



# Mapping the landscape: Growth and trends in ethnomathematics research – A bibliometric review

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## Abstract

**Background:** At the intersection of mathematical principles and cultural perspectives, ethnomathematics is gradually establishing its academic footprint. This journey, although occasionally marked by fluctuations, predominantly shows an encouraging trajectory.

**Aim:** This bibliometric analysis provides a detailed overview of publications related to ethnomathematics, identifies significant scientific platforms, and highlights leading figures in this arena.

**Method:** Using the VOSviewer software, this study delves into the vast knowledge presented in relevant articles and documents. The search focused on the term "ethnomathematics", selecting "article title, abstract, keywords" within the Scopus.com database.

**Result:** Among its revelations, the year 2020 emerged as a zenith in the publication landscape with 63 radiant documents. The "Journal of Physics Conference Series" emerged as a prominent source, accounting for 111 papers. Key figures, such as Herawaty, D., and Widada, were prolific with 15 publications each. The term "ethnomathematics" was notably recurrent, appearing 189 times in various articles with a collective link strength of 80.

**Conclusion:** This study concludes that even though there have been periods of decline, ethnomathematics publishing is on a generally upward trajectory. The findings of this research suggest the need for a more comprehensive keyword approach, inviting further exploration into the mesmerizing overlap of culture and mathematics. The insights gained underscore the need for more empirical and phenomenological research into the culturally-rich dimensions of mathematics.

## INTRODUCTION

In educational endeavors, culture serves as a conduit connecting mathematical ideas, enriching student comprehension (Bito & Fredy, 2020; Kusaeri et al., 2019). Recognizing the intertwined nature of mathematics and culture, ethnomathematics emerges as an innovative niche within math education. It transcends the mere amalgamation of "ethnic" with "mathematics". Instead, it embodies an ambition to weave mathematical principles into the tapestry of students' daily lives, mirroring a pivotal shift towards embedding mathematics into our cultural consciousness and lived experience (Prahmana & D'Ambrosio, 2020).

Inspired by D'Ambrosio (Rosa & Shirley, 2016), ethnomathematics presents a novel lens through which mathematics aligns with the lived realities of students. This intersection kindles both optimism and challenges in making the often-abstract realm of mathematics resonate with the tangible world. These intricacies magnify with the vast cultural tapestries that students hail from, coupled with the evolving landscape of education. Yet, this presents a golden chance to reinvigorate math teaching, making it more resonant, dynamic, and impactful for learners. As a transformative educational strategy, ethnomathematics is driven by a quest to ignite a passion

for mathematics while bolstering enthusiasm and ingenuity (Prahmana et al., 2021). With its emphasis on socio-cultural milieus and foundational mathematical tenets like counting and measuring, ethnomathematics crafts a fresh paradigm, bridging conceptual divides between educators and learners, theory and application.

Studies surrounding ethnomathematics have illuminated key facets in mathematical education. Notably, its incorporation into primary education allows for the weaving of mathematical notions with indigenous customs and heritage (Faqih et al., 2021; Fouze, 2018; Fouze & Amit, 2019; Kurniawan & Hidayati, 2020; Payadnya, 2019; Vitoria et al., 2021). Additionally, a significant body of research underscores the pivotal role of educator preparation in rolling out ethnomathematical techniques, equipping them to meld theoretical underpinnings with impactful pedagogy (Bravo et al., 2023; Jamaan et al., 2021; Sunzuma & Maharaj, 2020; Utami et al., 2021). Aligned with learner-centric paradigms, ethnomathematics emphasizes mastering geometrical content through tangible and relatable exemplars, seamlessly connecting esoteric mathematical principles with commonplace experiences (Noerhasmalina & Khasanah, 2023; Nugroho et al., 2021; Zhang et al., 2021). Moreover, the confluence of culture and math within the ethnomathematical realm forges novel educational trajectories, enhancing the relevance and resonance of mathematics and unveiling diverse cultural interpretations of mathematical concepts. Collectively, the rich tapestry of ethnomathematical inquiry showcases vast potential in reshaping our pedagogical and conceptual interactions with mathematics, opening doors for continued ingenuity in this domain. By charting the diverse terrains navigated by ethnomathematical investigations, bibliometric evaluations craft a robust scholarly scaffold. This aids in pinpointing research voids, promoting cross-disciplinary synergies, orchestrating well-structured research endeavors, and ensuring a balanced and targeted spotlight on every ethnomathematical dimension.

