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**A THEMATIC EXPLORATION OF CONCEPTS OF SETS, RELATIONS, AND  
MAPPINGS IN FISHING ACTIVITIES**

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**ABSTRACT**

Although mathematics is essential, many students struggle with it. Incorporating cultural contexts into mathematics education, ethnomathematics, can help alleviate this difficulty. This study examines how abstract mathematical concepts, such as sets, relations, and maps, are incorporated into traditional fishing practices in the Purba Barddhaman area of West Bengal, India. This research uses an ethnographic case study design. Thirteen fishermen were selected as participants, and their interviews were analyzed using deduction. thematic analysis. The study revealed that the fishermen used sets, relationships, and maps easily in their way of doing things. For example, they combine fish, nets, and tools and relate different types of fish to different sizes of nets. These findings suggest that complex mathematical knowledge can be deduced from the traditional fishing practice without introducing any formal mathematical notion. This study points to the importance of ethnomathematics in implementing it in daily life in order to make learning more relevant and meaningful to culture.

**Keywords:** Ethnomathematics, Sets, Fishermen, Deductive Thematic Analysis, Indigenous Knowledge, Mathematics Education.

**INTRODUCTION**

Research indicates that many students perceive mathematics difficult, and it causes low performance (Jackson et al., 2017). This difficulty creates a fear, and students consider mathematics a boring and dry subject. This problem is identified as developmental dyscalculia



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(Reusser, 2000). Moreover, in addition to individual learning challenges, classroom environment has a significant impact on poor mathematics performance. Present-day mathematics classrooms include a variety of students' perspectives, alongside diversity in languages, cultures, ethnicities, and prior mathematical experiences, reflecting a globalized society marked by heightened movement between nations and regions (Meissner & Vertovec, 2015). Sutarto et al. (2022) found that certain mathematics classrooms lacked innovation and technology and were teacher-centered and textbook-focused, lacking cultural context. Students struggled to comprehend arithmetic concepts in textbooks, highlighting the necessity to include local culture in math instruction. Magni (2017) argued that indigenous knowledge may be used to teach mathematics, since mathematics is socially and culturally constructed. Ethnomathematics serves as a conduit to connect cultural activities with academic mathematical education. D'Ambrosio (1985, p. 45) defines ethnomathematics as "*the mathematics practiced within distinct cultural groups, including national-tribal societies, labor organizations, age-specific children, professional classes, and others.*" In modern times, ethnomathematics has been recognized as a program that offers potential remedies to many challenges facing mathematics education by emphasizing the significance of the curriculum and grounding the courses in students' local cultures (Rosa & Orey, 2015).

The development of set theory is significant in the advancement of contemporary mathematics. In the late 19th century, Georg Cantor conceptualized how a collection of objects can be mathematically formulated. Fundamental notions such as functions, relations, sequences, and algebraic systems can be described in terms of set. From a certain perspective, the notions of set, relation, and mapping may seem to be straightforward ideas to comprehend. Fisheries are an integral part of the blue economy and demand thorough research across multiple scientific disciplines to ensure sustainable management. These techniques include sorting, classifying, grouping, and making decisions, all of which show how arithmetic works. By looking at these hidden mathematical structures, we may learn how indigenous knowledge systems use formal mathematical ideas.



## **RATIONALE OF THE STUDY**

The NCF (2023) and the Position Paper of the National Focus Group on Teaching of Mathematics (PPNFGTM) and NEP-2020 strongly advocated that educators must understand their students' cultural and social backgrounds and utilize their everyday experiences to facilitate the learning of mathematics. Global research demonstrates that a student-centered instructional method markedly improves students' understanding of mathematical concepts (Nurbavliyev et al., 2022). Literature indicates a scarcity of studies about the application of advanced mathematics within diverse ethnic communities, such as carpenters, fishermen, and weavers. By relating what students learn to their culture and personal experiences, ethnomathematics seeks to make learning more relevant and meaningful for them. Connecting mathematical concepts with culture nowadays has become an essential part of teaching. On the other hand, research shows that students more often struggle with abstract mathematical concepts (Subedi, 2020). As set theory is the fundamental concept of higher mathematics, it motivates us in finding set-theoretic concepts in fishing activity.

