research has demonstrated that ethnoscience-based instructional approaches can improve students' patriotism. Mulyani et al. (2023) found that an ethnoscience-based smart module helps students learn independently in a fun way and contributes to improving their patriotism. The study concluded that an ethnoscience-based smart module can improve students' patriotism in elementary schools (Mulyani et al., 2023).

Similarly, research on developing physics teaching materials with cultural ethnoscience found that students using ethnoscience-based materials demonstrated patriotism higher than those using other teaching materials (Proceedings UNNES, 2025). The mechanism involves validating students' cultural heritage and demonstrating its intellectual sophistication.

4.2 From Local Pride to National Identity

a. Local Identity and Cultural Pride

When students see their community's knowledge reflected in the curriculum, it validates their heritage and instills pride. As Gela and Agegnehu (2025) note, integrating indigenous knowledge systems, cultural practices, and values into formal education actually creates hooks for the marginalized in forms of identity. This local pride is the foundation upon which broader national identity is built.

b. Ethnic Identity in a National Framework

Ethiopia's diversity "a rich array of languages, traditions, and customs" is not an obstacle to national unity but a resource for it. By incorporating knowledge from multiple ethnic groups, the curriculum can teach students to appreciate the nation's multifaceted identity. As one study found, IK integrated into CE is contributing to civic engagements in peace, respect, unity in diversity, national identity and sense of patriotism (Gela & Agegnehu, 2025).

c. National Identity

At the highest level, ethnoscience pedagogy cultivates a sense of belonging to a nation with a rich intellectual heritage. By showcasing the scientific sophistication of Ethiopia's diverse communities, it challenges the assumption that scientific knowledge is exclusively Western and positions Ethiopia as a contributor to, rather than a consumer of, global knowledge.

4.2 Ethnoscience and the Decolonization of Education

Ethnoscience pedagogy represents a form of epistemic decolonization—reclaiming and validating indigenous ways of knowing. Gela and Agegnehu (2025) note that indigenist thinkers have advocated for the recovery and promotion of Traditional Indigenous Knowledge systems as an important process in decolonizing Indigenous nations and their relationships.

The Ethiopian context is particularly significant given the nation's unique history. This history provides a foundation for an educational vision that is not merely reactive against colonialism but proactively grounded in indigenous traditions. As noted by experts, the need to work on building indigenous values and personalities along with the formal educational knowledge in the education system is critical to building a reasonable generation that loves the country (Ethiopian News Agency, 2023).

4.3 Empirical Evidence: Linking Ethnoscience to Patriotism

While research directly linking ethnoscience to patriotism in the Ethiopian context is limited, studies from other contexts provide supporting evidence. An ethnoscience-based smart module was found to have a positive impact on students' patriotism (Mulyani et al., 2023). Students using this approach showed a higher value of patriotic character compared to those learning conventionally.

In the Ethiopian context, research on Citizenship Education found that indigenous knowledge integrated into CE is contributing to civic engagements in peace, respect, unity in diversity, national identity and sense of patriotism (Gela & Agegnehu, 2025). It enhances school-based activities which cultivate essential skills like empathy, agency, and social awareness in students for developing leadership, accountability, and democratic participation.

4.4 Patriotism as Active Citizenship

Ethnoscience pedagogy cultivates active patriotism by:
Empowering students with knowledge and skills to address local challenges
Fostering critical thinking about the relationship between traditional and modern knowledge
Developing agency and the capacity to contribute to national development
As noted by African Press (2025), the initiative to centralize indigenous knowledge will significantly bolster the nation's capacity to address local challenges with home-grown solutions. By tailoring educational curricula to incorporate indigenous knowledge and cultural practices, Ethiopia can cultivate a generation deeply grounded in its heritage and better equipped to shape the nation's future.

4.5 Implementation Pathways, Challenges, and Conclusion

a. Policy Framework and Institutional Support

Successful implementation requires a supportive policy environment. Recent developments are encouraging: the Ministry of Education has established "a national framework designed to consolidate Ethiopia's vast indigenous knowledge into a central repository" (Africa-Press, 2025). Efforts are "underway to incorporate these findings directly into the national curriculum" (Africa-Press, 2025). The new Curriculum Framework for General Education and the revised Curriculum of Teacher Education have placed due emphasis on such integration and utilization of indigenous practices and knowledge systems (Herut, 2025).

