Out-of-basic school mathematical knowledge meets algebraic word problems: An anthropo-didactic evaluation

Conhecimentos de matemática fora da escola básica ao encontro de problemas algébricos: Uma avaliação antropo-didática

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Abstract. The study examines the contributions of school mathematics and ethnomathematics to out-of-basic school mathematics by analyzing the methodologies employed to solve practical algebraic word problems. The uniqueness of this study was centered on how the technique (τ_i) and technological (θ_i) concepts in the Anthropological Theory of the Didactic (ATD) approach were used to discover certain distinct ethnomathematics approaches used by the masses in solving practical word problems that were not well established in the available data. In a mixed method approach, the 353 respondents conveniently sampled from the Kumasi Metropolis demonstrated real enthusiasm in responding to the four tasks $(T_{i=1,4})$ offered through interviews and questionnaires, demonstrating support for research into their out-of-basic school mathematics $(I¿¿o)¿$. The study found that not all working-class people rely solely on Western mathematical skills but blend them with ethnomathematics. Some interviewees used simple, readily available instruments to explain tasks, which could be relevant for mathematics instructional approaches. Despite applying their school mathematics and ethnomathematics knowledge to practical word problems, the results were unsatisfactory. The study recommends ethnomathematics as a potential

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intervening instructional approach that can make school mathematics applications easier and closer to students by leveraging their culture and understanding of real-life contexts.
Keywords: school mathematics, ethnomathematics, out-of-basic-school mathematics, praxeology, anthropodidactic.

Resumo. O estudo examina as contribuições da matemática escolar e da etnomatemática para a matemática fora da escola, analisando as metodologias empregadas para resolver problemas de palavras algébricos práticos. A singularidade deste estudo centrou-se em como os conceitos de técnica (τ_i) e tecnológico (θ_i) na abordagem da Teoria Antropológica da Didática (ATD) foram usados para descobrir certas abordagens etnomatemáticas distintas usadas pelas massas na resolução de problemas práticos de palavras que não estavam bem estabelecidos nos dados disponíveis. Numa abordagem de método misto, os 353 participantes, selecionados por conveniência na Metrópole de Kumasi, demonstraram um verdadeiro entusiasmo ao responder às quatro tarefas $(T_{i=1,4})$ propostas por meio de entrevistas e questionários, demonstrando apoio à investigação sobre a sua aprendizagem de Matemática fora da escola básica (*I*¿¿*o*).¿ O estudo constatou que nem todas as pessoas da classe trabalhadora dependem exclusivamente de competências matemáticas ocidentais, mas combinam-nas com a etnomatemática. Alguns entrevistados utilizaram instrumentos simples e facilmente disponíveis para explicar as tarefas, o que pode ser relevante para abordagens de ensino da Matemática. Apesar de aplicarem os conhecimentos escolares de matemática e etnomatemática a problemas de palavras práticos, os resultados foram insatisfatórios. O estudo recomenda a etnomatemática como uma potencial abordagem instrucional intermediáira que pode tornar as aplicações da matemática escolar mais fáceis e mais próximas dos alunos, alavancando a sua cultura e compreensão dos contextos da vida real.
Palavras-chave: matemática escolar, etnomatemática, matemática extraescolar, praxeologia, antropodidática.

Introduction

The most intriguing concerns that students frequently raise, and which quickly receive real-life responses from teachers, are those about the importance of the mathematics course in their after-school lives. As a result, teachers, as institutional actors, primarily incorporate some previous knowledge, cultural understanding, contexts of reference, and events and festivals of students from diverse backgrounds into their strategies, which are universally available in public sources concerning contemporary society integrated into the school system mathematics program (Dorier & García, 2013). These practical problem-solving challenges are offered to students to make mathematics education more “culturally relevant” and “effective” by preparing them for life after basic school education (Gay, 2000; Oppong-Gyebi et al., 2023). Nonetheless, such activities often adhere to educational institutional standards. According to Nasir et al. (2008), teachers who use this method make learning more meaningful and successful for students, allowing them to build connections with schools, community, and their diverse cultures.

Beyond basic schooling, educators presume that pedagogic connections are also an intrinsic element of working life and that day-to-day activities will be confronted with, and must reconcile with, a variety of other important workplace ideologies, both cognitive and social/cultural in nature (FitzSimons & Björklund Boistrup, 2017). As indicated by Bunge (2003), solving word problems appeals to a diverse group of people who, regardless of their expertise, are drawn to exciting general challenges rather than educational or occupational ones. Diego-Mantecón et al. (2021) are of the view that there is a common interest in assessing citizens' and students' mathematics proficiency and understanding their challenges when confronted with real-world problems. According to (OECD, 2015), both individuals and students globally have low math ability when solving contextual mathematical problems, but the causes for this low proficiency remain unknown. Studies of everyday scenarios associate low math proficiency with numerous elements other than those that distinguish the standards of education, such as motivation to solve a problem and the living environment in which it occurs (Howker & Black, 2025; Kikas et al., 2009; Lave, 2019). In this regard, the study realised the importance of anthropo-didactic, a theoretical approach that integrates didactic and anthropological theories to study problem-solving techniques used outside the classroom. The approach focuses on the cultural aspects of problem-solving contexts and didactic methods, considering mathematical knowledge structure and outcome response modalities, to understand problem-solving phenomena (Rajotte et al., 2021).

Statement of the problem

Sociocultural studies, according to Ju et al. (2016), demonstrate that each community has traditionally built a type of mathematics distinct to its culture and history. Until the late 1970s, the term "ethnomathematics" was dedicated for the practices of mathematical by primitive peoples or "non-educators" (Ascher, 2017; Hidayati & Prahmana, 2022). What was required was a thorough examination of the advanced mathematical principles found in ethnomathematics, which were said to be connected to and as complicated as those found in current, western mathematics (Karen, 2009). Ubiratan D'Ambrosio pioneered the ethnomathematics initiatives and advocated a wide framework of "ethno" to cover all culturally marginalized groups with their idiomatic expressions, languages, symbols, myths, and even distinctive ways of thinking and inferring (Powell & Frankenstein, 1997; Rosa, 2020). As a result, scientists are currently collecting empirical data on the mathematical practices of culturally diverse populations, whether educated or not and has its impact on mathematics educational philosophy (Karen, 2009).

According to D'Ambrosio (1990), it is crucial to acknowledge ethnomathematics as a programme of study that directs educational pedagogical approaches. However, Monteiro and Nacarato (2004) make reference to the fact that the integration of the ethnomathematics plan's goals as instructional practices in education systems, as well as its design and implementation in the realm of education, is the latest domain of study that continues to evolve its very own uniqueness in the didactical field. The ethnomathematics program is based on an integrative theory set that shares a humanistic and constructivist perspective on the nature and formation of knowledge, as well as a desire to engage in the links between cultures and mathematics and their significance for mathematics education (Albanese, 2021; Albanese & Perales, 2014).