## **RESEARCH QUESTIONS**

Based on the research gap, the following research question is addressed in the present article:

RQ 1: How do fishermen's narratives of their daily fishing activities reflect mathematical concepts such as sets, relations, and mappings?

## **OBJECTIVES**

RO1: To explore how fishermen's narratives of their daily fishing activities reflect underlying mathematical concepts such as sets, relations, and mappings.

## **DELIMITATION OF THE STUDY**

The present study was delimited to fishermen from Purba Barddhaman district of West Bengal and focused exclusively on traditional inland fishing practices. It examined only three



mathematical concepts sets, relations, and mappings, within the context of these activities. The study adopted a qualitative ethnographic approach and did not involve any quantitative analysis. Furthermore, the participants were restricted to experienced male fishermen, based on specific inclusion criteria.

## METHODS

**Research Design:** To understand the concepts of sets, relations, and mappings in traditional fishing, an ethnographic case study design was conducted. This technique was chosen because it allows for a contextualized study of geometrical notions in a community's cultural activities. Ethnography is qualitative research that uses observations, interviews, and documentary evidence to provide rich and complete narratives of social phenomena, according to Reeves et al. (2013). Case studies, on the other hand, are empirical investigations “*that facilitates exploration of a phenomenon within its context using a variety of data sources*” (Baxter & Jack, 2015). Schwandt & Gates (2018, p. 344) define ethnographic case studies as “*employing ethnographic methods and focused on building arguments about cultural, group, or community formation or examining other sociocultural phenomena*”. An ethnographic case study is ideal for our research because we want to find the underlying geometric pattern behind fishing, which demands an in-depth look at this community's culture and tacit knowledge.

**Participants:** To maintain consistency with the principle of reflexive thematic analysis (Braun & Clarke, 2022), a total of 13 fishermen with an age range from 30 to 70 in Purba Bardhaman district were taken as participants for this study. Since, women participants in fishing is comparatively less in India (Gopal & PS, 2022), only men fisherman were considered. We set the inclusion criteria that fishing is the primary source of income, and each of them has more than 5 years of fishing experience.

**Tools for data collection:** Semi-structured interviews were used for data collection. The researcher used this way to gather open-ended data based on fishermen's thoughts, feelings, and issues of personal nature (Denzin et al., 2023). It consists of three parts, as shown in the



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interview schedule. It followed the closed-ended demographic, eight questions about demographics. Part two consists of eight open-ended questions regarding their native fishing, plans, ceremonies, and traditional practices. The third part consists of twelve open-ended questions related to mathematical ideas (e.g., daily planning, fishing tools, fishing places, boats) in the practice of fishing strategies. The researcher had a conversation with the fisherman to make an open-ended question for this interview. To ensure that the interview questions are clear and understandable, they were tested with three fishermen before conducting the final interview.

**Trustworthiness of the study:** Our approach was built on (Lincoln & Guba, 1985) to make sure the reliability of qualitative data. This first data was put into context and grew with more involvement from September 2024 to April 2025. Triangulation was used to make the results of this study more reliable and trustworthy. Three different types of data collection were used: semi-structured conversations, subject observation, and photos. We talked to three fishermen to see if what we thought was the same as what they thought. Colleagues who worked with the managers went over the tapes and study reports. Before they spoke publicly, the researchers wrote in journals about their own biases and assumptions about mathematical ideas that were connected to fishing. This was done to get rid of researcher bias.

**Procedure for data collection:** Data was collected during winters and summers from September 2024 to April 2025. As we wanted to reach a hard-to-reach population (Noy, 2008), snowball sampling was used for participant selection. These interviews were in-person. This study obtained doctoral committee (DC) ethical clearance from the University of Burdwan. As the interviewers' mother tongue is Bengali, each interview question was translated into Bengali. This translation was thoroughly checked by a high school English teacher. Data was collected using video and photography. Preliminary data analysis was conducted parallel to data collection for the determination of data saturation. For confidentiality, all potentially identifiable information (i.e., other than the generic names of the village and/or other

