Situated Perspectives on Creating Mathematics Tasks for Peace and Sustainability

Kwesi Yaro, University of British Columbia
Emmanuel Amoah, University of British Columbia
David Wagner, University of New Brunswick

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Abstract: In this paper we reflect on our experiences teaching and working with mathematics teachers in Canada, Ghana, India, and Swaziland to explore challenges and opportunities for creating mathematics tasks for peace and sustainability. Our exploration of these experiences is oriented around our interest in embedding peace and sustainability into mathematics education following the Sustainable Development Goals identified by the United Nations. We claim that attention to local contexts affords mathematics educators a medium for engaging in authentic, meaningful and context driven mathematics tasks that address issues of local environmental, cultural and societal concerns. However, we argue that globalization has already colonized local communities. The associated "technoscientificity", along with the conservative nature of textbooks, time constraints and the dominant force of poverty remain hindrances in creating mathematics tasks that are issue centric and socially relevant to address concerns of the local community. We end this paper by suggesting a development of a mathematics task to illustrate the possibility of creating what we call a 'situated mathematics task' for students that respond to issues of local community using rural Ghana as a context.

Situated Perspectives on Creating Mathematics Tasks for Peace and Sustainability

In 2015, leaders from around the world agreed upon seventeen goals, called the Sustainable Development Goals (SDGs), as part of the 2030 Agenda for Sustainable Development (United Nations, 2015). These goals focus attention on common needs across nations, societies, and cultures for practices that ensure viable environmental and social structures with consideration of people's needs for economic viability. Building on the above, UNESCO in 2016 signed a declaration on education, which was inspired by "a humanistic vision of education and development, based on the principles of human rights and dignity, social justice, peace, inclusion and protection" (p. 24).

As mathematics educators and researchers, we believe employing critical perspectives in the teaching and learning of mathematics could be an effective response to the myriad national and international social, political and ecological challenges humanity faces today. We emphasize that sustainable development as described in the SDGs includes the goals of peace and good citizenship, going beyond some conceptions of sustainability that focus on the environment. Of course, peaceful coexistence needs a healthy environment, and sustainable environments depend on peace (war destroys ecosystems). The UN resolution motivates attention to concerns for peace and sustainability, though these concerns would be important even without a UN resolution.

In this paper, we draw on our range of experiences teaching and working with mathematics teachers in Canada, Ghana, India, and Swaziland to consider challenges and opportunities for creating mathematics tasks for peace and sustainability. Each of these contexts has a history of British colonialism but this history has played out differently in each location, perhaps relating to relative wealth and poverty. The experiences we draw upon were not research contexts. Rather, they involved collaborative work with local mathematics educators, working together toward practical goals. Thus this paper is not organized around data, but rather built on our experiences as educators, described in ways that avoid identifying particular collaborators. We draw on our experiences teaching and working with teachers in these four countries to discuss challenges of creating situated mathematics tasks for peace and sustainability. We close the paper by exploring possibilities of creating math tasks that respond to the needs of local context of the students, which we consider appropriate for any of these contexts. However, we focus on Ghanaian contexts for the developed examples or tasks in this paper. The issues and challenges we identify extend to the other contexts we have worked in as well.

This paper begins with a consideration of how mathematics could be positioned within the traditional natural science school subjects, with an interest in peace and sustainability. The letter M in the STEM acronym relates to that positioning. Next we identify the challenges we have faced when working to support educators in Canada, Ghana, India, and Swaziland with an interest in peace and sustainability.

1. Reconceptualizing and Repositioning the M in STEM for Peace and Sustainability

In mathematics education, scholarship has been addressing concerns for social justice in various ways, usually under the umbrella of critical mathematics education (e.g., Bartell, 2013, Coles, Barwell, Cotton, Winter & Brown, 2013, Gutstein, 2012, Skovsmose, 2018, Wager & Stinson, 2012). We build from recent cross-cultural work that follows in this tradition, spearheaded by the Mahatma Gandhi Institute of Education for Peace and Sustainable Development, which supports the development of discipline specific teaching resources for making peace and sustainability the heart of teaching (e.g., UNESCO, 2017). The mathematics-focused part of that work identifies 15 interrelated guidelines for embedding peace and sustainability into mathematics education (italicized in the following paragraph). We focus on the guidelines that are most specifically related to task design, but the others are important especially for the pedagogy.

