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Scaffolds for teachers' integration of social justice issues in mathematics education: A pilot study

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Abstract
In this article we report on a pilot study conducted in the Philippines in which the aim was to investigate the scaffolding that mathematics teachers needed to participate in a project in which social justice issues were incorporated in their classroom activities. We collaborated with 2 mathematics teachers at public high schools to implement activities developed by us in which social justice issues were integrated in their mathematics classes. We then interviewed the teachers to gain insight into (1) the teachers' decisions and actions during the implementation of these activities, and (2) their learners' experiences and views working on such mathematics activities. Based on an analysis of their interview responses, it was found that both the teachers and learners welcomed the incorporation of social justice themes in their lessons. However, it was also found that teachers required more support to develop their agency in two main areas: (1) crafting contextualised mathematics activities incorporating social justice issues, and (2) creating learning environments that develop learners' agency to participate effectively in such activities.

Keywords: contextualisation; critical thinking; mathematics education; social justice; teacher scaffolding

Background
Over the past three decades, social justice concerns have gradually moved from the margins of mathematics education policy, research, and practice to a central concern (Atweh, 2009). Some scholars discuss social justice **in** mathematics education which covers the traditional discourses of equity and exclusion of many disadvantaged learners (e.g. Burton, 2003). International literature on mathematics education now regularly explores issues related to gender, multiculturalism, and ethnomathematics, as well as the effects of ethnicity, indigeneity, and learners' socio-economic and cultural backgrounds on their participation and performance (Harper, 2019). Other scholars explore the idea of social justice **through** mathematics education referring to using mathematics to achieve social justice in the world (Gutstein, 2006; Le Roux & Rughubar-Reddy, 2021). To use the metaphors by Gutiérrez (2009), social justice has become a concern for mathematics educators both in terms of helping disadvantaged learners "play the game" (p. 5) through increasing their access to, and achievement in mathematics, as well as to "change the game" (p. 5) by developing their agency to become critical citizens towards building a more equitable society. In the South African context, Graven (2014) calls for more research into disempowerment and agency that would "shift the focus from a discourse of deficit and helplessness towards a discourse of possibilities in the struggle for equity and quality education for all" (p. 1039). However, this wider trend to investigate the relationship between mathematics and social justice in society is limited in Asian countries. In this article we report on pioneering work done in the Philippines aiming to use mathematics education as a way to help learners reflect on how they can build a more socially just world while learning mathematical content.

Literature Review
In an age dominated by the discourse of measurement and testing, educational theorists have argued for the need to re-engage with the fundamental question of the purposes of education (Biesta, 2009). Traditionally, the purpose of mathematics in the curriculum has often been framed in terms of its perceived relationship with learners' future employment opportunities and the economic development of nations. However, Atweh and Brady (2009) argue that such a relationship should not be accepted uncritically, citing the example that mathematics achievement in certain Asian countries occurred after, or as a result of, their economic development rather than the other way around. Furthermore, they point to evidence that during the period between 1972 and 1992, the mathematics achievement of Latino learners in the United States of America (USA) had increased in comparison with other learners despite a decrease in their socio-economic status. A further challenge to the career-oriented and economic justifications for mathematics education is the societal change brought about by digital technology. Technological advancements have made the demand for most of the calculations and algorithms that dominate the majority of school teaching, obsolete. Indeed, Jablonka and Gellert (2007) point out that, in certain careers, mathematics has become mostly invisible due to technological advances. Arguably, the nature of the mathematics used in society has changed more rapidly than school curricula.

In this context, we align ourselves with other scholars who argue that a primary role of mathematics education in the curriculum is to enhance civic and social participation in society and contribute to creating a more just and equitable world (Atweh, 2009; Frankenstein, 1983; Gutiérrez, 2009; Gutstein, 2006; Skovsmose, 1994). Integrating social justice issues into mathematics lessons is consistent with the view that mathematics education ought to help learners become citizens who can use mathematics to enhance their critical understanding of how their world works and endeavour for a better world for themselves and their society.

Atweh and Brady (2009) identified both curricular and pedagogical implications of integrating social justice issues into mathematics education. For such integration to happen, priority within the curriculum should be given to the application of mathematics to real-life social problems and the development of critical thinking rather than rigorous, abstract and decontextualised mathematical knowledge. This is consistent with the social justice pedagogy of Gutstein (2006) where mathematical knowledge is developed at the same time as social justice awareness through the use of real contexts, rather than developing mathematics knowledge first and then applying it to social justice situations. The pedagogical approach should be based on intellectual quality, connectedness, the creation of classroom environments supportive of critical discourse, and the recognition of differences among learners.