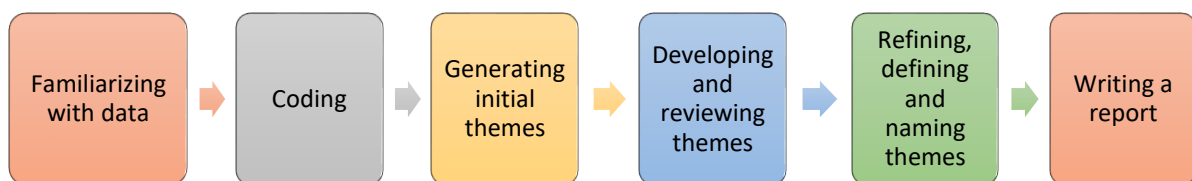


identifiers) was removed from the transcripts and field notes. All participants are referred to in this study by pseudonym (e.g., Fisherman 1, Fisherman 2).

## DATA ANALYSIS

The deductive thematic analysis (Braun & Clarke, 2022) was used to analyse the interview data. This method was used because it was guided by established mathematical concepts, namely, sets, relations, and mappings. Rather than allowing themes to emerge entirely from the data, deductive thematic analysis applies pre-existing theoretical knowledge (Naeem et al., 2023). The goal was not to test a hypothesis but to explore how participants' descriptions of fishing activities reflect forms of mathematical reasoning consistent with these concepts. The six phases of the reflexive thematic analysis proposed by Braun and Clarke (2022) as follows:

*Figure 2: Six phases of thematic analysis*



Both researchers began the analysis process by reading and rereading the transcript, as well as watching recorded videos to become familiar with it (phase 1). In phase two, researchers coded the transcript using MAXQDA 24. Since we are using deductive thematic analysis, we, at first, start with a set of pre-defined codes. Following the research question, we categorized the pre-defined codes into three themes (Phase 3):

- i. **Sets:** references to groups of fish, fishing zones, or daily catch sets.
- ii. **Relations:** descriptions of connections between fishermen, nets, locations, or tasks.
- iii. **Mappings:** assignments of fish types to locations or fishermen to specific tasks.



## RESULTS

**Findings:** In this section, we explore how set-theoretic mathematical knowledge is embedded in traditional fishing activity. Set-theoretic mathematical knowledge, i.e., the concept of set, relation, and mapping, is very abstract in nature. However, our study reveals how naturally these abstract concepts work behind traditional activities like fishing.

### i. Theme 1: Sets

The following comments from fishermen reveal how the concept of sets naturally arises in fishing activity. In layman's terms, a collection of distinct objects is called a set. For example, a collection of fish or a collection of fishing tools such as nets and traps are sets.

*“For small fish like shrimp, we use specific methods... tools like polo, birti, or jhapa. For larger fish like Pangas, we use nets with specific gaps to trap them...we make tools like bira or polo for catching shrimp and smaller fish...” (fisherman 1)*

*There’s karen net, so many names—fandi net, bashari net. How many names should I tell you? There are a lot—bin net, and those spiked nets (you can’t see them from here)...(Fisherman 11)*

*“There are different types of nets like Ghurna Net, Ghai Net, and Fadi Net. Each net serves a specific purpose. We buy the type of net we need at that time....Some ponds are shared among partners, and we mainly grow large fish in those. For business purposes, we also have smaller ponds where we grow baby fish, called Chara Pona...” (fisherman 4)*

From the comment of fisherman 4, we can construct a set that includes ponds of different sizes and shapes. Additionally, we can introduce the concept of subsets; for example, if we have a collection of fishing tools like nets, traps, and containers, we can create subsets such as traps specifically for small fish, like polo, bira, etc. Moreover, we can perform basic set operations



like union and intersection. For instance, we can find the intersection of tools used for small fish and those for large fish.