Pais (2011) identified two types of remarks about ethnomathematics in contemporary literature: epistemological, which concerns how ethnomathematics presents itself in regards to mathematical understanding; and pedagogical, which concerns how ethnomathematical concepts are embedded in formal education. In relation to epistemological development, Bunge (2003) is not fascinated by idle dreams, but rather by a variety of issues that arise in every aspect of knowledge that investigates the truth of the matter or ways to govern it in its uniqueness and originality.

Bunge (2003) expresses his concern with the convergence of relatively separate lines of inquiry, but he recommends a straightforward definition of the notion of occurrence to substitute for that which brings up and explains the conceptions of system, a realistic possibility, an invertible problem, knowledge exchange, the formation of ideas, social innovations, and part of the truth that take place in all disciplines. In the same view, Godino and Batanero (1998) suggested that to complete the epistemological examination of practical-life difficulties, mathematics education must evaluate the contributions of other disciplines and also provide the basis for an analysis of the nature and concept of mathematics, as well as their personal and cultural growth.

After realizing that epistemology and cognitive challenges could not be differentiated from ontological reflective thinking, Godino and Batanero (1998) developed axioms suitably rich to classify mathematical activity and the procedures of interacting with their "products," as well as a particular procedure of analysing the frameworks of mathematical signs used in didactic connections. In addition to mathematical objects, intentional objects, first analysed by Ingarden in "Das literarische Kunstwer", have been opined by Błaszczyk (2005) to be successfully applied to the ontology of informatics, economics, and mathematics, but rather stress their applicability to the ontology of mathematics. After examining why this viewpoint is so prevalent and highlighting the issues posed by reality in mathematics, Font et al. (2013) discuss the key features of rational and anthropological signs and symbols and how they could function as an overview of a mathematical philosophy formed from the perspective of mathematics education. This technique can describe how mathematical objects develop from mathematical practices from a quasi-perspective (Font et al., 2013).

Problem solving in real context

Problem-solving strategies to achieve contextual solutions have been a component of human civilizations since time immemorial, and their effectiveness has been encouraged all over the world via national curriculum design and formal manuscripts in an attempt to master this component of mathematics from the lower to upper stages of the educational system, as stipulated by Ortiz-Laso and Diego-Mantecón (2020). According to Schoenfeld (2007), problem-solving was a prominent emphasis from the mid-1970s through the mid-1990s, when scholars' interests switched to other areas. However, several concepts from problem-solving research (Hoogland et al., 2018; Ishibashi & Uegatani, 2022; Verschaffel et al., 1994) were included in those field studies, and that effort is still evolving tremendously, reshaping the curriculum to keep up with the times.

Theoretical breakthroughs in "metacognition" in mathematics education first occurred in the research topic of problem-solving, which is strongly tied to the practical challenge of how to understand (and instruct) to answer non-routine problems (Öztürk, 2021; Rodríguez et al., 2008). Wilson and Clarke (2004) studied student metacognition in the domain of mathematical problem-solving and how to report the empirical validity emerging from the solution to the problem using a multi-method approach.

Tasks, according to Doerr and English (2006), should be intended to immerse individuals in key mathematical situations such that their descriptions and arguments provide an understanding of their mathematical reasoning. Booth et al. (2014) and Graesser et al. (2018) expressed how exceptionally challenging problem solving can be, not just because it incorporates more abstract concepts and more interrelations between quantities, but also because it necessitates critical thinking and knowledge in the creation of some techniques and technology capable of extracting the answer from the problem at hand. Fantinato's (2004) study discovered a strong relationship between the use of mathematical abilities in everyday interactions and self-sufficiency tactics to fulfill fundamental necessities like tactfully utilizing a limited budget, but it also seemed to be tied to psychological variables such as defending one's personality. In contrast to only cultural influences, Fantinato's (2004) research findings demonstrate the dominance of economic and social elements in dealing with the construction, representation, and application of mathematical knowledge in an urban setting.

In addition to the student metacognition, the language wherein contextual factors to which the interpretations of mathematical objects are related and with which attribute a functional aspect to them play an important part (Godino et al., 2007). According to Font et al. (2013) the essence of mathematical objects, their many forms, how they are generated, and how they partake in mathematics activities are all issues of mathematical and philosophical education interest and are very necessary when dealing with algebraic word problems. Mathematical objects that intervene in or emerge from mathematical practices are reliant on the linguistic system in which they engage and can be regarded via simultaneous aspects (Godino et al., 2007, 2011; Godino & Batanero, 1998).

Popovic and Lederman (2015), and Sommerauer and Müller (2014) investigate how using real-world problems in informal settings connects classroom mathematics to its applications in the real world. Filloy et al. (2004) investigated the sensations and meanings formed in the representation of unknowns in the solving of word problems containing two unknown items, demonstrating the challenges that beginning algebraic people experience when applying the equality between the unknown items.

Anthropological Theory of the Didactic

The study framework, Anthropological Theory of the Didactic (ATD), was conceived by a French mathematician, Yves Chevallard, in the 1980s with the concept of didactic mathematics translocation and analysis in terms of the nature of knowledge (Chevallard & Bosch, 2020; Utami et al., 2022).

The ATD is a mathematical knowledge epistemological model that can be used to clarify human societies' mathematical activities' relationship to "the didactic," or to all diverse learning factors based on two key concepts: institution and praxeology (Chaachoua et al., 2019). An institution (a producer and supplier of goods and services) is a dependable organization that provides individuals with the material and intellectual resources they need to do specified tasks efficiently (Castela & Romo, 2019). The lack of support from the institution can contribute to an inadequate relationship between the components of the praxeology (Putra, 2016).

The theory of praxeologies is an ATD sub-theory established to address the question, "Where do institutional and personal connections arise from?" In other words, how can we make clear the substance of the personal relationship? How does it emerge to include this but not that? What I need to do, what I do with something, think about it, love it, toss it away, and so on determines my (personal) relationship to the items in my cognitive universe (Chevallard, 2019). To begin as a fundamental instrument for investigating human action, whether mathematical or otherwise, the notion of praxeology is classified as "anthropology" (Chevallard, 2019; Schmidt, 2016). Castela and Romo (2019) describe praxeology as the smallest unit of analysis for any human action (having your launch, walking to school). Adopting an anthropological perspective, praxeologist seeks to accept the didactic whenever it might manifest itself around us, with a particular focus on institutional developments of knowledge and the various decision-making processes to propagate it (Bosch & Gascón, 2014; Chevallard & Bosch, 2020).

Dorier and García (2013), Putra (2016), and Diego-Mantecón et al. (2021) use Chevallard's ATD as a theoretical basis to organize their analysis into four levels of institutional systemic that evaluate any human behaviour, composition, and didactical aspects in solving practical word problems in mathematics integrated into our diverse community, schools, and our everyday lives.

Physical processes of mathematics problem-solving practices in an anthropo-didactic method, according to Marchive (2005), are the result of a dual structuring process: didactic composing around knowledge transmission and the social "responsibility" that the main characters face (teaching for the teacher, learning for the student); and anthropological composing around the non-didactic conditions through which this knowledge is transferred (a form of school, family culture, status and role of those concerned, pedagogical convictions, value system, and so on).