The project reported on here was planned in Philippine schools and was thus anchored on priority areas identified by the Department of Education (DepEd) in the country for its K-12 curriculum. The curriculum articulations of the target proficiencies did not mention any specific area in the real world in which mathematics may or should be applied. In particular, there was no explicit mention of social justice. However, in separate policy statements, we note two priority areas that would enable teachers to integrate social justice into their mathematics teaching.

The first priority mentioned in policy documents was the development of learners' critical thinking. The phrase "critical thinking" is renowned in educational literature for having multiple definitions. For instance, Ennis (1991) defines it as "reasonable and reflective thinking that is focused on deciding what to believe or do" (p. 6). On the other hand, Maričić, Špijunović and Lazić (2016), in the context of mathematics education, define it more operationally as a complex intellectual activity that includes abilities related to solving mathematical problems. The DepEd itself refers to critical thinking as a set of high-order thinking skills such as analysis, evaluation, interpretation, or the synthesis of information and application of creative thought to form an argument, solve a problem, or reach a conclusion (Republic of the Philippines, DepEd, 2013). This definition aligns with what Davies (2015) describes as a "skills-based view" (p. 54) of critical thinking, focused on logical argumentation. However, as Davies (2015) shows, this is just one view of critical thinking, and it is the narrowest. Theorists today primarily hold the view that the composite cognitive elements of critical thinking go beyond mere argumentation to also include different forms of judgements, including metacognitive ones. In addition, they also consider particular dispositions to be central to critical thinking, whether these are dispositions in relation to the self (e.g., the desire to be well-informed), in relation to others (e.g., open-mindedness, scepticism), or in relation to the world (e.g., viewing both sides of an issue) (Davies, 2015). In our study, we viewed critical thinking as the examination of the validity of arguments through the scrutiny of the assumptions by others, whether implicit or explicit, and the investigation of the biases of those making the argument. Perhaps, in this context, it is useful to point out that this definition is not consistent with the common assumption that mathematics is a universal and objective field of knowledge that always yields a single correct answer. It is consistent, however, with the way in which mathematics works in the world where mathematical solutions always depend on the specific questions raised and these questions are always subject to assumption and values (Bishop, 1988).

The second relevant educational policy promoted by the DepEd in the Philippines was related to the contextualisation of the learning process. As defined in DepEd Order No. 32 S. 2015, "contextualization refers to the educational process of relating the curriculum to a particular setting, situation or area of application to make the competencies relevant, meaningful and useful to all learners" (Republic of the Philippines, DepEd, 2015:6). The term "refer" is open to varied interpretations and implementations ranging from mere mentions of particular settings to using the local context as a source of content for learning, as in problem-based learning. In our study, contextualisation was taken to mean the selection of social justice issues in the national or local context as a basis for mathematical activities to achieve the development of content knowledge and high-order thinking, including critical thinking, as stipulated in the K-12 curriculum. Perhaps it is significant to point out that in this approach the term "context" is understood differently from some other related approaches such as realistic mathematics education (Das, 2020) in insisting that the context refers to real situations and data that illustrate the specific social justice issues in actuality rather than merely realistically.

Study Aims

The findings reported here are from a pilot of a larger study which aimed to document the learning trajectories of a group of high school mathematics teachers in the Philippines in their attempt to integrate social justice issues in their classroom activities. The pilot study involved two high school teachers who agreed to integrate social justice activities developed by the researchers in their mathematics classes.

The aim of the pilot was to investigate the scaffolding that teachers needed to engage in the main project. The term "scaffold" was originally used by Hogan (1997, as cited in Ertmer & Simons, 2006:320) to refer to instructional tools used "for enculturating students in the thinking patterns of experts" but has since also been used in educational research in the context of teacher training and teachers' learning (Ertmer & Simons, 2006). To achieve the aim of the pilot study, we identified two subordinate aims: (1) to investigate teachers' decisions and actions in their implementation of mathematics activities integrated with social justice issues, and (2) to investigate the learners' experiences and views working on such mathematics activities.