The guidelines encourage authors of mathematics teaching resources to *use real contexts*, as opposed to imaginary ones "to support the message that mathematics is a useful tool for addressing human physical needs in sustainable ways" (UNESCO, 2017, p. 50). The focus should be on *current issues* to "inspire students to consider how mathematics may be a useful tool for sustainable development in their own contexts" (p. 50). In mathematics applications, contexts are often simplified to make the mathematical concepts more clear, but the guidebook

encourages resource authors to *pursue complexity*. “Oversimplification may suggest that the mathematical abstractions are more important than the contexts they were invented to address, or that mathematics cannot handle real complexity” (p. 50). Related to this it is important to use *real data*. When resources point students to sources of current data “they develop the skills and confidence for doing this when they face sustainability challenges outside school” (p. 50). Further, in these real contexts, it is important to *draw attention to human activity*, particularly the choices people make with their mathematics. In this, the guidebook encourages that resources and teachers “identify people from diverse demographic groups (especially marginalized ones) [using mathematics] so students can visualize themselves using mathematics” to address social and environmental issues in their communities” (p. 50). With contexts that embrace the complexity, *interdisciplinarity* is unavoidable. The guidebook encourages explicit identification of the interdisciplinarity.

We will focus on two concepts from these guidelines because they relate to the challenges we will be outlining below. First, interdisciplinarity is a necessary result of foregrounding context in mathematical activity with a particular focus on the M in STEM—mathematics viewed from an interdisciplinary perspective. The UNESCO-MGIEP (2017) document from which we draw our inspiration conceptualises interdisciplinarity as “issue-centric approaches to identifying socially relevant real-world issues with curriculum content to engage students with wider issues of sustainable development” (p.24). By relating children’s learning to real word issues bordering the spheres of social, political, economic, and ecological or environmental, learners are “able to analyse a complex topic in more than one subject” (p. 24). Such an approach is a clear departure from the discipline driven curriculum where subjects (mathematics, language, social studies and so on) are compartmentalised and studied as individual subjects or disciplines. Such context-oriented curricula in itself (connecting to the seventh item in the list above) is a precursor for discussing issues of sustainability and peace in in-depth and authentic ways. This means that students, through systematic inquiry, construct their own meaning and produce knowledge that has immediate social value in making a judgment on a specific issue that is real and meaningful to them (Newmann, Secada and Wehlage, 1995). A move toward interdisciplinarity adjusts the M in STEM by reconfiguring its relationship with the disciplines around it.

Second, real issues in local contexts make mathematics learning meaningful. We argue that in addition to making tasks address local contexts, the process of creating such tasks needs to be attentive to local cultures. We note that attention to local culture, local community concerns, and the local environment does not ignore global perspectives because local issues are connected to global ones, whether these are environmental or social issues. The SDGs may be viewed from a global perspective or a local one but, we argue that the local perspective is most important for mathematics learning. For example, one of the SDGs is “no poverty”. We probably all wish for no poverty in the world. To engage students in activities that help them understand poverty and understand possibilities for addressing poverty, we argue that local poverty is the best starting point. Understanding poverty in the local setting gives students a window into more global issues relating to poverty. The same goes for all the SDGs. This turn to local contexts may seem like a departure from mathematics’ characteristic interest in abstraction.

Thus, the M in STEM is reconfigured to adjust our view of mathematics and to adjust its relationship with the contexts around it. Mathematics is positioned as responsive to particular contexts, which challenges the view of mathematics as abstract. And mathematics is positioned in relationship with other disciplines in response to particular contexts, which challenges the view of mathematics as an independent discipline.