Rodríguez et al. (2008) and Grigoraș et al., (2011) express how the Anthropological Theory of the Didactic (ATD) plays a vital role in research by providing new methods for thinking about practical problems, primarily by changing them into mathematical issues that can be defined, characterized, and handled more easily. For this reason, recognizing the populace's specific tactics that differ from school mathematics has a high potential for equality, which is connected to the political aspect of ethnomathematics, which D’Ambrosio (2001) emphasizes as the most essential. In a systematic approach, the study adopts the sense that would not focus on teachers as people, curricula, teacher training organizations, or textbooks themselves, but rather lay emphasis on how citizens use their techniques and technology acquired either through mathematics learning or diverse cultural understanding to come up with some solutions to practical word problems (Albanese, 2021).

Ethnomathematics as a study program is new around the globe and, for that matter, in Africa (Pradana et al., 2022). Many researchers have now shifted their focus to this area of mathematics education research, but little or no research has been conducted in Ghana using an anthropo-didactic approach to discover the techniques and technology used by the diverse citizens to solve real-life word problems outside of school mathematics learning. In particular, research on how the masses who have completed school or have never attended school uses their cultural intuition in conjunction with school pedagogy to respond to practical, real-life mathematical problems that occur in their homes and workplaces, which may be relevant to classroom mathematics instruction.

Research objectives and research question

For this study, we examined the methodologies used by the masses to assess mathematics in real-world contexts to identify the contributions of school mathematics and ethnomathematics to out-of-basic school mathematics through practical word problems. The researchers examined a real-world setting in which mathematics is essential to find such linkages. As stated above, the purpose of this research is to discover the mathematics that arises in real-life circumstances and to analyze how individuals use such mathematics by addressing the research question:

- What forms of mathematical knowledge do working-class individuals acquire in various real-world contexts?
- How are out-of-basic school and classroom mathematical knowledge related?
- Can a greater understanding of various types of ethnomathematical knowledge provided by low-educated individuals be beneficial to educational practices?

Conceptual framework

The study examined how working-class individuals exploits their out-of-basic school knowledge to solve word problems, focusing on praxeologies, in the ATD to interpret knowledge types, techniques, and usage. Every praxeology is composed of four components: type of tasks (T_i), that is the word problem; technique (τ_i) the approach to solving the problem; technology (θ), used to explain the technique in solving the word problem; and theory (Θ), to justify the technology (Chevallard & Bosch, 2020; Putra & Witri, 2017). They are further subdivided into a praxis (practical) block (task (T_i) and technique (τ_i)) and a knowledge block (technology (θ_i) and a theory (Θ_i) (Berggren et al., 2023; Diego-Mantecón et al., 2021; Putra, 2016, 2019).

Taking into account "out-of-basic school mathematics" (I^o) as an institution, and the praxeologies, ($T_i, \tau_i, \theta_i, \Theta_i$) for any given task ($T_i$), it requires ($\tau_i, \theta_i, \Theta_i$) to come out with a practical and epistemological development in solving the problem. Because the theory(Θ_i), justifies the technology (θ_i), for any giving (T_i), it requires (τ_i, θ_i). Hence, the model can be presented as $I^0, [T_i \longrightarrow (\tau_i, \quad \theta_i)], \ \forall\, i = \overline{1,4}$ and can be expressed as:

$$I^O, \begin{bmatrix} T_1 & \rightarrow & (\tau_1, & \theta_1 & \Theta_1) \\ \vdots & & & \vdots & \\ T_4 & \rightarrow & (\tau_4, & \theta_4 & \Theta_4) \end{bmatrix} \Rightarrow I^O, \begin{bmatrix} T_1 & \rightarrow & (\tau_1, & \theta_1) \\ \vdots & & & \vdots \\ T_4 & \rightarrow & (\tau_4, & \theta_4) \end{bmatrix}$$

Methods

Research design

This study employed a basic mixed method design described by Creswell (2015) and Creswell and Plano Clark (2011). According to Creswell and Plano Clark (2011), robust quantitative studies investigating the strength and frequency of concepts, as well as robust qualitative research investigating the interpretation and comprehension of concepts, are used in mixed methods. This design is distinguished by the collection of two data sets to allow findings to be reached from a single research project using quantitative data analysis and corroborated using qualitative data analysis or vice versa (Creswell & Plano Clark, 2011). Because the study is focused on the social and etymological heritage of mathematical understanding, in addition to what is learned in basic school and how that knowledge is implemented in our daily lives, the mixed method would be an ideal approach to studying out-of-basic school mathematical knowledge, especially with participants who have previously been kept away from the education system. Furthermore, the research design allowed for the integration of ethnomathematics, school and out-of-basic school mathematics, and didactic elements.

Population

In Ghana, mathematics, which includes algebraic sessions, is mandatory at all basic school levels, which is completely free for all her citizens. As a result, all Ghanaians, regardless of their education level, are expected to use their classroom mathematics to solve practical word problems even beyond junior and senior high (SHS) schooling. To highlight the link between out-of-basic school and classroom mathematics knowledge, the study centered on working-class individuals, assessing how much of their basic school algebra remains relevant up to date. In addition to above-targeted population with some level of basic education, the researchers wanted to hear from respondents who have never attended school or dropped out before junior high school (JHS) to study the various types of ethnomathematics knowledge used in solving practical mathematics problems that would be beneficial to educational practices. Above all the geographical location of the Ashanti Region of Ghana and its capital, Kumasi, which is well known for its highly cosmopolitan status where varied people live and work, makes the city an ideal place to consider the study population.

Sample size and sampling techniques

Researchers purposively sampled workers from some institutions like the Manhyia Government Hospital, Old-Tafo Divisional Police Station, Kofi Agyei SHS, Bampenase, and AAMUSTED, to assess the relevance of school mathematics in respondents' daily life. The study also aimed to assess the ethno-aspect of problem-solving by low-educated individuals at Kumasi City Mall and Kejetia Market Centre. In all, sample size of 298 respondents from the working class population in addition to 7 respondents (4 male and 3 female) that were interviewed for the qualitative aspect of the study. Although the individuals chosen are not typical of the entire population, the situation in which they are connected is suitable for answering our questions about the study objectives.

In total, twelve of the 298 prospective active respondents were excluded from the final analysis due to insufficient responses to the questionnaire, resulting in a response rate of 95.97%. As a result, the final sample size for the study is 286 people (177 men and 109 women), drawn at random from all of the outfits. The majority of females were hesitant to respond to the questionnaire, and it is not remarkable that male respondents exceeded female respondents by 23.8%. The majority of responders (35.3%) are between the ages of 36 and 45, with the least (11.2%) being above the age of 50.

