Uncovering Ethnomathematics and Indigenous Epistemology: A Study of Chundara Culture

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ABSTRACT: The primary aim of this paper is to delve into the realm of ethnomathematical concepts and indigenous epistemology of Chundaras culture. To accomplish this, I employed a methodology that included in-depth interviews and participant observations conducted at various stages of the process, focusing on professionals selected for the study. My analysis encompassed a comprehensive exploration of the Chundaras' daily routines, their workplaces, their actions, methods, and the outcomes they produced, with particular attention to uncovering the hidden mathematical knowledge woven into various aspects of their lives. The study revealed that the Chundaras' approach to teaching and learning was marked by participatory and cooperative methods, where they acquired knowledge with the guidance of their parents. This aligns with Vygotsky's perspective, which views learning as a social activity through which shared mathematical understandings are collectively constructed. However, it became evident that the conventional pedagogy followed in schools stood in stark contrast to the indigenous knowledge of the Chundaras, appearing distant and disconnected from their unique ways of knowing and learning.

Introduction

Knowledge is a multifaceted concept encompassing information merged with context, interpretation, and experience (Davenport & Prusak, 1998). It exists in both explicit and implicit forms, where explicit knowledge is formally expressed through symbols or language, while implicit knowledge remains uncodified and resides in individuals' minds. In the context of our evolving knowledge society, it has become imperative to manage both explicit and implicit knowledge effectively (Drucker, 1995). In the realm of education, indigenous learning predominantly takes on non-formal and informal dimensions. Indigenous education spans a lifetime, commencing from birth and persisting throughout one's old age. It thrives on the intergenerational transmission of knowledge and encompasses both empirical and normative elements (Pradhan, 2023; Trommsdorff, 2008). A distinguishing feature of indigenous knowledge and teaching is its emphasis on social value and the incorporation of students' past experiences. In indigenous pedagogy, knowledgeable elders responsively observe changes in

their younger counterparts, providing immediate feedback within the teaching and learning process. Learning through practical engagement is a fundamental premise of indigenous traditions.

Indigenous knowledge is often referred to as traditional or local knowledge, deeply rooted in specific cultures, locations, or societies. It encompasses local customs, beliefs, practices, and worldviews, frequently encompassing informal knowledge systems. Knowledge arises when individuals make sense of their surroundings, constructing tools, methods, and approaches to navigate their circumstances. This concept of knowledge production highlights the existence of power imbalances within society (Hill, 1998). Vygotsky (1978) further underscores the universality of learning as an integral aspect of developing culturally organized, distinctly human psychological functions. Aligning with this perspective, indigenous knowledge generation and application emerge as participatory, communal, experiential processes deeply connected to local geography. Indigenous knowledge comprises a vast repository of skills and insights that have evolved outside formal educational systems, enabling communities to thrive. It is crucial to remember that, over many centuries, humans have cultivated knowledge and strategies vital for their survival and harmonious coexistence with the natural and social environment. Indigenous knowledge, intimately tied to survival and sustenance, serves as a foundation for localized decision-making across various sectors, encompassing knowledge generation, dissemination, control, and other pertinent matters.

Nepal has a rich source of indigenous community having distinctive characteristics and their daily activities. It consists of different communities and it is obvious that all these communities have some amount of traditional knowledge. Within these diverse ethnic groups, traditional knowledge has been passed down through generations, forming an integral part of their cultural heritage. Among these groups are the Chundaras, an occupational caste in Nepalese society. Many cultures rely on indigenous mathematical knowledge to structure their social and economic activities, and often, the mathematical aspects are subtly embedded within their context. Ethnomathematics is a field of study that examines the relationship between mathematics and culture. Ethnomathematics often focuses on the mathematical knowledge and practices of indigenous cultures (D'Ambrosio, 2006), which have their own unique ways of understanding and using mathematics. It recognizes that mathematical knowledge is not universal, but rather, it is shaped by the cultural, social, and historical context in which it arises. Chundara culture encompasses the mathematical practices, and concepts in their everyday activities regarding wooden crafts. It looks at how Chundara cultures engage in mathematical activities, including their problem-solving methods, counting systems, geometric constructions, and other mathematical processes.

The Chundaras, known for their artistic skills, embedded ethnomathematical knowledge in crafting wooden goods, a practice deeply rooted in their culture. Their ethnomathematical knowledge has evolved and been refined over generations to meet their daily needs. Their wisdom, skills, and insights are transferred verbally and experientially from one generation to the next (Pradhan, 2012). Research in the field of Chundara mathematical practices and their ancestral knowledge offers an opportunity to gain a deeper understanding of their culture and harness ethnomathematical knowledge. However, it's important to note that research on mathematics education in our specific context is still in its infancy. Few studies have delved into mathematics from the perspective of indigenous knowledge generation and

distribution, and how it might influence curriculum development (Acharya, 2015). This paper explores the Chundaras epistemology in generating and distributing knowledge for their everyday tasks and the ethnomathematical concepts they engage with.