## ii. Theme 2: Relation

In mathematical terms, a relation means pairing two objects within a set while satisfying a certain condition. More specifically, a relation is a subset of the Cartesian product of two sets. There are many types of relations, such as binary relations, order relations, equivalence relations, and partial order relations. In fishing practice, the following comments demonstrate how the concept of relation can be constructed:

*“Usually we use nets — like encircling nets, drag nets, circular nets, and traps. In small areas, we also use fishing rods or bamboo traps. In rivers like the Damodar, encircling nets and drag nets work best. ...If we want to catch small fish, the gaps are small. For bigger fish, the gaps are made larger. Typically, in encircling nets, the gap is about 2 to 3 lagas, and in circular nets, it’s smaller — around one laga ...” (fisherman 10)*

*“...First, we think about what kind of fish we want to catch—because different fish need different mesh sizes. For example, to catch small fish, we use nets with one or two-finger-sized holes. For bigger fish, we need nets with four or five-finger-sized holes...” (Fisherman 13)*

We can create a relation like this. Suppose, we made three sets:

A= Collection of fish, B=Collection of fishing nets, C= Gap sizes of net.

Now, define a relation on  $A \times C$  by a fish (by size) is related to a particular mesh/gap size; depending on the size of fish it can catch. Also, we can define a relation on  $A \times B$  by relating the net to their gap size.

## iii. Theme 3: Mapping



One of the fundamental concepts in mathematics is mapping or function. Mapping means a correspondence between two elements of two sets. Fishermen use this concept abundantly in their daily activities.

*“I adjust the size of the net holes based on the size of the fish. For example, for catching small fish like "chuno," I use 1-size holes, and for bigger fish like rohu or katla, I use 2 to 3-size holes....” (fisherman 8)*

*“I choose nets based on the size of the fish. Bigger fish need wider mesh, smaller fish need finer mesh....To catch small fish, we need nets with small mesh; for big fish, we need larger mesh. For example, if I want to catch chuno fish, the mesh has to be 1 mm. But if I want to catch rohu or catla, then I need 50 mm mesh. Without knowing this, it’s hard to catch the right fish!” (fisherman 7)*

*“Yes, yes, we plan it out. For example, if we go out in the morning, we can’t fish the entire day without eating. We usually spend about five to six hours on the boat, casting the net two or three times. After catching the fish, we return, take a bath, eat, and then go out again to fish until around 8 PM...” (fisherman 1)*

*“There’s jal (net), thela jal, pata jal, fandi jal, tana jal...Yes, the gaps are different...The sizes are like 1 laga, 2 laga, 2.5 laga, 3 laga...” (Fisherman 12)*

From the above comments, we can gather various notions of mapping. For example, we can have two sets: set A containing fish and set B as the collection of net holes. Now, we can define a function between A and B by connecting a fish with a particular hole size of the net used for catching. This type of function is not injective but surjective.

## DISCUSSION

Our study explores various set-theoretic concepts in fishing activities.

Fishermen use different nets and traps in order of daily use. From the quote of fisherman 11, we have nets like Karen's net, Fandi's net, Bashari's net, and bin nets. It clearly shows that



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the fisherman is using categorical data. According to its formal definition, a set is a collection of unique things already well-defined. Think of these collections of fishing nets as a set. Another excellent example is selecting different fish of various sizes and weights. As we see in the quotations of Fisherman 4, there are two kinds of ponds: a shared pond and a smaller-sized pond for baby fish. This is a significant observation. In truth, the member of a set in formal set theory does not change with time. However, in fishing, one pond could be “community” during one season but “private” at another. This element of the set can be recognized as a time-dependent element. Thus, this set has a fixed number of items in it, but its name changes with time. Some sets are also relative to fishermen. Ex. set of large fish (fisherman 7). It relies on the judgment of an individual or a collective to adjudicate this assembly of fish.

And the idea of relation itself that a fisherman uses unconsciously through his daily life. Let us have the collection of fish with different weights, as Fisherman 11 said there are big fish and small fish. Now, let us induce a relation on the set of all fish: A is related to B if and only if the weight of A ( $W(A)$ ) = the weight of B ( $W(B)$ ). This type of relation is known in the formal language of mathematics as an 'equivalent relation. Now we can construct a class from this relation, i.e., the set of fish of a given weight. Abstract mathematical concepts can be expressed through everyday life practices such as this. As Stoica (2015) argued, mathematics is not only meant to learn the concepts and techniques until they come out of one's ears but also a perspective in which one must understand at least enough of it to be able to utilize it in their daily activities. Our research backs up that assertion. And again, based on the fisherman's interview, we understand that not every kind of net (or trap) is effective to capture each kind of fish. Therefore, if you want to catch some fish, then we tend to want a specific net. This gives us a correspondence between the nets and the fish. Mathematically, this is commonly referred to as a function or a mapping.