Table 1. Demographic statistics

Measure	Category	Freq (N)	Percent (%)
Gender	Male	177	61.9%
	Female	109	38.1%
	Total	286	100.0%
Age	16 - 25	48	16.8%
	26 - 35	51	17.8%
	36 - 45	101	35.3%
	46 - 55	54	18.9%
	50 +	32	11.2%
	Total	286	100.0%
Highest Level of Educational	Primary	1	0.3%
	JHS	27	9.4%
	SHS	182	63.6%
	Tertiary	76	26.6%
	Total	286	100.0%
Number of Years after School	0	0	0.0%
	< 5	85	29.7%
	5 - 14 yrs	55	19.2%
	15 - 24 yrs	44	15.4%
	25 - 34 yrs	56	19.6%
	35 - 44 yrs	34	11.9%
	>45 yrs	12	4.2%
	Total	286	100.0%

The study sought to reveal the highest point in education at which the respondents last entered school to learn classroom mathematics. Apart from six out of the seven interviewees that had a highest level of education below primary school, there was a respondent that also has a primary education as the highest education level. Aside from that, the majority of respondents (63.6%) had completed SHS, followed by tertiary (26.6%) and JHS (9.4%). Because the study is interested in how a diverse community solves practical problems after school, the sample was able to target 286 respondents who are currently not at school with some completed for less than five years (29.7%), over twenty-five to thirty-four years (19.6%), five to fourteen years (19.2%), fifteen to twenty-four years (15.4%), thirty-five to forty-four years (11.9%), and more than forty-five years (4.2%) in descending order.

Olivia, Adongo, Justice, Mumuni, Adu, Pinamang, and Polo are the participants whose coded responses from the in-depth interview were persuasive enough to be chosen and analyzed in the respective Task $\left(\mathrm{T}_{\mathrm{i}=\overline{1,4}}\right)$. Olivia sells phone cards at Kejetia Central Market. She is only twenty-three years old and was unable to finish junior high level one for undisclosed reasons. Mad. Adongo is a 64-year-old trader at the Kumasi central market from Ghana's upper-east region. She left school in "class four" (primary four) and has been in Kumasi since 1982. Justice is a twenty-nine-year-old elementary school graduate who works as a driver's assistant on the Kejetia-Kokoben route. Mumuni is thirty-five years old. He is an elementary school dropout who works as a cleaner at Manhyia Hospital. Mr. Adu, a fifty-five-year-old security guard at the Prudential Bank's Adum Branch, had never attended school. Maame Pinamang is 47 years old, has never attended school, and was trained as a fishmonger in her early years at Asante Mampong. She continues to sell fish in Kumasi Central Market. Mr. Polo, is a Suame magazine vehicle technician who has never attended school in his fifty-three years of existence.

Data collection instruments

The administration of interviews and questionnaires would aid in gathering information regarding praxeologies, particularly the mathematical technique (τ_i) and mathematical technologies (θ_i) employed in solving practical life situation tasks (T_i). The data was collected by the researchers on regular working days in September and October 2022. The interviewer assumed a passive position, acting to seek answers to the established questions and taking notes on the interaction between the general public throughout the interview process. To gain a deeper understanding of the pragmatic elements used by the general public, questionnaires were distributed to the selected areas, which targeted hospital workers, teaching and non-teaching staff, police staff, pre-service teachers, and the general public at large. Before collecting the questionnaires from the responders in the process of validating their data, the researchers ask them if their responses reflect their full potential or if they would need extra time to complete the tasks. The researcher also gathered personal information from the participants for data analysis purposes (e.g., gender, age, educational level, and number of years after last school attended). After the interviews, the recorded data was translated from Asante Twi to English before coding. The datasets of essential concepts and notions were coded under their respective tasks (T_i) during the coding procedure.

Data analysis approach

The respondents, drawn from a population outside the basic school system $(\mathrm{I}^{\mathrm{o}})$, were given four practical word problem tasks $\left(\mathrm{T}_{\mathrm{i}=\overline{1,4}}\right)$ designed to explore their respective techniques $\left(\tau_{\mathrm{i}=\overline{1,4}}\right)$ and technologies $\left(\theta_{\mathrm{i}=\overline{1,4}}\right)$ used in interpreting mathematics in real-world contexts.

Although the tasks appeared to address similar types of praxis, they were purposefully selected by the researchers based on varying levels of knowledge complexity (levels one to four) required from the respondents. This approach aimed to surface any ambiguities that could lead to technological discussions, suggest alternative approaches, or prompt the formulation of mathematical expressions - ultimately providing technical insights into the relationships among school mathematics, ethnomathematics, and mathematics acquired outside the formal education system. The kinds of tasks (T_i) in this study, T_1, T_2, T_3, and T_4, sought from the respondents their respective technique τ_1, τ_2, τ_3 and τ_4, and technology θ_1, θ_2, θ_3 and θ_4 to complete with the theory Θ_1, Θ_2, Θ_3, and Θ_4 to justify $\theta_{i=\overline{1,4}}$.

The praxeology reference model for the tasks $\left(T_{i=\overline{1,4}}\right)$ can be written as follows:

T_1: According to your wife, who is yet to start giving birth, her senior sibling already had 3 children. Your wife can give birth to 3 children every five years, whereas her sibling can only produce 2 children per five years. How many years will it take your wife to catch up with her sibling?

T_2: You and your business partner, Oppong together invested ₵5,200.00 in a business and agreed to share the profit in the ratio of their investments. You receive ₵500.00 and Oppong ₵800.00 as profit at the end of the first year. How much did each invest?

T_3: A contract job was awarded to a man for 30 days. He was to receive a fixed amount of ₵1,500.00, less ₵20.00 for every day he was absent, and an additional ₵15.00 for every day he worked. How much did he earn if (a) He worked for 30 days continuously, and (b) He worked for only 27 days?

T_4: As an assembly member in your area, a man has been accused of stealing ₵100.00 bill from a store's register. He then buys ₵70.00 worth of goods at the same store using the ₵100.00 bill and gets ₵30.00 change. How much money did the store owner lose if you were to collect the money for the owner?

The study then necessitate the knowledge block, which comprises a technology ($\theta_{i=\overline{1,4}}$), required to interpret the practical block ($T_{i=\overline{1,4}}$, $\tau_{i=\overline{1,4}}$), and a theory ($\Theta_{i=\overline{1,4}}$) to defend $\theta_{i=\overline{1,4}}$ from the responders (Putra & Witri, 2017). In this regard, the respondents require some techniques (τ_i) to complete these tasks (T_i). Because those tasks are more concerned with didactical organization, the techniques can be more challenging to develop or express to others (Putra, 2016). Barbé et al. (2005) noted that an actual didactic process would eventually illustrate how certain mathematical and instructive variables affect the internal workings of the didactic process. This implies that an anthropological perspective assumes any 'style of solving' to get the problem solved needs the development of a technique.