Method and Procedures

In my research, I opted for qualitative research methods because I aimed to gain a deep understanding of the intricate world of the Chundaras' ethnomathematical knowledge and their epistemology. The nature of this knowledge couldn't be captured through quantifiable figures and numbers. Qualitative researchers are individuals who create meaning by drawing upon their own experiences, knowledge, and theoretical perspectives to gather data and convey their insights to the world (Fetterman, 2010; Glesne & Peshkin,1992). Thus, my research evolved into a process of constructing meaning in collaboration with my research participants, the Chundaras, rather than simply reporting an objective reality.

In my study, I employed purposive sampling, a commonly used strategy in qualitative research, to select participants based on specific criteria relevant to the purpose of my research. Given that my research aimed to explore ethnomathematical knowledge and Chundaras epistemology regarding knowledge generation, I employed ethnographic methods for data collection. More precisely, I conducted participant observation and in-depth interviews, also known as open-ended or ethnographic interviews (Fetterman, 2010). The use of interviews in research underscores the significance of the perspectives and interpretations of particular social actors, their knowledge about the specific social context, and their accounts of that social environment (Dunne, Pryor & Yates, 2005). To ensure that I obtained comprehensive answers to my research questions, I developed interview guidelines for Chundaras, along with a checklist for observations of their natural settings. This approach allowed me to facilitate data generation in the field. Instead of structured questionnaires, I used unstructured questions, aligning with the qualitative research methodology (Creswell, 2014). I created a comfortable environment that encouraged my research participants to freely express their thoughts and experiences regarding their ethnomathematical knowledge. During data collection, I diligently recorded all relevant conversations using video cameras and took extensive field notes. Although I had initially planned a schedule for data gathering, it proved largely ineffective as I needed to adapt to the preferences and availability of my research participants. I followed them wherever possible; I followed them in their workplace, even tracing their children's schools, visiting them, speaking with headmasters and teachers, and gathering information about their ethnomathematical knowledge and their ways of knowledge generation and distribution. I maintained daily field logs, jottings, and diaries, remaining immersed in their lives to ensure thorough data collection. I became an integral part of their families, making it easier to engage in discussions on various topics.

After the data collection phase, I proceeded to transform the conversations and interviews into written manuscripts for the purpose of facilitating analysis and interpretation. I dedicated considerable time to thoroughly familiarizing myself with the content, listening to the recorded voices of the research participants multiple times and repeatedly reading through

the gathered data (Creswell, 2014). This extensive engagement allowed me to pinpoint key themes and patterns. Next, I systematically deconstructed the field data into smaller segments and applied codes to different sections, aiding in the identification of novel themes. During this phase, my focus was on delving deeper into the categories and themes to uncover the underlying meanings and patterns hidden within the data. This entailed activities such as comparing and contrasting various categories, seeking out connections between themes, and extracting significant insights and conclusions. Ultimately, the data collected from the Chundaras community and their workplaces shed light on their abundant indigenous epistemology and their unique system for generating knowledge, which relies heavily on implicit and tacit mathematical concepts.

Ethnomathematics and Chundaras' Epistemology

Knowledge is generated in many ways. According to Ascher (2002), indigenous communities have developed unique perspectives on connections with the world, the cosmos, and one another. Their traditional methods of imparting knowledge and facilitating learning were intricately woven around the observation of natural phenomena, the adaptation of survival strategies, and the utilization of natural resources in crafting tools and implements. Similarly, the Chundaras possess their own distinctive methods of knowledge generation and distribution. In the context of acquiring the skills to craft wooden goods, one of the individuals I interviewed, Mangal (whose exact age he couldn't recall but could recall the earthquake of 1990 B.S.), expressed the following:

> I acquired these skills by closely observing my maternal uncle at his workplace. Everyday, I shadowed him and paid attention to how he worked with wooden materials. This hands-on experience became the foundation of my proficiency in this craft. This is how I learnt to work on this . . . when I made a mistake he used to hit badly on my hand, and I always tried to do it consciously without making a mistake.

