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Beyond the Classroom: Exploring Everyday Mathematical Practices with out-of-school Children

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ABSTRACT

This study explores the everyday mathematical practices of out-of-school children living and working in a recycling and waste-management plant. Drawing on qualitative methods including observation, discussion and field notes, the research identifies the types of mathematical tasks children perform, the strategies they use to solve problems, and how these practices reflect foundational concepts such as number sense, measurement, estimation, and spatial reasoning. The findings show that children routinely engage in counting, grouping, weighing, money-handling, sharing, and spatial arrangement while performing work-related activities. Their methods are oral, context-based, and efficient, relying on estimation, repeated addition, skip-counting, decomposition, and practical manipulation rather than written algorithms. Although these strategies demonstrate strong informal mathematics, they differ markedly from the abstract and symbolic procedures that are often emphasised in school mathematics. The study argues that these work-based mathematical competencies represent a valuable resource for teaching and align with NEP 2020’s emphasis on connecting mathematics to lived experiences.

Introduction

Mathematics has been perceived as a subject confined to textbooks and classrooms, but in everyday life, it is a part of daily activities. Children and adults use mathematical concepts in a simple and meaningful way, such as counting objects, working with money, comparing weights or sharing resources. These practices develop naturally as a part of everyday activities, even for people with or without formal schooling.

In India, children of low-income families often contribute to household income by participating in small-scale trading, vending or waste-related activities. Through such activities, they learn about numbers, quantities and simple calculations, but in ways that are different from school mathematics. For instance, children are able to work out how much they will earn, work out the profit and loss, calculate the weight, etc. Their knowledge is practical, oral, and context-specific, and it connects to their lived experiences.

Over the past four decades, research has shown that children, including those with little or no formal schooling, often acquire strong mathematical abilities through participation in their daily work and community activities. The term "street *mathematics",* as coined by Carraher, Carraher and Schliemann (1985), refers to mathematics that is used in real-world situations, the strategies for which are verbal, manipulative, and flexible in response to contexts. Related concepts such as informal mathematics and everyday mathematics highlight that the ways in which mathematical thinking can be culturally and socially situated may take form that is different from the formal classroom ways but are equally useful in their contexts.

Review of Related Literature

The relationship between children's everyday practices and school mathematics has been widely studied across different cultural settings.

Carraher's and Schliemann's (1985) study in Brazil demonstrated that street vendors could perform mental calculations with speed and accuracy while selling goods, yet struggled with the same problems when written on paper. Saxe (1988) further showed how child vendors developed grouping and multiplication strategies through their trade, highlighting the creative ways in which children generate methods suited to their contexts. Similar patterns emerged in Liberia, where tailors solved measurement and arithmetic problems through practical manipulation rather than abstract computation (Reed & Lave, 1981). These studies established that informal environments often nurture robust mathematical reasoning, though it may not align with school-based expectations.

Beyond specific country studies, researchers such as Resnick (1987) and Nunes, Schliemann, and Carraher (1993) have described this divide as a distinction between "everyday cognition" and "school cognition". Everyday mathematics is embedded in activity, oral in nature, and guided by purpose, whereas school mathematics is abstract, symbolic, and rule-bound. While both forms have value, the lack of connection between them creates difficulties for learners. Pattison, Rubin, and Wright (2017), in their review of mathematics in informal learning environments, emphasised that learning is often richer when it is linked to cultural practices, tools, and shared activities.

In the Indian context, Khan (2004) explored the mathematical practices of working-class children in Delhi who sold newspapers, paan, and other goods. She documented how these children's numeracy was embedded in occupational tasks such as making change, estimating quantities, and mentally adding or multiplying prices while noting the mismatch between their functional competence and the abstract focus of school mathematics. Subramaniam (2010) extended this perspective by framing such practices within an ethnomathematical lens, emphasising the role of culture and social participation in shaping mathematical reasoning and arguing for their recognition in curriculum design.

Bose and Subramaniam (2011) investigated everyday mathematics among school-going children in Dharavi, Mumbai, a context rich in household-based economic activity. Their findings revealed that children possessed strong currency-handling skills and oral calculation strategies for multidigit numbers yet struggled with written place-value representation. The study highlighted the influence of daily exposure to economic transactions, even among children not directly engaged in work, and pointed to the gaps between everyday and school mathematics.