Table 2: Ways respondents presented the praxeology

Task (T_i)	Technique ($\tau_{i=\overline{1,4}}$)	Technology ($\theta_{i=\overline{1,4}}$)	Theory ($\Theta_{i=\overline{1,4}}$)
T_1	Cumulative Table Representation, verbal expression, mathematical object representation	Addition comparison, multiplication, finding object represented	Linear equation, algebraic expression, comparison of numbers, cumulative frequency
T_2	Mathematical object representation	Changing ratio into fraction, part of a whole, part of a fraction, multiplication of a whole number by a fraction, addition and subtraction, finding object represented.	Application of fractions, ratio and proportion, algebraic expression
T_3	Mathematical object representation	Addition and subtraction of expressions, object substitution, product of expressions	Algebraic expression, linear equation
T_4	Verbal expression	Addition comparison, addition and subtraction	Business Mathematics, logical reasoning, algebraic expression

Meanwhile, the researchers learned from the respondents that: cumulative table representation, verbal expression, and mathematical object representation were the common techniques ($\tau_{i=\overline{1,4}}$) used; addition comparison, multiplication, changing ratio into fraction, part of a whole, part of a fraction, multiplication of a whole number by a fraction, finding object represented, addition and subtraction of expressions, and product of expressions were the technologies ($\theta_{i=\overline{1,4}}$) used; and linear equation, algebraic expression, number comparison, cumulative frequency and application of fraction were the theories ($\Theta_{i=\overline{1,4}}$) used to justify the technology (Table 2).

Data Analysis

Techniques and technologies employed by respondents

The four aspects (T, τ, θ, Θ) are linked to serving as a comprehensive approach to studying respondents' knowledge. All of the approaches and technologies were exact replicas of the responders' notes. Before displaying the replicas of their notes, the most commonly utilized steps for the particular task have been expressed. The techniques for Task One (T_1) have two alternative techniques and technology employed by most respondents. (τ_{11}) involves cumulative table representation.

Years		Wife		Sibling	
Count	Cum. Sum	Count	Cum. Sum	Count	Cum. Sum
0	0	0	0	3	3
5	5	3	3	2	5
5	10	3	6	2	7
5	**15**	3	**9**	2	**9**

Figure 1. Calculation of Task One (τ_1); A replica of respondents' note

(τ_{12}) technique involved four steps: (1) mathematical object representation for 5 years; (2) express the number of births per 5 years for your wife and sibling; (3) equate your wife expression to that of her sibling and solve for the mathematical object representing the 5 years; (4) Multiply 5 years by the mathematical object representing the 5 years to get the number of years. Likewise, a lot of respondents preferred using sibling and wife instead of characters represented by mathematical objects.

(1)	Let $x = 5\ years$	(4)	No of years = $x(5)$
(2)	$sibling = (2)x,\quad Wife = (3)x$		$= 3(5)$
(3)	$3 + (2)x = 0 + 3(x)$		$= 15\ years$
	$3 - 0 = 3x - 2x$		
	$3 = x$		

Figure 2. Calculation of Task One (T_1); A replica of respondents' note

Aside from the most frequently utilized technique (τ_1), there were several unique approaches that contributed to the outcome. The researchers discovered that some of the respondents had numerous optimal techniques (τ_1) with precise technologies (θ_1) that produced the predicted results, as demonstrated in Figure 3 by examples A, B, C, and D.

In task one (T_1), a few of the responders came up with some unconventional techniques (τ_1) to tackle the provided task, in addition to the standard classroom mathematics notion. This depicts how they grasped the task in their primitive cognitive and presented it based on how their minds conceptualized the technique and added technology (from school) to validate it, which resulted in excellent results.

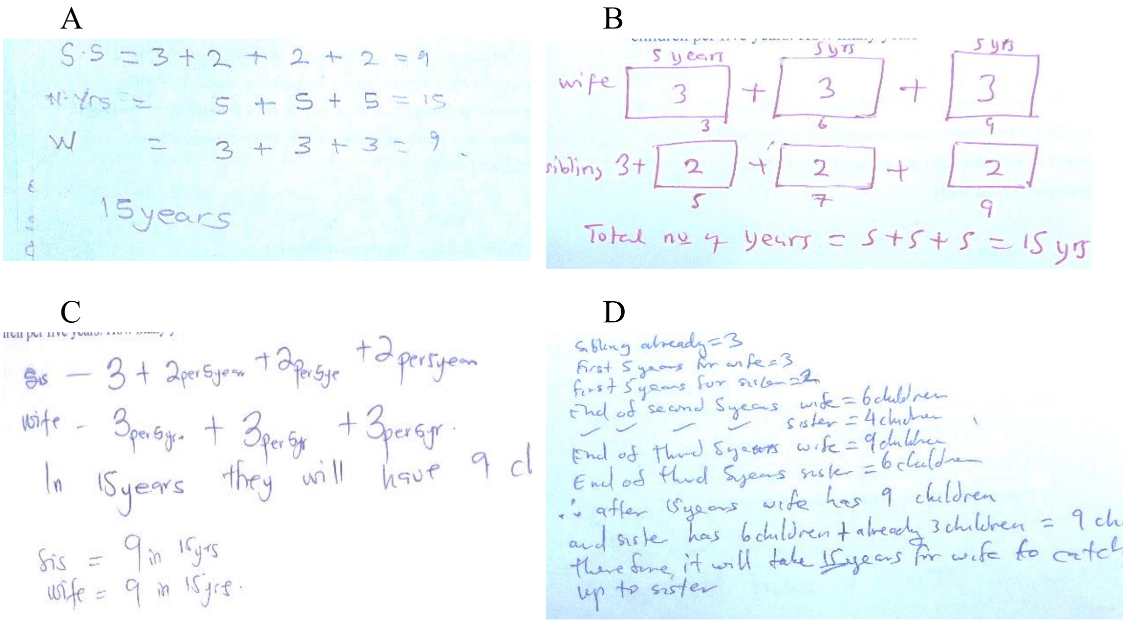


Figure 3. Screenshot of some of the (Task One) responses

For Task Two (T_2), most of the respondents used the theory of ratio and proportion. The technique (τ_2) and technology (θ_2) used involve five steps; (1) mathematical object representation for You and Oppong; (2) Express mathematical object representation for you and Oppong interest in the form of ratio; (3) Find the total ratio; (4) Express mathematical object representation for you and Oppong's ratio as fraction; (5) Express each fraction as a product of their total investment.

(1) Let y= You and $z = Oppong$

(2) $y:z =$ ₵ 500:₵$800 = 5:8$

(3) Total Ratio $= 5 + 8 = 13$

(4) y as a fraction $= \frac{5}{13}$,

x as a fraction $= \frac{8}{13}$

(5) y investment $= \frac{5}{13} \times$ ₵5,200

= ₵2,000.00

z investment $= \frac{8}{13} \times$ ₵5,200

= ₵3,200.00

y = Your investment = ₵2,000.00

z = Oppong's investment = ₵3,200.00

Figure 4. Calculation of Task Two (T_2); A replica of respondents' note

After critically analyzing some of the T_2 responses, the researchers observed from Figure 5 that response E had a technique (τ_2) but omitted most of the technologies to attain the final result. Response F lacked both technique (τ_2) and technology (θ_2) but "miraculously" achieved the desired outcome. It was discovered that using the improper technique would result in an erroneous outcome. A typical example is Response G, which adopted a θ_2 based on the most suitable τ_2 available to the respondent yet produced incorrect results. The respondent has a technique (τ_2), good technology (θ_2), and a correct result in response H.