The provided statements from Mangal account offer valuable insights into the unique methods of knowledge acquisition within Chundaras indigenous communities. These narratives underscore the profound connection these communities have with their environment and their resourceful ways of passing down knowledge. Mangal's journey, driven by the aspiration for better sustenance, reveals the practical motivations behind knowledge acquisition. His observational learning, closely watching and emulating his uncle's wooden craftwork, emphasizes the importance of hands-on experience and visual learning in these communities. The acknowledgment of making mistakes and enduring consequences underlines the significance of trial and error as a key component of indigenous knowledge transmission. It can be observed that these statements underscore the intricate web of practicality, observation, and experiential learning that characterizes the indigenous approach to knowledge generation and highlights their deep-rooted connection with their culture and environment. About the ways to knowledge generation, my next research participant, *Namaraj* (16), speaks:

> My father used to go to the work place early in the morning. So, I had to take food for him in the same place. I was interested in his work and used to closely observe when he worked. I wished I could do this work someday. I was curious what it would be like if I worked that way. This became a regular routine. After

> some time, I started working with him. This is how I learnt to make wooden things.

Namaraj's account offers a distressing illustration of the indigenous approach to knowledge generation, which is deeply rooted in practical experience and close observation within a familial and communal context. His narrative highlights the pivotal role of family members and seniors in passing down knowledge in natural settings. This aligns with the idea that all knowledge, whether personal or academic, is socially constructed (Vygotsky, 1978). The dialectical process of constructing understanding is intricately tied to a system of social relations, emphasizing the communal aspect of learning. The Chundaras' method of learning through experience, observation, estimation, and imitation is not a solitary endeavor but a collaborative one, where the expertise of elders plays a central role. This expert-apprentice model creates a collaborative teaching and learning environment that enriches the knowledge generation and distribution within the Chundara community. Overall, Namaraj's narrative underscores the profound interplay between experiential learning, social interactions, and the communal transmission of knowledge in indigenous cultures like the Chundaras. My research participant, *Namaraj* said:

> The selection of timber is based on the materials to be constructed. When we see the timbers then we have an experience it is possible to make particular stuffs. We estimate in all stages of constructions. For the preciseness, we use our body to measure the the height (uchai) and diameter (golai).

Namaraj's insights affirmed by all the research participants, provide a remarkable glimpse into the indigenous wisdom of the Chundara community. Their approach to crafting wooden items is marked by flexibility and adaptability, devoid of strict, rigid rules. Instead, they rely on their collective experience and keen observation of timber to determine the feasibility of creating specific items. The emphasis on experiential knowledge suggests a rich repository of tacit mathematical understanding, acquired through generations of hands-on craftsmanship. Additionally, the reliance on estimation throughout the construction process underlines a reliance on practical, context-driven ethnomathematics, avoiding formal calculations in favor of intuitive approximations. Estimation plays a crucial role throughout the construction process, showcasing their practical and intuitive grasp of mathematics and geometry. Moreover, the practice of using one's own body as a unit of measurement illustrates a deep-seated connection between the human form and the built environment. This localized system, focusing on measuring height (uchai) and diameter (golai), exemplifies a unique mathematical framework tailored specifically for the demands of woodworking.

For instance, in the case of crafting a "pathee," a cylindrical timber with specific dimensions, the Chundaras understand that the length should be one "bitta" while the circumference is twice the height. The hollow section is skillfully created using a "bako." This method is not limited to "pathee" alone but is applied to constructing other items like "theki" and "theko." What stands out is their exceptional ability to calculate and create the required hollow volume within the timber, underscoring their deep understanding of spatial relationships and the mathematics hidden within their craft. In essence, these observations highlight the Chundara community's remarkable indigenous knowledge, shaped by practical experience, intuition, and a profound connection with the materials they work with. One my research participant Mangal said:

> We need a cylindrical timber of length two bitta and five amal and base perimeter of five bitta to make a theki of two pathees. We put this timber in the machine to give the external shape and the internal hollow part be made with the help of bako. For estimating the two pathee theki, the hollow part of the theki should be loosely measurable by bitta. We put the dust of the timber to outer surface of the theki and knocking the surface by fingers, if the dust falls down; we understand it is a theki of two pathee. If the dust doesn't fall, we understand that we should still keep on hollowing the inside.

The insights shared by Mangal and supported by other research participants offer a compelling glimpse into the intricate mathematical knowledge embedded within the Chundara community's traditional craftsmanship. In their pursuit of creating a "theki" with specific dimensions, they rely on a sophisticated estimation process. The required cylindrical timber's length and base perimeter are meticulously calculated, reflecting a high level of mathematical acumen. The external shape is achieved through machine work, while the internal hollow component is meticulously crafted with a "bako." What stands out is their ingenious method of using timber dust to determine the instrument's suitability. If the dust falls off upon knocking, they deem it a "theki" for two "pathees"; if not, they continue hollowing the interior. This method underscores their profound understanding of spatial relationships and measurement, all acquired through their hands-on experience. Furthermore, Gam Bahadur's input reveals an additional layer of mathematical sophistication within the community. He suggests that the equivalence of wooden instruments can be estimated by comparing the dust from two different instruments. This method of measurement further illustrates their mastery of mathematical concepts, which may not be formalized but are deeply ingrained in their craft.