2. Challenges for situated mathematics

We have each led and been part of work with teachers and teacher leaders in various contexts in Canada, Ghana, Swaziland, and India with the express goal of making mathematics teaching more responsive to sustainability and peace. We draw on these experiences to outline challenges we have encountered or witnessed. We did not collect data in these contexts. They were professional interactions that were not research contexts. Thus we rely on our perspectives of these challenges and leave it to the reader to consider the extent to which these challenges have currency in their contexts. We focus here on the general conservative forces of key instructional resources, on technoscientificity and the way it favours abstraction, and on time, which exacerbates the forces of technoscientificity.

2.1 The conservative force of textbooks

Although we are aware that in Canada mathematics teachers are increasingly turning to a range of resource materials, our work in less wealthy countries sees a continued dominant presence of textbooks. This reliance on textbooks was, in fact, a motivating force in the MGIEP-UNESCO decision to focus on giving guidance to textbook authors to embed peace and sustainability into textbooks. We attribute teachers' dependence on textbooks to a variety of factors.

First, teachers in countries with relatively less wealth have less access to other resources that Canadian teachers can access easily. Most particularly, we think of resources available online. It is not a given that teachers in Ghana, India and Swaziland would have dependable access to the internet, and even less likely that they would have access to the kind of bandwidth and hardware that would allow them to use the resources available online in their teaching. We add that there are disparities even within Canada. Remote communities, especially in the North, do not have sufficiently high bandwidth (Kakekaspan, O'Donnell, Beaton, Whitemark, & Gibson, 2014; Simon, Burton, Lockhart, & O'Donnell, 2014). This resource impoverishment is exacerbated in First Nations communities, which are chronically underfunded (e.g., Blackstock, 2009; Cherubini, Hodson, Manley-Casimi, & Muir, 2010). Further, it is our experience that online materials tend to be produced in contexts that are relatively wealthy and depend on the use of items typical to the wealthy English-speaking countries (especially the USA). For example, a video may show someone using kitchen or building tools that are common in Canadian and US households. Though English is the dominant language of instruction in all these countries, it is not the first language of most students in Ghana, India and Swaziland. It would be beneficial to have more linguistically and culturally relevant resources available.

Second, in the contexts we have experienced with less wealth, the preparation or training of teachers is reduced in comparison to Canada. This is likely due to reduced financial resources to support higher education studies and to lower capacity to pay teachers sufficiently. We see teachers with less training and development who are more dependent on textbooks.

Furthermore, textbooks have a conservative force on a discipline. Kuhn (1970) recognized this decades ago in science textbooks. He called them conservative exemplars of disciplinary paradigms. Kuhn noticed that textbooks tend to present the least controversial aspects of a discipline. Applied linguistics scholarship has confirmed this more recently and more widely: Hyland (2000) described textbooks as a conservative force promoting "tamed and accepted theories of a discipline" (p. 105), a canonizing discourse.

Kim and Wagner (2019) are currently researching the way mathematics and science textbook authors reconcile their hopes and fears for their students with disciplinary demands. Their preliminary findings reinforce the conclusions of Kuhn and Hyland. The textbook authors interviewed by Kim and Wagner (2019) described how their writing tends to be rejected unless it looks sufficiently similar to previous textbook material. This underlines the conservative force of these texts. They can change, but only incrementally; otherwise they will be rejected, not recognized as textbooks.

We wonder if other resources being used by teachers in relatively wealthy regions are similarly conservative forces of the discipline. Kim and Wagner (2019) interview with textbook authors revealed a general resistance to teaching and learning materials that did not seem similar to past materials. This appears not limited to textbooks. We would suggest research similar to Kim and Wagner (2019) be undertaken to learn more about the way developers of alternative resources experience disciplinary demands.