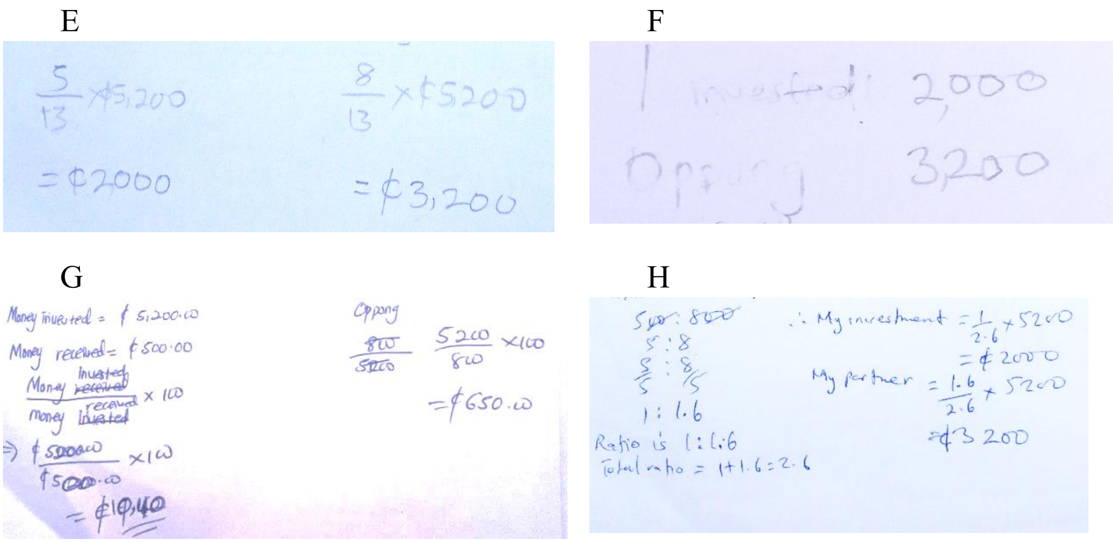


Figure 5. Screenshot of some of the (Task Two) responses

The technique and technology mostly used for Task Three (T_3) involves five steps; (1) mathematical objects representation for the number of days he worked, was absent and total amount earned; (2) Express mathematical objects representation for the number of days he worked and absent in money terms; (3) Express the mathematical object representation for total amount earned in terms of the number of days he worked and that which he was absent. This will give you a general equation for the total amount earned; (4) Substitute 30 working days which implies 0 day absent into the general equation obtained for the total amount earned to get the answer for T_{3a}; (5) Again Substitute 27 working days which implies 3 days absent into the general equation obtained for the total amount earned to get the answer for T_{3b}.

(1) Let number of days worked $= a$,
number of days absent $= b$, and

Total amount earned $= c$

Fixed amount $=$ ₵1,500.00

(2) Amount earned for days worked= ₵$(15 \times a)$
Amount earned for days absent= ₵$(20 \times b)$

(3) $c = fixed + days\ worked - days\ absent$

$c =$ ₵1,500 + ₵$(15 \times a)$ − ₵$(20 \times b)$

(4) (a) When $a = 30$ and $b = 0$

$c =$ ₵1,500 + ₵(15×30) − ₵(20×0)

$c =$ ₵1,500 + ₵450 − 0

$c =$ ₵1,950

(5) (a) When $a = 27$ and $b = 3$

$c =$ ₵1,500 + ₵(15×27) − ₵(20×3)

$c =$ ₵1,500 + ₵405 − ₵60

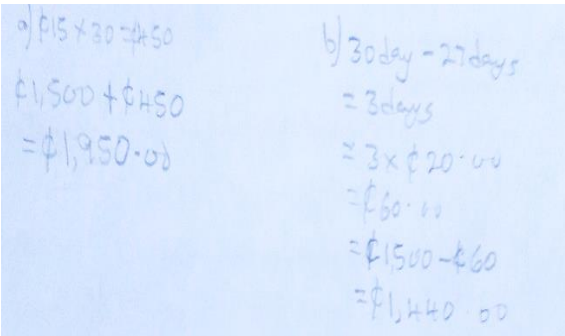
$c =$ ₵1,905 − ₵60

$c =$ ₵1,845

Figure 6. Calculation of Task Three (T_3); A replica of respondents' note

According to the responses for T_3 in Figure 7, Response I had a good technique (τ_3) but the technology (θ_2) was incorrect for only T_{3b}. In Response J, the respondent correctly identified both technique (τ_2) and technology (θ_2) resulting in a correct result.

I



J

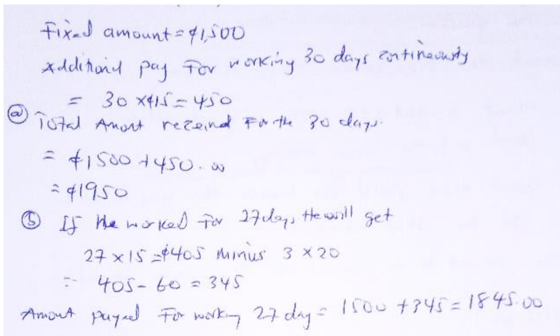


Figure 7. Screenshot of some of the (Task Three) responses

Finally, the task four (T_4) also involves with four steps; (1) Find the total cash out from the store; (2) Find the cash that come into the store register; (3) Subtract total cash in from total cash out to get the amount to be collected for the shore owner.

(1) $Total\ Cash\ out = Stolen\ Amount + Goods\ stolen + Change$

$$Total\ Cash\ out = ₵100 + ₵70 + ₵30 = ₵200$$

(2) $Total\ Cash\ in = \ Amount\ paid\ for\ the\ goods$

$$Total\ Cash\ in = ₵100$$

(3) $Amount\ to\ be\ paid\ to\ the\ store\ owner = Total\ Cash\ out - \ Total\ Cash\ in$

$$Amount\ to\ be\ paid\ to\ the\ store\ owner = ₵200 - \ ₵100$$

$$Amount\ to\ be\ paid\ to\ the\ store\ owner = ₵100$$

Figure 8. Calculation of Task Three (T_4); A replica of respondents' note

Response from participants interview

Participants such as Olivia, Adongo, Justice, Mumuni, Adu, Pinamang, and Polo provided some impressive responses that will be analyzed in the respective task $\left(T_{i=\overline{1,4}}\right)$ to determine whether there is a growing realization of different kinds of enthomathematics knowledge at their disposal that would be desirable to educational practices. This section reports on the reactions that appear to contribute positively to the study's conclusions. None of the seven respondents attempted to answer to T_2. However, only Justice and Polo responded to T_3 with a technique that can be evaluated using school mathematics.