Scope of the Study

While there is extensive research on children's out-of-school mathematics learning in the areas of street vending, tailoring, and household-based businesses, little is known about mathematical practices in municipal waste and recycling plants. In the current study, the waste management plant, Ghaziabad, is gathering waste from housing societies and conveying it to a recycling plant where the dry and wet waste gets separated by workers. Children separated plastic, metal and glass from others; plastic is sent to the recycling process. The majority of the labourers in this plant are migrants from Assam and their children, who are mostly out of school, are associated with the plant throughout the day. They are usually involved in small jobs like collecting plastic goods for recycling, sorting the plastic waste and selling them to the kabadiwalas or selling mobile phones and scrap to the kabadiwalas.

This study aims to understand everyday mathematics practices of these children by observing their work practices and analysing the role of their experiences in development of their foundational numeracy. National Education Policy (NEP) 2020 aims to ensure that by the end of grade 3, the students are able to read, write and perform basic mathematics. Studies on children's informal practices therefore provide important evidence for how policy can move beyond abstract goals and engage with the actual ways children learn and use mathematics outside of school.

Research Questions

1. What mathematical tasks do children perform in everyday life, and how do these differ from school mathematics?

Research Objectives

1. To identify the various types of tasks that the children perform during their daily activities.
2. To observe the methods that children use to solve mathematical problems in their work context.
3. To explore how the children's mathematical practices demonstrate their understanding of number concepts, measurement, estimation, and spatial reasoning.
4. To compare the nature of mathematics used in these real-life contexts with the methods of formal school mathematics.

Research Methodology

This study used a qualitative research design to explore children's mathematical practices in their natural work environment. Specifically, the research focused on children aged 6 to 14 years residing in a plastic and waste management plant in Ghaziabad, Uttar Pradesh. These children, primarily from migrant families in Assam and West Bengal, were actively engaged in various tasks such as collecting, sorting, and weighing recyclable materials. A purposive sampling technique was used to select participants who met the inclusion criteria: children who were not enrolled in formal schooling and were involved in any small tasks. The sample consisted of approximately 10 children who were observed during their daily work routines.

Data Collection: An observation checklist for children who are involved in mathematics during their work was used to collect data. Indicators included counting and grouping, estimating weight, estimating quantity, using spatial sense when arranging materials, and using money when selling or buying. Field notes were also taken during the data collection process to record what the children did, the tools and materials they used, local terms used to count or measure and the researcher's reflections.

Data Analysis: Thematic analysis was used for data analysis, with the four research objectives serving as the organising themes. The result of the observation process was analysed to identify the common patterns of children's mathematical behaviour in the field notes.

Ethical Considerations: Parents or guardians of all the children in the study were informed of the study's purpose, methods, and their right to withdraw. Permission to conduct observations and interactions within the recycling plant was formally obtained from the owner. To protect the privacy and safety of participants, all identifying details have been kept confidential. The real names of the children have not been used anywhere in the study. Instead, the children are referred to using pseudonyms (e.g., “Child A”, “Child B”, etc.). All data collected were used solely for academic purposes and stored securely.

Results and Findings

Objective 1: To identify the different types of mathematical tasks performed by the children during their daily activities

Findings

Counting was the most visible practice. Younger children were able to count plastic bottles, glass bottles or other scraps in their native language (Bengali) and older children could count in groups of 10 or 50. Children were also used to handling money; they worked out how much they could earn per kg of plastic or glass and bargained with the local kabadiwala. Children used a half kg (adha kilo) and a full kg (ek kilo) for weighing the weight of the sack. They talked about being aware of time and having a daily routine of being at work at 8 or 9 a.m., stopping for lunch at 1 p.m. and then getting back to work after lunch. They also exhibited spatial reasoning skills, pushing bottles into sacks to make more space and stacking objects to fill it.

Discussion

The observations align with those of Carraher et al. (1985), who demonstrated that out-of-school children are exposed to all areas of mathematics in meaningful activity without formal schooling. The diversity of tasks, such as counting, measuring, handling money, and spatial understanding, which reflects a variety of activities. Moreover, Saxe (1988) described the process as being presented through occupational activity to children's number sense. A study by Khan (2004) of working-class children in Delhi also revealed that practical activities like estimating quantities and calculating earnings dominated the children's numeracy development. Pattison, Rubin and Wright (2017) also points out that, in the best of all possible worlds, learning happens when it is in a culture's tools and when it is part of a culture's activities, and this is exactly what these children's daily life activities offer. Yet, as Resnick (1987) observed, school mathematics rarely acknowledges this range of competencies because it privileges symbolic representation over contextual reasoning.