2.2 Technoscientificity

We have highlighted above the importance of cultural responsiveness in education oriented around peace and sustainability. This is important because our conception of peace includes attention to local culture and cultural diversity. Our view aligns with SDGs 5 and 10, which respectively call us to work toward gender equality (empowerment of women and girls) and reduce inequality within and among countries. These SDGs aim to reconfigure current systems of power which favour male perspectives and certain global discourses. In other words, these goals encourage us to foreground the perspectives of people who are underrepresented in decision making. This kind of cultural responsiveness also draws our attention to people who are most impacted by local environmental and social issues. Thus cultural responsiveness is related to peace and to understanding environmental and social concerns.

However, in our experiences working with mathematics teachers, the most noticeable cultural distinctive that confronts us in developing resources for environmentally and socially responsive mathematics is what Toledo, Knijnik & Valero (2018) call *technoscientificity*. Knijnik and Valero (2018) describe technonoscientificity as the dominance of a discourse that intertwines "the production of scientific knowledge, techniques, and capitalism within the current neoliberal form of reasoning" (p. 75). The relevance of mathematics here is its uses in scientific and technological fields due to it formalism and abstraction. Technoscientificity valorises abstraction. It has colonized mathematics education. In our work with educators, when we want to be responsive to their cultures, we find this irony: we say we want to be responsive to local culture, but the local culture which comprises mathematics educators in the region, honours abstraction (the ignore-ance of local culture). While we try to be responsive to local educators' concerns, they are unaccustomed and thus reluctant to escape this colonizing force that distracts from a prospective focus on local concerns.

The local educators' fixation on abstraction is partially attributable to a view of mathematics as abstract. Bishop (1990) described how exponential-based numbers, which comprise a relatively abstract system of representing quantity, made colonialism possible. Wagner and Davis (2010) added that colonialist aspirations also made exponential-based numbers necessary: necessity is the mother of invention. They highlighted the need for learners to get beyond abstract calculations and to feel number, which is a way of counteracting the colonialist tendencies of mathematics. Thus moving beyond abstraction is a form of decolonization. We think the favouring of abstraction we have experienced in our work with mathematics educators is also attributable to larger forces of

colonialism. In fact these abstraction and these larger forces go hand in hand, as explained by Bishop (1990).

Bishop (1990) also showed how systems of education were a major medium of cultural invasion, playing a critical role in promoting western mathematical ideas. For example, Ghanaians seem to prefer education ideas from the United States over ideas from Ghana. The former being perceived as having the propensity to yield better economic and social outcomes for students. Mathematics continues to be used as a colonising force because of its rationalism and objectism nature (Bishop, 1990).

To trace an example of the power of colonialism, we consider the context of present-day Ghana. More than sixty years after independence from Britain as a colony, the remnants of colonialism continue to be pervasive in the Ghanaian education sector. The educational systems have not changed significantly to meet the needs of all students. For example, the teaching and learning practices have not improved to help the average Ghanaian student acquire the skills needed to succeed in the 21st century. There are still major beliefs that have become an impediment to Ghana's economic, social, and political growth. For example, Osei (2015) noted that most Ghanaians' continue to have an entrenched belief that everything Western is good and everything African is bad. The average Ghanaian has confidence in non-Ghanaian Eurocentric ideologies regardless of how ineffective and inapplicable they are to their local situation.

Ghana depends on the World Bank for funding for educational initiatives. For example, the World Bank Group and the Ghana government in 2014 signed a $156 million financing agreement to improve access to secondary education in underserved districts throughout the country. Most of the funding provided by the World Bank in the past came with stringent measures in the era of structural adjustment programs. The experiences of Ghanaians with free market systems such as privatization makes Ghanaians unsure of loans that are provided by the World Bank. However, with this $156 million loan, the terms of the agreement are favourable to Ghanaians. It is difficult to become independent as a nation, when Ghana is still dependent on the World Bank for major educational improvements. This situation reverts Ghana back into the era of colonization where her internal, including economic, affairs were managed by external forces. Could there be true decolonization and economic emancipation when Ghanaians, in particular, and developing countries, in general, are still dependent on organizations such as the World Bank?