The Chundara community's traditional knowledge is not reliant on formal education but thrives through observation and practice. As exemplified by Kanchha, who holds a prominent role as a headmistri despite being illiterate and physically challenged, their skills are honed through hands-on experience and keen observation. This traditional knowledge is a testament to their adaptability to local culture and environment, serving to sustain their community, culture, and genetic resources essential for their survival. The preference of many Chundara children for the traditional methods of learning and crafting wooden items over formal schooling highlights the effectiveness and cultural significance of their indigenous knowledge. It underscores the vitality of this traditional knowledge in preserving the Chundara way of life and maintaining their unique cultural heritage. During my stay with the Chundara community, I had the privilege of engaging in candid conversations with them. Their innocence and unwavering commitment to honesty were evident in their responses to my questions. It was clear that they had a remarkable capacity for imitation and replication, especially when it came to crafting various wooden wares. Their ability to learn through observation, imitation, and hands-on participation was striking, and they seemed to derive genuine enjoyment from this practical and personalized learning process. However, I noticed a contrasting challenge when it came to more traditional school-based education. When I asked them, questions related to geometric concepts or measurement and volume problems, they struggled to provide answers. This disconnect underscores the stark disparity between our formal school pedagogy and the indigenous approaches to knowledge generation they are accustomed to (Hammond & Brandt, 2007). This situation prompted me to ponder why our curriculum and teaching methods failed

to capture the interest of these children. The feedback I received from them was enlightening: they felt that the knowledge imparted in school had little relevance to their everyday lives. It seemed disconnected from practical applications, and they didn't see how it would benefit them in their daily routines. Their perception of school was that it primarily involved rote memorization and regurgitation during exams, with limited real-world application. This disconnects between the formal education system and the practical knowledge they valued highlights a significant challenge in bridging the gap between indigenous ways of learning and school pedagogy.

In my observation, it became evident that the children of the Chundara community didn't find school enjoyable. This was largely because their cultural practices were not integrated into the school curriculum, and the teaching methods predominantly relied on theoretical approaches, often through lecture-based instruction (Acharya, 2015; Pradhan, 2017). At home, they felt a sense of belonging and learned their own culture from their elders, eliminating feelings of isolation or neglect. In contrast, at school, they often felt lonely among their peers and teachers, with their voices going unheard and their needs unaddressed. The Chundaras' indigenous epistemology is characterized by specific methods such as close observation, imitation, and active participation, aligning with Bandura's principles of attention, retention, behavioral production, and motivation (Bandura, 1986). Indigenous knowledge system is not formally documented but is passed down orally from one generation to the next. My field observations within the Chundaras' workplace and daily activities revealed a distinctive aspect of their unique ways to knowledge generation and distribution process. Their craftsmanship and the artifacts they created inherently contained ethnomathematical knowledge. They employed mathematical concepts and understanding implicitly, setting their approach apart from conventional school pedagogy. The key attributes of the Chundaras' indigenous knowledge and pedagogy include learning by observation, learning by doing, learning through authentic experiences, a focus on individualized instruction, learning through enjoyment, and a tight integration of teaching and learning with lived experiences, rooted in observation and imitation.

Concluding Remarks

The narratives from the Chundara community paint a vivid picture of the unique and sophisticated indigenous knowledge generation processes embedded within their culture. These accounts underscore that indigenous communities, like the Chundaras, possess a deep connection with their environment, and their knowledge is intricately tied to their daily experiences and observations. The hands-on, practical approach to learning and crafting wooden items is a hallmark of their culture, where mistakes are seen as valuable learning experiences. This indigenous epistemology, passed down from generation to generation, showcases an impressive understanding of mathematics and geometry, even though it may not be formally documented or structured. The Chundara community's ability to estimate and create intricate wooden items demonstrates their innate grasp of spatial relationships and measurement, which is honed through practice and observation. What's striking is the stark contrast between their traditional knowledge and the formal education system. The Chundara children often find the school curriculum detached from their practical lives and devoid of relevance. This disconnect raises important questions about how modern pedagogy can better

integrate indigenous knowledge and cater to the unique needs and experiences of these communities. In essence, the Chundara community's indigenous knowledge is a testament to the resilience and adaptability of indigenous cultures. It is deeply rooted in their everyday way of life, and making it a valuable resource for both their survival and the broader appreciation of diverse indigenous epistemology and ethnomathematical concepts.

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