Prior research has delved into various bibliometric dimensions within mathematical education. This includes an examination of the bibliometric methodology applied to bio-eco-techno processes in digital mathematical pedagogy (Hasumi & Chiu, 2023), as well as investigations into mathematical education problem posing (Cansiz, 2022), trends in artificial intelligence research (Hwang & Tu, 2021), and underlying themes in mindset literature (Xu et al., 2022). Some explorations are centered on technological applications, such as game-centric learning (Chen et al., 2021), and the assimilation of ICT supported by a Scopus-informed scientific bibliography (Trinh et al., 2022; Julius et al., 2021). Further, there's scrutiny of the evolution of realistic mathematical education in the Scopus Database spanning 1972-2019 (Phan et al., 2022) and an assessment of the progression of mathematical education research in Turkey (Dede & Ozdemir, 2022). Nevertheless, amidst this plethora of topics, there exists an untouched niche: a focused discourse on the emergence and trajectory of ethnomathematical research. The distinctiveness of our study stems from its intent to methodically chart the contours of the ethnomathematical canon. This involves deciphering dominant scientific platforms, spotlighting seminal contributors, and decoding the lexicon predominantly embraced by scholars. In doing so, our endeavor not only supplements but also enriches the bibliometric tableau in mathematical academia. In contemporary academia, bibliometric scrutiny has become integral to researchers, frequently employed in canvassing scholarly literature. Given

this backdrop, we aim for a meticulous exploration of available publications. This propels us to articulate our research conundrum as follows:

RQ1: How can we characterize the global publication landscape in the realm of ethnomathematics?

RQ2: Which scholarly platforms predominantly serve as the epicenters for ethnomathematical article submissions?

RQ3: Who stands out as the most prodigious contributors in the ethnomathematical discourse?

RQ4: Which terminologies frequently feature in the author-generated keyword list?

## **METHODS**

### *Research Design*

Rooted in a quantitative paradigm, this investigation leverages bibliometric techniques to decipher evolving patterns and organizational architectures in ethnomathematics. The approach encompasses a sequence of meticulously delineated phases, cumulatively shedding light on the contemporary expanse of ethnomathematical scholarship.

### *Keyword Selection for Search*

The pivotal keyword anchoring this scrutiny is "ethnomathematics." Chosen for its intrinsic relevance, this term served as the lynchpin during TITLE-ABS-KEY searches within the Scopus reservoir.

### *Exploring Initial Search Results*

An inaugural trawl through the Scopus repository, renowned for curating avant-garde academic contributions, culminated in the identification of 453 manuscripts. This expansive search aspired to encompass all manuscripts resonating with the designated keyword, mirroring the panoramic intent of this study.

### *Preliminary Search Exploration*

While all manuscripts were retrieved unconditionally, a bibliometric cartographic analysis was marshaled to ascertain the congruence of the enlisted articles with ethnomathematics. The data acquisition was stamped on January 23rd, 2023.

### *Initial Data Aggregation*

Data for the bibliometric review were extracted in both Research Information Systems (RIS) and Comma-separated Values (CSV) formats. This approach facilitated the initial statistical compilation of the data, providing a robust foundation for the subsequent analysis (Sofyan, 2022b; Abdullah & Sofyan, 2023).

### *Data Analyzing*

The concluding phase summoned an intricate dissection of the data. Top-tier author references and seminal keywords underwent evaluation via the VOSviewer software suite. Furnished with tools tailored for envisioning and decoding intricate data interlinkages, the software unlocked vistas into the reigning trajectories underpinning ethnomathematical exploration.