Globalization has become a distraction to countries who are trying to attend to their own needs. The external pressures inherent in globalizing education cannot simply be ignored. One of the external pressures is provided by the Organization for Economic Cooperation and Development (OECD). The OECD coordinates and ranks countries based on their performance on the Program for International Student Assessment (PISA). Top-performing countries on PISA such as Singapore and Finland are always ranked higher by the OECD. The impression that is created by this ranking is that these countries provide good education for its populace and consequently good jobs and better economic opportunity for its citizens. These countries perform well on PISA because they prioritize teaching and learning and they dedicate equitable resources (Darling-Hammond, 2017) to students and teachers' to enable them optimize their potential. In Finland, for instance, the educational authorities appear to ensure that the best and the brightest teachers' are recruited to teach at each level of the educational system. Resources are equitably distributed to schools, teachers' are compensated well, and there are opportunities for teachers' to ultimately become leaders (Agustini, 2016). Countries that rank high on the PISA examination tend to have some level of economic power and respect in the world. Developing countries tend to pay more attention to these rankings often times ignoring the key problems that confront their education

systems locally. This is because funding agencies dictate the education or curriculum direction for the country (Ghana) using the tenants of PISA and other OECD reports.

We are not arguing that Ghanaian educators have misplaced priorities. We are pointing to real external factors that make it difficult for them to change their mathematics teaching practices. Abstraction, globalization, and the power/wealth structures in our current world work together to foreground technoscientificity in countries with relatively little wealth. The educators are subject to the discourses around them, which value colonialist/globalization forces and which are enforced to some extent by these same forces. Additionally, even if educators see through the false hopes of globalization, they are bound to some extent by the values of the people around them. The stakeholders around educators hold them to account and thus doubly enforce the impacts of globalization. For example, students are evaluated against standards that have a traditional view of mathematics that favours abstraction. We know that educators want to do what is best for the learners in their schools and their communities, but these good intentions do not make them immune to the discourses around them.

2.3 Time

Time constraints of educators exacerbate the challenge of overcoming technoscientificity, especially in contexts with relatively few financial resources. We think particularly of Ghana and India, which are contexts in which we have worked recently. We have seen that teacher leaders who develop resources for other teachers (e.g., textbooks) are asked to do this above their already demanding full time roles as teachers.

Ideally, we would want teacher leaders who develop resources and guide colleagues in professional development to have time to develop an understanding of the socio-political, economic and environmental issues in their contexts and to develop their understanding of situated mathematics in such contexts. Thus we see a second irony: in contexts where poverty is a dominant force, it is hard to dedicate and justify attention to local contexts right where it is probably needed most.

Another dimension to the time factor, is teachers' willingness to invest time in creating situated mathematics task that speak to students' lived experiences and local context considering that educational systems of Ghana, India, and Swaziland and many other developing countries place an insistent demand on teachers to tutor students to pass gate-keeping national mathematics exams. Most teachers are tempted to stick to their familiar textbook activities rather than to try something different or do something out of their comfort zones. Again, as noted in the section on the conservative force of textbooks, teachers in less wealthy regions tend to have less education to support them in thinking differently about their work.

3. Suggestions for situated mathematical activity – follow the resources

In this section, we describe what we refer to as "situated mathematics" activity and give an example based in a Ghanaian rural community context. Such activity positions mathematics as a human endeavour and initiates critical thinking and responsiveness to local community concerns. We follow a framework developed by Wagner (2019) to position mathematics as a human activity. We show here how the example activity begins responsive to local technoscientific interests and has the potential to move into other culturally and locally specific concerns.

Wagner (2019) called on mathematics educators to 'walk mathematically' and notice "the roots and fruits of mathematics" (Wagner, 2019, p.10). The roots refer to what nature inspires us

to think about mathematics and the fruits denote how mathematics influences the way we design things. For instance, when we see how people apply mathematics in local business transactions or during purchases in a local shop, we ask how mathematical ideas influence and structure the transactions. The next steps in Wagner's (2019) guidance for situating mathematics call us to choose a context that involves local concerns that relate to tensions involving sustainability, to identify the mathematics that people do and might do in that context, and finally to develop mathematical tasks for classroom action.