Based on our interview, Mr. Adu was able to respond to T_1 with some demonstration on the floor. Below are excerpts from Mr. Adu's interview and observations:

Observation from (T_1)

Mr. Adu divided the floor into two and called his left-hand side "Me Yere," meaning "my wife," and the right-hand side "Ne nua," which means "her sibling. He requested that the interviewer repeat the question, to which he complied. He then proceeded in search of an unknown number of stones and inquired further about the individual, who already had three children. According to the interviewer, it was the sibling. He placed three stones on the "Me nua" side, which is unusual. Mr. Adu switched the number of births for the two ladies every five years, and the interviewer corrected him. He places two stones on the left and three on the right while watching intently. He then took five more stones and placed them in front of him. After a brief moment of reflection, he repeated the action, counting the stones on both sides and murmuring. When I asked him how many stones he had collected, he told the interviewer that he was left with one stone to balance it. Later, he recommended that we add a stone on each side, but the interviewer reminded him that the difference would remain the same, so he backed down. He repeated the previous actions and counted them again. With a sigh of relief, he exclaimed, "I have nine on both sides." To motivate him, the interviewer gave him a thumbs-up. The interviewer asked him about the number of years, to which he counted all the stones in front of him and said ten years. However, the interviewer reminded him to add the last five stones to it, so he went for extra stones to make up for the insufficient stones remaining and finally offered the answer of 15 years.

Mr. Adu expressed himself very well in his local dialect, "Twi." After reaching a decision, he came up with a plan (τ_1) that required stones to carry out (θ_1), and at the end of the process, he got a result. Although he is unsure of what theory his illustration relates to, he has delivered as planned. This demonstrates proper mathematical concepts developed outside of school by solving a real-life mathematical word problem with an ethnomathematics technique by using primitive instruments such as stones, the floor, and the local language.

The narratives from (T_1)

Adongo: Well because the elder sister already has three children, she will get five, while the wife will get three in five years. It will go to seven and the wife, and six children. She then swiftly said fifteen years.
Interviewer: How could you get to fifteen so quickly?
Adongo: In fifteen years, each of them will have nine offspring.

Even though she did not write or illustrate it like Mr. Adu, Adongo likewise demonstrated her internal ethnomathematics experience in this task, comparable to written Responses A, B, and C in Figure 3. Although Adongo did not explain the conclusion part of her explanation, she was able to devise a technique and verbally apply the technology to achieve a result.

The narratives from (T_3)
Polo: For the first part (a), you will add ₵15 to ₵1500 to get ₵1515 and for (b), oh is simple, the answer is ₵1480. **Interviewer:** Tell me about how you managed to get the ₵1480. **Polo:** It is just a matter of subtracting ₵20 from ₵1500. That is all.
Justice: As for me, I will add ₵15 thirty times and add it to the ₵1,500. **Interviewer:** Please tell me the answer. **Justice:** Let him compute it himself. **Interviewer:** What if he only worked for twenty-seven days? **Justice:** Oh! just add ₵15 twenty-seven times and add it to ₵1,500 to get the answer.

In Task (T_3), to the best of Polo's ability, he attempted to generate a result by devising a technique, but either his technology was poorly performed or his technique contained flaws. On the other hand, Justice had a perfect technique and the correct technological implementation but was unable to produce an answer for task (T_{3a}). However, this time, there was an error in his technique that did not work out for task (T_{3b}) technology. The interviewer saw some peculiarity in the mathematical knowledge possessed by both interviewers in their technique, which led them to believe that the task was part of their daily life activities and could be readily solved. However, technology exposed Polo's incorrect technique choice. But it validated Justice's approach to task (T_{3b}), which may have delivered a proper result if he had access to any technological means to generate a conclusion.

The narratives from (T_4)
Olivia: The correct answer is ₵100. **Interviewer:** Please tell me how you got the ₵100. **Olivia:** I got ₵100 since he returned the same amount, he stole to the store in exchange for items worth 70 and a change of 30. These are made up of ₵100. **Mumuni** responded in the same manner.
Justice: The thief was given ₵30 in addition to the ₵100 stolen. Therefore, the assemblyman will collect ₵130 from the thief.
Pinamang: The thief has already taken ₵100, spent ₵70 on things, and earned ₵30 in change. As a result, the assemblyman will collect ₵200 for the storekeeper in total. This corresponds to **Mr. Adu's** response.

All three, Justice, Pinamang, and Mr. Adu, experienced problems with their praxeological aspects after applying a technology that was based on erroneous techniques and produced an improper result. On the other hand, Olivia and Mumuni had both technique and technology correct and produced their initially predicted outcomes.

Respondents Findings

Table 3 summarizes the percentages of 286 respondents praxeology elements inside tasks $\left(\mathrm{T}_{\mathrm{i}=\overline{1,4}}\right)$. An average of 5.3% did not react to some of the tasks despite having responded to others. Notable among them was T_3 (8.4%), followed by T_2 (5.6%). T_1 (97.2%) attracted the respondents' curiosity, followed by T_4 (95.5%). 61.6% of the total respondents were able to adapt to some optimal techniques, but only 33.2% were able to execute the techniques to produce the correct response. Although 70.6% and 60.8% of respondents were able to adopt good techniques for Task T_1 and T_2, respectively, only 42.7% and 37.4% correctly executed the techniques τ_1 and τ_2 to reach their respective correct solutions.

Table 3. Respondents Praxeologies Summary

Task	No. of Questions		Optimal Technique (%)	Issues Related to Praxeological Elements: No Technique (%)	Issues Related to Praxeological Elements: Incorrect Implementation of Techniques		Correct Implementation of Technique (%)	Correct Response with no Technique and Technology (%)
	Responded (%)	Not Responded (%)			Errors related to techniques (%)	Errors related to technologies (%)		
T_1	97.2%	2.8%	70.6%	26.6%	23.8%	4.2%	42.7%	9.4%
T_2	94.4%	5.6%	60.8%	33.6%	17.1%	6.3%	37.4%	2.4%
T_3	91.6%	8.4%	42.7%	49.0%	15.4%	11.9%	15.4%	4.5%
T_4	95.5%	4.5%	72.4%	23.1%	29.7%	5.2%	37.4%	16.8%
Average	94.7%	5.3%	61.6%	33.0%	21.5%	6.9%	33.2%	8.3%
Total	100.0%		94.7%		61.6%			

Task T_3 seems to be pretty tricky for the respondents. It had the lowest response rate of 91.6%. 42.7% of those who responded were able to come up with an ideal technique, whereas 49.0% had no technique to accomplish the task, yet 4.5% got their responses correct. Only 15.4% of those with the ideal solution correctly executed the technique, with 11.9% having faults in their technologies when implementing the technique. There were also some problems with the praxeological elements. Surprisingly, while 33.0% of respondents did not use any ideal technique in solving the respective tasks, 8.3% of them managed to write correct answers only. Among these group of respondents, those who solved T_4, recorded the highest (16.8%) provision of straightforward answers without using any technique or technology followed by T_1.

The majority of respondents had various optimal mathematical techniques, however, 21.5% of them failed to implement them owing to flaws in their techniques. Furthermore, some (6.9%) possessed a decent technique but were unable to adapt to a good technology due to technique implementation flaws. This was most prevalent in task three (θ_3), with 11.9% of respondents experiencing technological difficulties followed by (θ_2). Of all the 72.4% respondents that presented an ideal technique for T_4, it was surprising to note that as many as 29.7% had some errors related to their choice of technique (τ_4) and very few (5.2%) had errors relating to their technology (θ_4).