Strategy Identified

Contextual multi-domain engagement: Children naturally switch between counting, measuring, estimating and spatial reasoning within one task. These should not be treated as discrete areas of mathematics but rather should be incorporated into integrated activities, such as sorting and pricing objects, which involve several mathematical areas at once, in the same way that these children think.

Objective 2: To observe the methods that children use to solve mathematical problems in their work context

Findings

The children used primarily oral strategies to solve practical problems. Addition and subtraction were performed mentally; even the youngest children (6-7 years) were able to add numbers up to 20 without using fingers or pen and paper. Children were asked to find the cost of 5 kg of plastic at ₹12/kg; they didn't multiply 5 x 12 but added 12 five times. Some of the older children mentioned that they had memorised tables (pahada). The word ‘aadha' (half) or ‘lagbhag' (about) was used to make an approximate judgement about weight or quantity. If there were no more space in the sack, children pushed or pressed bottles into the sack; if the two sacks were believed to be of unequal size, children offered to weigh one to make sure that they were equal.

Discussion

The two approaches observed here were very similar to those of Carraher et al. (1985) in their study of problem-solving among Brazilian street vendors; their accuracy in solving problems was comparable in real transactions but was lower when problems were presented on paper. In this way, Nunes, Schliemann, and Carraher (1993) distinguish between oral mathematics, in which the learner is flexible and context-sensitive, and written mathematics, in which the learner is rule-bound and context-free. Resnick (1987) also makes a distinction between everyday cognition and school cognition, pointing out that school cognition is based on procedure, while everyday cognition is based on purpose. Children's mathematical competency in the use of approximation language is culturally embedded in practices that are not validated within the school context, despite its importance as a mathematical competency, as mentioned in NCF-FS 2022.

Strategy Identified

Oral mental calculation and estimation: Children show fluency in mental arithmetic and sensible approximation without any introduction of written procedures. Teachers can then expand on this skill by presenting oral number problems in familiar contexts first, validating estimation as a valid approach, and then only later linking the same reasoning to written notation, rather than the beginning.

Objective 3: To explore how the children's mathematical practices demonstrate their understanding of number concepts, measurement, estimation, and spatial reasoning

Findings

Children were able to count in Bengali *(ek, dui, teen, chaar, panch…)*, but only 6 out of 10 children could write numerals. Child 1 (age 8) counted the bottles in sets of 50, going from two sacks to 100 without counting the individual bottles *(Ek bori mein 50 hote hain, do bori mila ke 100)*. When asked how many were left after giving 40 out of 120 to their parents, child 2 (age 11) answered instantly: *'Assi bache hain'* (80 left). Child 3 (age 7) added the amounts of coins out loud to arrive at ₹35, saying, *'Paanch, dus, bees milakar paintees ho gye.' Child* 4 (10 years old) used decomposition to calculate 7 kg at ₹15 per kg: *'Teen kilo ka 45, phir do kilo aur 30, mila ke 75… aur do kilo aur 30, toh 105.'* Child 5 (Age 9) explained that tilting bottles while packing in sack allows more to fit: 'Seedha *rakho toh jagah kam padti hai, agar tedha karke rakho toh zyada aa jayega*.' Child 6 (age 8) gave away 30 rupees among two as *'pandra main, pandra tu'* and then asked to divide it among the three immediately, saying, 'Ab *10-10-10 ho jayega.'*

Discussion

Child 1's fives collection is similar to the NCERT Class 2 Mathematics textbook activity of skip counting by 2s, 5s and 10s, and she developed this strategy without schooling but through repeated work experience. Indeed, Saxe (1988) noted that grouping strategies are not taught but rather arise from the demands of trading numbers; he specifically noted that among candy sellers, the grouping strategies are precisely what they are. Child 4's decomposition algorithm for multiplication (decomposing a problem into a series of smaller, manageable addends) is a mathematically valid strategy for solving multiplication problems, one that is rarely recognised in formal tests. Child 5's "spatial insight" in terms of the orientation of the bottle is similar to Reed and Lave's (1981) observations of Liberian tailors who used physical manipulation in solving geometric problems rather than abstract reasoning. Bose and Subramaniam (2011) point out that these skills are not recognised in school as mathematical skills, as they are not represented symbolically, which leads to a false perception of a lack of mathematical competence.