## RESULTS AND DISCUSSION

This research harnesses a quantitative approach to delineate evolving patterns within the realm of ethnomathematics. We've employed a bibliometric assessment drawing from the Scopus repository to discern the trajectories and structural contours of ethnomathematics. A comprehensive delve into the Scopus archive, recognized for curating advanced scientific insights, formed the bedrock of this endeavor (Sofyan, 2022a). The methodological arc of this investigation spans five distinct phases: keyword selection, data retrieval, article shortlisting, data validation, and in-depth analysis. Employing "ethnomathematics" as the primary search criterion within the TITLE-ABS-KEY scope in Scopus, a total of 453 manuscripts emerged. This data compilation occurred on January 23rd, 2023. For our bibliometric critique, data harvested in both Research Information Systems (RIS) and Comma-separated Values (CSV) formats were pivotal (Sofyan, 2022b; Abdullah & Sofyan, 2023).

Table 1 underscores an intriguing chronology: the recent decade (2013-2022) witnessed a surge in article contributions, reflecting an approximate 450% escalation compared to the preceding decade (2002-2012) which accounted for 79 manuscripts. When parsed by document classification, the category "article" prevails with 240 entries, overshadowing alternative formats. Examining the modes of scholarly dissemination, the "Journal" emerges as the predominant conduit for academic articulations, surpassing alternatives like conference proceedings, books, and book chapters. In the context of the publication status, an overwhelming 99.78% of the entries are published, while a singular piece, constituting 0.02%, remains in the pipeline, potentially slated for a 2023 release.

**Table 1.** Profile of ethnomathematics publications

Period		Document Type		Publication stage	
Year	Documents	Type	Total	Stage	Total
2013-2022	332	Article	240	Final	452
2003-2012	79	Conference Paper	140	Article in press	1
1993-2002	32	Book Chapter	37		
1984-1992	10	Conference Review	12		
		Review	9		
		Book	8		
		Editorial	3		
		Note	3		
		Short Survey	1		
Total	453		453		453

Publications serve as invaluable resources for both journal editors and researchers. By disseminating scientific articles, researchers with aligned interests foster the expansion of knowledge. This propagation of new ideas engages the attention of fellow scholars and professionals, spurring the progression and application of these insights (Abdullah & Sofyan, 2023). Given its elevated impact factor and rigorous review protocols, Scopus-indexed sources have emerged as the gold standard for academics and researchers. Table 2 details the foremost scientific repositories that scholars predominantly choose for their academic contributions. Notably, the "Journal of Physics Conference Series" from IOP Publishing has featured 111 scholarly articles. Furthermore, Table 2 unveils an additional eight related observations.

**Table 2.** Main objective scientific sources

Scientific Sources	Total
Journal of Physics Conference Series	111
Bolema Mathematics Education Bulletin	32
AIP Conference Proceedings	24
ZDM International Journal on Mathematics Education	17
Educational Studies in Mathematics	15
Journal on Mathematics Education	9
International Journal of Scientific and Technology Research	8
International Journal of Mathematical Education in Science and Technology	6
Mathematics Education Research Journal	6