Discussion

This study evaluates the methodologies used by the masses to assess mathematics in real-world contexts to determine the contributions of school mathematics and ethnomathematics to out-of-basic school mathematics through practical algebraic word problem-solving. The 286 respondents from the masses demonstrated real enthusiasm in responding to the four tasks $\left(\mathrm{T}_{\mathrm{i}=\overline{1,4}}\right)$ offered through interviews and questionnaires, indicating support for the institution, out-of-basic school mathematics (I^o) (Putra, 2016).

Connecting knowledge and practice to make the proper choice to discover a suitable technique can be challenging at times, making them the main impediments to mathematics problem-solving. Confirming Barbé et al. (2005)'s anthropological approach notion that every method of doing any activity or resolving any problem necessitates the presence of technology, the study found that respondents who did not have any optimal techniques encountered difficulties in getting an accurate response to the task. However, there were several instances in which 8.3% of the 33.0% responders who lacked technique and technology provided the right, easy responses, with as many as 16.8% out of 23.1% coming from T_4 followed by T_1 (9.4% out of 26.6%). The questions still remain: how were they able to come up with the answer? Were they finding it difficult to express themselves? Which intuitive knowledge, whether it be ethnomathematics or classroom mathematics, was employed to get the correct response? There is still a puzzle left to uncover, as rightly put forward by Chevallard (2019).

The techniques used, by default, revealed whether the respondents used school mathematics or an ethnomathematics method of problem solving. The study also found that 61.6% of respondents came up with an appropriate technique, but not all of them correctly implemented it to obtain the desired result. For the 33.2% out of 61.6% who came out with the desired results, the researchers observed that the majority of them used mathematical objects to represent the characters in the given task before applying other mathematical technologies, as presented in Figures 2, 4, 6, and 8. The responders' approaches adopted Godino et al.'s (2007, 2011) and Godino and Batanero's (1998) concepts, which confirm how the masses continue to use their classroom mathematics even when they are not in school.

It was worth noting that not all working-class people rely on their "western" acquired mathematics abilities but instead combine some ethnomathematics that connect to school mathematical principles, supporting Karen's (2007) assertion. There was some evidence of alternative techniques being followed to tackle the supplied tasks $\left(T_{i=\overline{1,4}}\right)$, in addition to the normal school mathematics notion, as seen in all of the cases in Figure 3, confirming the Albanese (2021) and Karen's (2007) point of view concerning the links between cultures and mathematics. These findings corroborate those of Barbé et al. (2005), who showed how participants grasped the task in their culturally oriented cognitive state, presented it based on how they imagined the procedure, and validated it using technology (from school), yielding positive results.

In addition to the above findings, the culturally sensitive understanding of mathematics made two interviewers bold enough to respond to T_3 which was even a no-go area for some respondents with higher educational levels. This means that some simple real-world mathematical riddles can be solved using basic ethno-cultural knowledge, myths, idiomatic expressions, languages, and symbols, as indicated by Powell and Frankenstein (1997). However, the lack of certain school mathematical technologies (such as converting a ratio to a fraction, multiplying a whole number by a fraction, mathematical object substitution, and so on) undoubtedly exposed any math knowledge-deficient individual when solving real-life mathematical puzzles. A finding that backs up Booth et al.'s (2014) argument about how tough problem-solving can be since it necessitates critical thinking and expertise in the development of techniques and technologies capable of extracting the solution from the task at hand.

As indicated by Bunge (2003), the excerpts from the interview further revealed how solving word problems appeal to a diverse group of people irrespective of their occupation, culture, and educational level adopt ethnomathematical knowledge in responding to some tasks like T_1, T_3, and T_4. The presentation and justification of T_1 by some interviewers with no or little educational expertise appears to be of great significance to mathematics educational practices as suggested by Karen (2009). Marchive's (2005) anthropological composition of the non-didactic conditions via which this appropriate ethnomathematical notions devised outside of school mathematics communicate was showcase by the two interviewers who responded to T_1.

One respondent used the expressions *"Me Yere"* and *"Ne nua"* in his illustration, which are non-symbols but really helped him to showcase the technique and technology that underpins the proof to the outcome, confirming Font et al. (2013) viewpoint on anthropological signs and symbols developed from mathematical practices from a seemingly perspective. This respondent's actions were inadvertently employing Godino and Batanero (1998) axioms suitable for classifying mathematical activity in a framework of mathematical symbols utilized in didactic connections.

In finding out how out-of-basic school mathematical knowledge and school mathematical knowledge related, the study reveals that in all, only 33.2% of the respondents were able to come up with good techniques and technology, despite the fact that an average number (61.6%) of respondents were able to adapt to some optimal school math and ethnomathematical knowledge in solving practical word problems to the best of their abilities. Furthermore, a tiny percentage of respondents (5.3%) did not respond to certain questions, as did nearly one-third of all respondents (33.0%) who had no technique but intended to produce a misleading conclusion. Broadly speaking, the masses made more than the effort to apply their school mathematics and ethnomathematics, but the results were unappealing, which may be due to the global low mathematics competency among both individuals and students, as revealed in the OECD (2015) study.

Limitation and strength

The novelty of this study was centered on how the technique and technological concepts in the anthropo-didactic approach were employed to find certain distinctive ethnomathematics approaches used by the masses in solving practical word problems that were not well established in the published literature. This study added to existing knowledge by presenting ethnomathematics as a potential intervening instructional approach that, if well embraced by educators and students, would make mathematics application much easier and closer to the general populace by leveraging their culture and how they understand things around them in a real-life context. It was very cumbersome to collect data in a problem-solving state, as most of the respondents saw it in the form of a quiz, and time-consuming.

Conclusion and recommendations

The study determined the contributions of school mathematics and ethnomathematics to out-of-basic school mathematics through practical word problems and by evaluating the approaches employed by the masses in assessing mathematics in real-world circumstances. The study also revealed that not all working-class people depend solely on their 'western '-acquired mathematics skills, but rather combine them with ethnomathematics. A lack of certain school mathematical technologies may undoubtedly show implementation errors in some ethnomathematics techniques unless one has an ethnomathematics technology to solve real-life mathematical puzzles. The study also discovered that clear practical application, particularly the representation of characters in word problems with mathematical objects, makes knowledge implementation quite simple in problem-solving. The study also found that some interviewees with no or little educational knowledge used simple available materials to demonstrate the provided task, which appears to be quite important in mathematics instructional methods.

In all, 61.6% of the masses made an above-average effort to apply their school mathematics and ethnomathematics to solving practical word problems, but the results (33.2%) were unappealing.

The researchers recommend that teachers incorporate ethnomathematics elements into their lessons so as to make the students feel the realities of mathematics as well as the belongingness of mathematics in their cultural and historical settings. We again encouraged teachers to substitute characters in mathematical problems with names from students' cultural settings to feel their inclusiveness in mathematics learning. Curriculum developers and implementors should make every attempt to incorporate more practical, real-world-related tasks into the curriculum and lesson design in order to better prepare students for life beyond school.

Future researchers should conduct additional research to examine the approaches used by only the female masses to assess mathematics in real-world contexts in order to determine the contributions of school mathematics and ethnomathematics to out-of-basic school mathematics through any refereed mathematics topic.

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