Strategies Identified

1. Grouping and skip counting using place value: Children use grouping and skip counting to build up their understanding of place value concepts and multiplication.
2. Decomposition for multiplication: make larger calculations smaller additions first before they are introduced to times tables.
3. Intuitive division by equal sharing: flexible division reasoning through partitioning objects into non-uniform groups of varying sizes.
4. Spatial packing reasoning: Children's problem-solving in the context of orientation can be related to geometry and volume tasks.

Objective 4: To compare the nature of mathematics used in these real-life contexts with the methods of formal school mathematics

Findings

The mathematics practised by children was oral and based on real-life contexts. They counted in their local language, put things in groups, measured weight in half kilos and kilos, calculated earnings for the day, and divided things up equally. For instance, child 7 (age 9) connected daily time landmarks with productivity: *'Subah 9 baje aate hain, 1 baje lunch ke baad ke liye jaate hain, fir shaam 5 baje tak kaam karte hain, aur pure din me 10-12 kilo sookhi roti bech dete hain, 10 rupay kilo ke hisab se lagbhag 100-120 rupay mil jate.'*

These practices were purposeful and clearly linked to sales and segregation of waste. However, they were rarely expressed in symbolic or written form, such that children could state that 15 kg at ₹10 per kg gives ₹150, but they did not write it as '15 × 10 = 150'. Also, they had no issues working with kilos, but with grams they faced confusion, as they didn't use them in measurements. They use local language terms such as ‘taka’ and 'rupay', indicating that mathematics is not a standalone abstraction but is part of the culture.

Discussion

This discrepancy is the contradiction between the means in which children can perform their skills orally and in writing that this study documents. Rampal (2003) reported that the school doesn't recognise out-of-school strategies, so this approach reduces children's confidence when they are faced with written algorithms. Consistent with Khan (2004), teachers also overlooked working-class children's ability to solve real-life problems using calculations in the classroom. Bose and Subramaniam (2011) noted that vendors often used shortcuts that teachers considered wrong, rather than another valid approach. Additionally, according to Subramaniam (2010) , there is growing disconnection between these two domains, with classrooms rarely creating bridges between them. Child 7's use of time, quantity, and money in a single oral calculation is just the kind of multi-step reasoning that NEP 2020 already mentioned connecting to classroom mathematics with daily life, but it is unrecognised in schools.

Strategies Identified

1. Oral to written transitions: Because children are doing mathematics correctly in their heads, teachers could start by working on problems orally in familiar contexts and later gradually move towards introducing written notation as a record of the oral mathematics work.

2. Time–money–quantity integration: Child 7's calculation of how much money she earns each day involves both time and measurement as well as multiplication in a real-life problem. With similar multi-domain word problems, teachers can also show how mathematical concepts are connected with one another and how written problems aren't random.

Conclusion

The study shows how children acquire mathematical understanding from participating in everyday activities in a meaningful way as they live and work in a recycling plant. The findings highlight the depth of children's informal numeracy but also reveal a considerable gap between children's real-world understanding of numbers and the forms in which they are required to show their knowledge in school. This gap indicates that the mathematics education system should rethink the definition of mathematical proficiency and the place of children's everyday thinking. The challenge is not so much about the children's capability but about how school mathematics recognises diversity in mathematical ways of thinking.

From a policy perspective (notably when compared with the NCF FS 2022 competencies), this study highlights the need to incorporate children's experiences into the curriculum, pedagogical practices and assessment systems. The creation of frameworks based on familiar contexts, and especially in contexts where children are working on labour or household tasks, this could be considered. Teacher training programmes need to also help teachers identify and develop strategies like estimation, grouping, repeated addition and real-life problem-solving. This can help promote equity in children's experiences of learning mathematics on entering school, as they have rich but informal prior knowledge of mathematics.

Longitudinal studies may be valuable for future research in determining the development of these informal skills over time and in linking them to written mathematics with proper scaffolding. Studies of comparative processes in various occupational settings (e.g., vending, tailoring, construction, agriculture) can also enrich our understanding of mathematical practices in everyday life across different communities. Researchers could also examine how multilingual contexts (such as those in this study) affect how children express mathematical ideas. The findings in this study show that children who live on the fringes of society are not mathematically illiterate but instead gifted in ways not captured by the formal system. It is not only a matter of academic interest but also of educational justice to honour their knowledge. The future of pedagogy and research needs to take account of the mathematics in children's lives so that the classroom is not a place where these two types of numeracy are in opposition to one another.

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