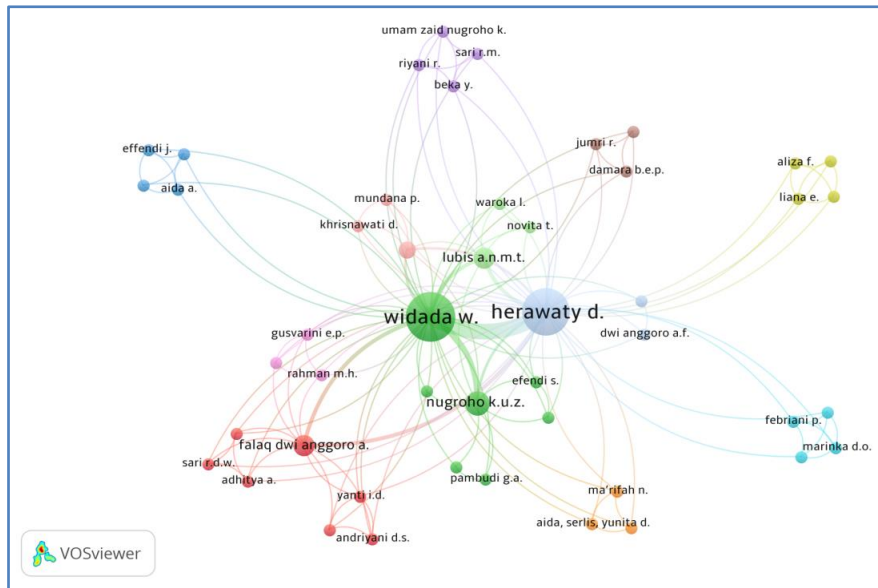
In scholarly publications, the institution affiliated with the conducted research is typically denoted as the author's affiliation (Abdullah et al., 2022). Properly citing this affiliation can profoundly influence the reputation of the respective university or research institution. Table 3 showcases leading affiliations that have a minimum of ten associated documents.

**Table 3.** Affiliation of the authors

Affiliation	Country	Total document
Universitas Pendidikan Indonesia	Indonesia	24
Universitas Negeri Yogyakarta	Indonesia	18
Universidad de Granada	Spanyol	15
Bengkulu University	Indonesia	15
Universidade Estadual de Campinas	Brazil	14
Universitas Negeri Semarang	Indonesia	13
Universidade Federal de Ouro Preto	Brazil	11
Universitas Ahmad Dahlan	Indonesia	11
University of KwaZulu-Natal	Afrika Selatan	10
Universidade do Vale do Rio dos Sinos	Brazil	10

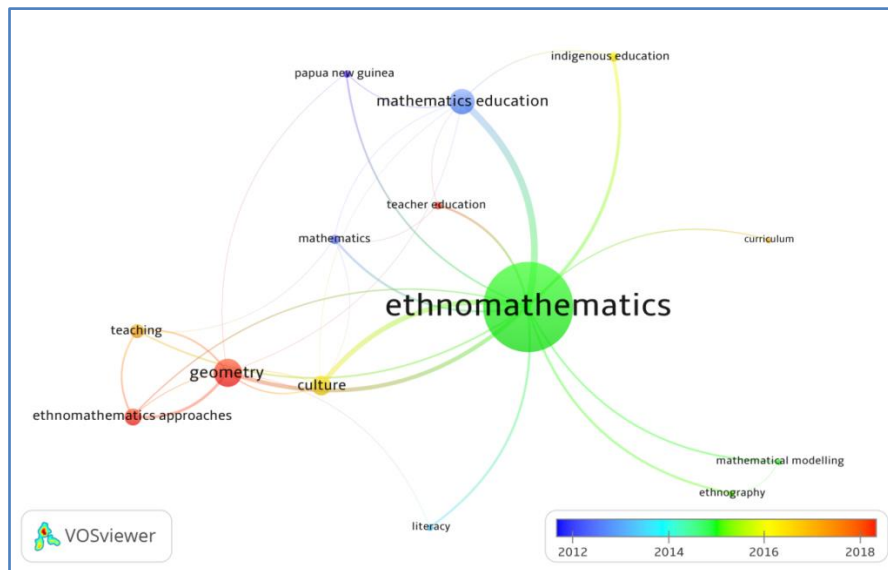
Among the 786 researchers contributing to ethnomathematics-related studies and publications, 499 authors have been identified with at least one documented article that has garnered a minimum of one citation. Widada, W., has notably etched his mark, with an impressive array of 15 scholarly pieces that have magnetized 113 nodes in citations, affirming their academic resonance. This prowess is further mirrored in a dynamic link strength of 58, illuminating his sprawling academic alliances and synergies in the field. Tailgating in her academic footprints, Herawaty, D., graces the scene with 14 academic treasures, reaping 104 citations and clinching a formidable link strength of 57. Her seminal insights, juxtaposed with tangible field implications, have punctuated the annals of ethnomathematics with gravitas. Occupying the bronze tier, D'ambrosio, U. accentuates quality, penning 12 treatises that have summoned a whopping 159 citations. His link strength of six, however, paints a portrait of selective yet impactful academic collaborations.