However, policy commitment must translate into concrete action. This calls for:

Explicit curriculum mandates requiring indigenous knowledge integration across science subjects

Resource allocation for documentation, teacher training, and materials development
Institutional mechanisms for ongoing curriculum review and revision

b. Teacher Preparation and Professional Development

As noted earlier, teachers hold positive attitudes toward indigenous knowledge but lack the training to integrate it effectively (Tegegne et al., 2025). Specific strategies include:

Pre-service education: Incorporating ethnoscience pedagogy into teacher education curricula

In-service training: Providing practicing teachers with practical strategies, resources, and ongoing support

Community engagement: Training teachers to work effectively with community knowledge holders

Resource development: Creating teacher guides that document local indigenous knowledge in educationally accessible formats

c. Curriculum and Materials Development

This section addresses the need for:

Textbook revision: Ensuring that science textbooks include indigenous knowledge examples and contexts

Supplementary materials: Developing lesson plans, activity guides, and multimedia resources

Local adaptation: Recognizing that indigenous knowledge varies by region and developing flexible resources that teachers can adapt to their local context

Gunjebo et al. (2025) found that although indigenous knowledge-related curricular objectives in the Curriculum Framework and Education Policy are mirrored in the science syllabi and textbooks, indigenous knowledge-related elements are rarely incorporated into the school curriculum materials. This gap between policy and practice must be addressed.

d. Community Engagement and Knowledge Documentation

Effective ethnoscience pedagogy requires genuine partnership with communities:

Knowledge holders as partners: Involving elders and traditional practitioners in curriculum development and classroom instruction

Ethical documentation: Ensuring that knowledge is documented with community consent and appropriate attribution

Sustainability: Building local capacity for ongoing knowledge documentation and preservation

4.6 Challenges and Barriers

a. Epistemological Challenges

The tension between indigenous and Western knowledge systems remains unresolved in many educational contexts. Some view indigenous knowledge as in opposition to modern Western science, while others argue it should be used as a foundation. Navigating this tension requires pedagogical sophistication (Tegegne et al., 2025).

b. Resource Constraints

Documentation, materials development, and teacher training require significant investment. Ethiopia's education system faces competing priorities and limited resources.

c. Assessment Challenges

Standardized examinations, which often prioritize Western scientific knowledge, create pressure to teach to the test rather than engage in culturally responsive pedagogy.

Risk of Superficial Integration

There is a risk that indigenous knowledge is incorporated superficially—as cultural decoration rather than as genuine epistemic content. Gunjebo et al. (2025) found that while curricular objectives exist, actual integration in classroom practice remains limited.

Risk of Cultural Appropriation

There is a risk that indigenous knowledge is extracted from communities without proper attribution or benefit. Ethical guidelines are essential to prevent misrepresentation and ensure communities benefit from the use of their knowledge.

Recommendations

Based on the foregoing analysis, this section offers specific recommendations: Establish a national ethnosience task force to coordinate curriculum development, teacher training, and resource development.

Mandate indigenous knowledge integration in science curricula at all levels, with clear learning objectives and assessment criteria.

Invest in teacher education at both pre-service and in-service levels, with a focus on practical pedagogical strategies.

Develop regionally appropriate resources that document local indigenous knowledge in educationally accessible formats.

Create school-community partnerships that involve knowledge holders in curriculum development and instruction.

Support research on the effectiveness of ethnosience pedagogy in the Ethiopian context, including rigorous evaluation studies.

Establish ethical guidelines for the documentation and use of indigenous knowledge in educational contexts.

V. Conclusion

Ethnoscience pedagogy is not merely an instructional strategy but a national project one that simultaneously addresses the imperative to develop scientific literacy and the imperative to cultivate patriotic citizens. By grounding science education in Ethiopia's rich and diverse indigenous knowledge, the nation can cultivate a generation of students who see themselves as inheritors of a profound intellectual legacy and as architects of their country's future.

The empirical evidence supports this vision. Tegegne (2025) demonstrated that integrating indigenous knowledge into biology instruction enhances students' academic performance. The results showed that traditional blacksmithing contains utilizable chemistry content. The indigenous knowledge integrated into education contributes to national identity and patriotism. The Ministry of Education's initiative to centralize indigenous knowledge represents a crucial policy commitment.

Ethnoscience as a pedagogy of patriotism offers a pathway to realize a vision that honors Ethiopia's past, equips its present, and builds its future. By empowering students with knowledge rooted in their own heritage while developing the scientific competencies needed for national development, Ethiopia can cultivate a generation deeply grounded in its heritage and better equipped to shape the nation's future.

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