We begin with walking mathematically with our colleagues. From our interactions with educators in Ghana, we know that they are attentive to business transactions because these transactions include obvious number work. We thought of agriculture food production because food products and supplies for farming are the most common transactions in the rural Ghanaian cash economy. There are also rich traditions of painting and textile work involving geometric and number thinking, but we choose to focus our example with monetary transactions to reflect the observations of the educators with whom we have worked.

In both rural and urban communities, buying of food stuffs and other local commodities are mostly done with cash. Thus there are many different ways that people sell their products. It is very common to see people hawking their produce along the shoulders of streets in cities and rural communities, and along roads connecting communities. Children are often highly involved with their parents in the buying and selling of food items; it is common to see young children selling items along the streets or parents sending their children out to buy things like paraffin fuel from local markets.

Having identified a context, we consider how we could go deeper to develop money exchange tasks for children. We want them to follow the money and the other resources. We cannot go into detail in this paper because such tasks for school would be responsive to the particular transactions identified by students. However, we can outline how this might look. For instance, if students and their families are involved in selling processed "fufu" (a major staple made from cassava), biscuits or packaged palm oil produced outside the community, they can discuss what portion of the money goes to the local seller, and thus stays in their homes or community, and what portion goes elsewhere. Following the money like this develops the students' knowledge of the structures of agriculture in relation to wealth and poverty in their communities. It could thus motivate them to make choices that keep money in their communities. Through this activity, they would develop mathematical tools that further enable them to critically examine their local economies.

Once children in a class or their teacher identify a particular context of buying or selling, they can ask the seller further questions to determine where the money goes, and they can ask the purchaser where their money comes from. Depending on how they answer these questions, we can see strong potential for working with percent. If the person answers with percent, students could calculate the actual amounts. If the person answers with actual amounts, students could calculate the percent.

Other details can be pursued in similar ways. Students can record how much profit they got, how much the manufactured (or processed) item cost the seller (cost-price), how much they spent on transporting the item to the community, and how much they spent on other necessary items (e.g., bags, rent). Furthermore, they can record detail on the seller's actions after the item is sold: what do they spend their income on? What portion for each of these transactions goes to someone else in the community? This all can lead to a very important question about rural economies: what do local people sell outside the community? This is important because this has to balance with the

money they expend outside the community for manufactured and processed commodities. Again, they can calculate the cost-price (manufactured versus raw farm produce), profits or loss, selling price, and their corresponding percentages.

The children from families that sell items like this can identify if their parents took a loan from rural bank or family members to start the business, and how much interest they paid at the end of a certain period of time. Students can further research different interest rates from rural banks across the community and make comparisons. This could be a starting point to discuss concepts of "simple and compound interest" which forms part of Ghana's grade nine mathematics curriculum.

Further, related to transportation and manufacturing or processing of food items outside the community, the distance travelled by food can be discussed in terms of carbon emissions. Students can compare this to data on carbon emission rates by countries that produce these processed or manufactured foods (many of the processed foods in Ghana are imported) and plot graphs to predict how much carbon will be emitted into the atmosphere as a result of food processing.

A further connection beginning in this context relates to labour. Again this relates to where the produce comes from and who produces it (SDG 8). Not only will this generate discussion on environmental issues related to food production, it will surface critical questions relating to gender disparity (SDG 5) and sustainable land use (SDG 15). For instance, students can keep record of how much time their mothers or elder sisters work on the farms throughout the cultivation period of a local crop, say cassava or maize, and compare the data to the male counterparts. Growing up in rural Ghana, women perform most of the farm activities as they undertake planting, weeding, post-harvest work and, marketing of farm produce. They could compare this to what the website of the Ministry of Food and Agriculture says, where it has reported that women make more than 40% of agriculture labour and they produce about 70% of the country's food stock (Food and Agriculture Organisation (FAO), 2011).