Together, their scholarly tapestries have woven new paradigms in ethnomathematics. Through avant-garde methodologies, immersion in variegated cultural canvases, and redefining mathematical tenets, these torchbearers have recalibrated the compass, pointing to the confluence of culture and mathematical lore. Their academic oeuvre has not only elevated discursive contours but has also armed pedagogues with a rich arsenal to render mathematics more contextually resonant and culturally aligned for global learners.



**Figure 1.** The most prolific author

Based on analysis of prevalent author keywords, 14 out of a total 799 keywords surpass the baseline, each appearing at least five times. Foremost among these is “ethnomathematics,” featured 189 times within articles and boasting a total link strength of 80. Following this, "mathematics education" is highlighted 21 times, carrying a total link strength of 23. Additionally, both "culture" and "geometry" recur in 12 distinct articles.



**Figure 2.** The most used author keywords

**Discussion**

The 2006 article "Culturally Situated Design Tools: Ethnocomputing from Field Site to Classroom" penned by R. Eglash and his team is notably renowned, having amassed 115 citations. This piece delves into the application of Culturally Situated Design Tools (CSDTs) and web-integrated software to allow students to craft models of cultural artworks, encompassing Native American beadwork, African American cornrow designs, urban graffiti, and beyond. The advent of expressive computing mediums, bridging ethnomathematics and

retrocomputing, unveils avenues to delve deeper into youth-cultural identity interplays, the cultural underpinnings of mathematics and computing, and the birth of cultural-technological syntheses.

Mathematics and culture share intrinsic ties in the tapestry of daily life. Both evolve organically within their respective milieu. Across the globe, diverse civilizations harness mathematics uniquely, underpinning the idea that mathematical elements permeate cultural facets of life. This symbiosis is crystallized in the concept of ethnomathematics, capturing the interrelation of these two realms of knowledge.

Embracing an ethnomathematics curriculum resonates with the aspirations of curriculum reformists. It not only facilitates the grasping of mathematical concepts but also fosters connections between formal education and students' cultural experiences. Through this lens, ethnomathematics bolsters the absorption and retention of formal mathematical doctrines. More profoundly, it promotes a culturally sensitive approach to teaching, challenging the predominant Eurocentric narrative in mathematical pedagogy (Rosa et al., 2016). Exploring ethnomathematics enriches our understanding of our own cultural roots, as well as those of distant communities. However, current educational landscapes often overlook the treasures of ethnomathematical insights. This perspective aims to ignite a spark among educators, urging them to weave ethnomathematics into their pedagogical fabric for their enrichment and that of their students (Shirley, 2015).

## **CONCLUSIONS**

From the 453 articles analyzed, a notable surge in publication trends was observed from 2019-2022, culminating in 2020 with 63 documents. The "article" format stands out as the predominant choice among authors, accounting for 240 documents. Specifically, the "Journal of Physics Conference Series" emerges as the leading scientific platform for ethnomathematics-related articles, boasting 111 documents. This journal remains the prime destination for academic contributors. Notably, Herawaty, D., and Widada, W., are the foremost prolific authors, each presenting 15 documents. The term "Ethnomathematics" graces the most articles, appearing 189 times.

The realm of ethnomathematics still holds vast potential for further exploration, especially when considering alternative terminologies. The VOSviewer application's insights, highlighting the underutilization and limited associations of certain terms, underscore this potential. As such, the ethnomathematics domain remains ripe for additional scholarly pursuits.

## **AUTHOR CONTRIBUTIONS STATEMENT**

In crafting this article, both authors engaged in a collaborative effort. The first author spearheaded the methodological design and data interpretation, while the second took the lead in drafting, refining, and finalizing the manuscript.

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