Concepts like relation and mapping are very abstract in nature. But by integrating these concepts with traditional fishing activities, we illustrate that not only elementary mathematics



but also highly abstract concepts are embedded in daily life. This opens up a new possibility in teaching set-theoretic concepts to students. Dorwu et al. (2025, p. 3) expressed that “*mathematics is a discipline influenced by human culture and subject to personal opinions, ideas, and values*”. Therefore, integrating mathematical concepts with culture is not artificial but natural; for example, research by Kyeremeh et al. (2025) shows how geometric concepts are abundant in architecture, cultural artifacts, cultural activities, craftworks, and the structure of animals and plants. Despite all this research, students find mathematics very artificial, and they can hardly link mathematical concepts with their lives. One of the reasons that the challenge emerges is that the connection to reality is frequently fabricated by the teacher, and rarely arises from an instinctive understanding by the kid (Hart, 1989). Studies show that this lack of connection is due to the way mathematics is presented to a student. They often struggle with numbers, formulas, and notations (Wisenoeker et al., 2024). By contextualizing sets and relational concepts within familiar practices such as fishing, we believe that students will be more engaged and demonstrate deeper conceptual understanding. Payadnya et al. (2024) clearly argued that including ethnomathematics in the educational framework can help create an accessible and stimulating classroom for students of all backgrounds.

## CONCLUSION

This study emphasizes the significant presence of set-theoretic principles in the daily fishing methods of traditional inland fishermen in West Bengal, India. Through deductive thematic analysis of interview data, we categorized the set-theoretic concepts into three themes: sets, relation, and mapping. Our findings indicate that, despite minimal or absent formal instruction in mathematics, fishermen exhibited practical applications of highly abstract mathematical concepts such as sets, relations, and mappings. Our findings demonstrate that mathematical reasoning is intricately integrated into culturally established work practices. This study promotes the implementation of culturally sensitive pedagogy in mathematics education. Integrating community-based knowledge into the classroom could reconcile the disparity between formal and informal mathematical instruction. One of the most effective methods for



making mathematics more relevant to learners and emphasizing its significance is to encourage them to explore mathematics within the framework of their own cultures (Kabuye & Marjorie, 2024). Furthermore, ethnomathematics may expose learners to different perspectives on mathematics that both contest and support the ideas and methodologies presented in the mathematics classroom.

## **RECOMMENDATIONS**

The study suggested the following to improve the teaching of mathematics using an ethnomathematics approach.

- Our fishing activity research is rich in mathematical concepts. Therefore, when teachers create curriculum, it is of utmost importance that example exercises and problems are culturally relevant to students.
- Teachers are to embrace continuous assessment and feedback mechanisms for evaluating ethnomathematics teaching. Hands-on practice in areas of ethnomathematics can improve the mathematical maturity of students. Teachers need to number the way that the students are going to participate in the ethnomathematics class, what will be assessed and what instructional strategies will be used so that they get involved.
- More research is needed to study alternative methods, technology, and theoretical frameworks. Mathematics instruction needs to improve, and students need to develop cultural awareness with respect to priorities for financing if there are gaps. Future studies could follow up on this research by applying it to other groups of fishers, such as those involved in marine fishing, or explore other mathematical disciplines, including algebra, statistics and probability, in applied aspects.

## **LIMITATIONS**

The following study limitations should be noted when interpreting the results:



- i. This qualitative study used a small sample size in a specific region, drawing conclusions from interview data. These findings may not fully explain how set is used in fishing. Again, in our study, we exclude the marine fishing. This limits our study.
- ii. We only include male fishermen in our study; this may lose gender-based information and bias results.
- iii. Although the researchers translated the interview transcripts from Bengali to English, meaning loss or distortion may occur, especially when translating indigenous fishing words.

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