Notwithstanding, women have very limited access to productive resources. For example, only ten percent of women own land compared to 23% of men according to the FAO (2011) report. There has been a recent push by the Government of Ghana and the Civil Society organisations to recognize the role of women in society and offer them equal financial opportunities to harness their contributions to local and national economic growth. To ensure social change and advocate for this recognition at the local or rural communities, we believe this advocacy could start from the household level where school children come from. Through the kinds of mathematics we describe here, students can base arguments on data they collect, to begin advocating for women in their homes and extend this education to the broader community level.

The kind of mapping activities we describe above would help students understand local economies and the value of buying local. It would also have a lot of mathematics involved as we have identified. Answering these questions would engage students in questions about sustainability: Where does the food come from and where does it travel to get processed and distributed? Who is paid for this work and what environmental costs are there in this travel?

4. General suggestions for task design

So far we have identified our broad goals for situated mathematics—a mathematics that responds to local environmental and social concerns—and have given an example of looking deeply into a rural context, starting with a simple monetary transaction and following the money and resources from that transaction. With our interest in task design, whether tasks are set in textbooks or used by teachers in classrooms, we want to give some general suggestions. We are

particularly interested in contexts where there might be limited resources for supporting teachers who want to change their practices to be responsive to local environmental and community concerns.

First, we recommend that teachers' be prepared to teach children in a dignified manner while upholding students' culture. The key question is this: how can we create awareness among mathematics teachers' that mathematics is a culturally-rich, rather than a culturally-neutral subject? We suggest the program of ethnomathematics for this. If teachers turn their attention and their students' attention to the way people in their communities have responded and continue to respond to local and community needs, they may increase their sense of agency. They see people in the communities doing innovative and responsive mathematics. When they see others using mathematics to respond to community needs, they may be motivated to do likewise—respond to community needs in innovative ways, perhaps drawing on some of the mathematics they see their community members use. Thus we teach responsability, the ability to respond (response-ability), and afford ourselves and our students an opportunity to address peace and sustainability goals for our local communities. By doing mathematics in response to community needs, we make mathematics meaningful, engaging, relevant, and attentive to local cultures. Students are positioned as agents of change in their communities as a result of doing mathematics in a responsive way—actively participating in the community rather than passively observing and memorizing procedures.

Second, we draw on Gutstein's (2012) three forms of knowledge needed to read (understand) and write (transform) the world to orient the attention to local mathematics. Gutstein describes three types of knowledge that are required for any mathematics task that seeks to engage its students and foster positive change—community, classical, and critical knowledge. In other words, to enact critical mathematics pedagogy, it is necessary to build on students' community knowledge to support the simultaneous, interwoven development of their classical and critical mathematical knowledges.

We turn to the Ghanaian context and the example we elaborated above. Most Ghanaians, even at a tender age, know much about money, food, and basic measurements through petty trading and household and farming activities. This knowledge can be promoted in the classroom. Following the orientation described by Gutstein, this knowledge would be connected to classical mathematics and community needs, and power relationships involved in the community context would be addressed.

Recently, first author (Yaro) worked with rural parents, their children, and teachers in Ghana to investigate how parents with no formal education support their children's (9 – 10 years) mathematics learning in Ghanaian rural context (Yaro, 2015). Rural parents in the study revealed interesting ways of supporting their children's mathematics learning. One such way is the use of local business transaction (buying and selling of items in retail stores with cash). Even though parents in the study were not formally educated they had profound understanding of basic financial transactions; "change", "profit", and "loss". They apprentice their children (informally) on the daily use of cash and coins in transacting businesses. More specifically is the concept of " change"—the change one gives or receives during financial transactions. The concept of "change" in financial transactions tends to have a lot of mathematics embedded (i.e., subtraction and addition, etc.). This in itself constitutes the role of mathematics as a helpful tool for humans to organize themselves to trade fairly in local and to a greater extent, global economies (UNESCO-MGIEP, 2017, p. 42). However, in the same study, the teachers were dismissive; they discounted or downplayed the routine mathematics these parents engage their children in at home because

such activities were seen as outside the realm of "formal school sanctioned" activities. If teachers saw the connection among the forms or knowledge delineated by Gutstein, they would not be so dismissive.

We follow Gustein's suggestion that knowledge of their students' native culture is useful for blending classroom instructions with students' Indigenous knowledge and practices for meaningful mathematics learning. It is not enough for a teacher to know only how the student is functioning cognitively. Teacher knowledge of the cultural and linguistic resources students might bring to classrooms and what dispositions students may hold towards mathematics and its relation to their future or personal lives is essential to the teaching of mathematics . In our view, educators will be doing a disservice to the communities they serve if they (educators) tend to ignore the very things (oral traditions and traditional practices) those communities cherish, uphold, value and think constitute mathematics, literacy and knowledge. However, we add that such knowledge of local contexts is not sufficient. The Ghanaian example reminds us that a changed orientation among the teachers is necessary in order for them to value local knowledge.

Considering the fact that many people in colonised education systems (e.g., Ghana, Swaziland, India, Indigenous people across North America, etc.), have had negative experiences with school and other formal education systems in the past; valuing their cultural practices and ways of knowing in classrooms could be a giant step in "restoring confidence" in the current school system and to send a clear signal that schools are spaces that value, respect and welcome the culture and traditions of every community. The local people in these communities will indeed recognize and appreciate that their traditional practices still have a place in our contemporary school curricula. This will require teachers to appreciate these practices.

An important aspect of the UNESCO-MGIEP (2017) advice for textbook authors is its recognition of the potential role of these authors in contributing to sustainable living, peace and global citizenship. In most countries, textbooks serve as prime resources for delivering the school curriculum. It is in this spirit that the authors of UNESCO-MGIEP suggest that authors embed education for sustainable development (ESD) into the mathematics textbooks. By doing this, mathematics will be viewed as a tool for enabling critical thinking of issues relevant to a particular context (UNESCO-MGIEP, 2017).

5. Looking to the future

We have attempted reconceptualising and repositioning the M in STEM to respond to the challenges of the sociocultural contexts of students by drawing attention to the possibilities of creating mathematics tasks for peace and sustainability. As discussed extensively, the challenges of creating situated mathematics tasks include; time, the conservative force of textbooks and technoscientificity. Here, we shift our attention to what could be done to engrain situated mathematics learning, and we focus on the context of Ghana for an example.

We see the need for further research that examines how the M in STEM can be reconceptualized to construct a mathematics that promotes sustainability and peace. First, professional development that focuses on continued integration of situated mathematics tasks with focus on peace and sustainability throughout the entire school year could benefit teachers more, rather than one shot professional development. A school year long professional development could engage teachers to reflect on their practice. Teachers might be guided by the following questions: what does it means to teach situated mathematics with a focus on peace and sustainability?, what might this look like within and across multiple units or single lessons? What would it mean to fully contextualize the issues of peace and sustainability over time?

(Bartell, 2013). The field of mathematics education would benefit from such professional development practices being documented and critically examined with research. We emphasize that this professional development would need to be responsive to context, and thus the research of these professional development practices should span a range of contexts and illuminate the contextual specificities of each context.

Second, there will always be a concern about how much time teachers would be willing to invest in creating 'good' situated mathematics tasks for students, considering that many educational systems and curricula place an insistent demand on teachers to tutor students to pass gatekeeping mathematics exams. The reality is that what is doable is always constrained by objective conditions and power relations, but teacher agency and spaces to work against the grain do exist despite the obstacles (Gutstein, 2013). The Teachers' role here is to push for educational reforms that privileges the needs of students' local communities—living a peaceful and sustainable life. We would hope that teachers of mathematics show interest in issues of peace, sustainability and social justice and ensure that educational reforms make room (in terms of time) for them to engage students in mathematical activities that foster peace and sustainability. Teachers who are engaged as activists themselves (in various ways) also ensure that their students have the opportunities to become agents of change (Gutstein, 2013).

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