Theoretical Framework

Our theoretical framework was based on the understanding of the construct of social justice as discussed by Atweh (2011). The initial growth in interest in social justice among Western mathematics educationalists – in the sense of helping learners "play the game" (Gutiérrez, 2009:4) – came on the heels of the dominant view of justice within political thought as simply distribution. This was the approach promoted by John Rawls, who sought to find a middle ground between libertarian defences of property accumulation and arguments for planned economies. Conceptualising justice as fairness, Rawls (1973, as cited in McInerney, 2004:50) argues that "the primary subject of social justice must be the basic structure of society, or, more precisely, the way in which the major social institutions distribute fundamental rights and responsibilities and determine the division of advantages from social cooperation."

Within the field of political thought, the last decade of the twentieth century saw increasing critiques of the Rawlsian model by scholars who argue that a distribution-focused framework of justice obscures disparities of power related to group identities. Gewirtz (1998:471), for example, notes that relational understanding of social justice was needed to "theorize about issues of power and how we treat each other, both in the micro face-to-face interactions and in the sense of macro social and economic relations which are mediated by institutions such as the state and the market." Young (1990) likewise criticises traditional conceptions of social justice for focusing on having rather than doing, and argues for discourses about social justice framed around the oppression and domination of social groups, in the same vein of what Honneth (1995) and Taylor (1992) came to describe as "misrecognition." This debate was most famously captured in the dialogue between Fraser and Honneth (2003). Fraser's (2001) own approach to social justice stresses both redistribution and recognition measures, and argues for a "critical theory of recognition" (Fraser & Honneth, 2003:159).

On the heels of these theoretical debates, Western mathematics education research too experienced what Gutiérrez (2013a:37) described as a "sociopolitical" turn at the beginning of the 21st century. Compared with the earlier focus on using socio-cultural theories to close mathematics achievement gaps, many mathematics education researchers and practitioners in the past two decades have foregrounded ideas surrounding power and political emancipation in their work on social justice.

Given the contested nature of the concept of social justice, we follow Young (1990:5) in her understanding that the principles of social justice are not theorems, but rather, arguments "addressed to others … [that] await their response, in a situated political dialogue." In other words, they are not based on abstract general principles that can be applied to specific practices and situations in all localities and in all societies; rather, they are statements that call for either defence or contestation.

Methodology

This study is informed by the interpretative phenomenological analysis (IPA) approach. Smith and Osborn (2003) argue that the aim of IPA studies is to investigate "how participants are making sense of their personal and social world, and the … meanings particular experiences, events, states hold for participants" (p. 51). Further, they note that such studies imply that the researchers are trying to make sense of the participants making sense of their experiences, which is also our intent.

Participants

Two public school teachers – Donna and Roger (both pseudonyms) – teaching high school mathematics subjects were recruited to participate in the study. They were recommended for participation by an official of the DepEd because of their openness to novel ways of teaching mathematics. Each teacher had at least 10 years' experience within the Philippine public school system. While the number of participants was limited, in line with qualitative research methodologies, the generation of in-depth data was ensured through choosing

appropriate participants and interacting with them extensively.

Procedures

The entire pilot study was done over a period of 3 months in early 2021, when pandemic-related government restrictions were in place. Ethics clearance was granted by the ethics committee of the university to which we were affiliated. An initial meeting with the teachers was held via video conferencing to discuss the aims of the project and to clarify their tasks and roles. After they consented to participate, we facilitated an induction session with them over video conferencing software to prepare them to implement mathematics activities that integrated the discussion of social justice issues and the use of open-ended questions. Based on our knowledge of Philippine traditional didactic classroom teaching and previous research experience in this particular area (see Atweh & Brady, 2009), the session included discussions about the following topics: the construct of social justice, mathematical investigations, implementing mathematical activities with open-ended questions in the classroom (challenges and teacher's role), and raising questions in the classroom using Philip Cam's (2006) question quadrant. The question quadrant is a teaching tool which is often used within the Philosophy for Children movement. It categorises questions into four types: those that are particular (about the text at hand) and closed (have one right answer), those that are particular and open, those that are general (beyond the text) and closed, and those that are general and open.

To illustrate the use and power of the question quadrant, a task that involves a table that enumerates the scores of certain learners is considered. A particular and closed question only requires one to retrieve information from the given (e.g., How many learners' scores are given?). General and closed questions are also factual but may require going beyond the given by doing some research or solving (e.g., What is the mean of the learners' scores?). Particular and open questions may require making inferences from the given (e.g., Why did many learners score below 50%?). Finally, general and open questions may delve more into philosophical questions or broader issues that relate to the given (e.g., Do scores provide an accurate measure of learners' abilities?). By consciously posing and answering these different kinds of questions for a mathematical task, more opportunities for critical thinking and contextualisation may be afforded.

The induction session lasted 2 ½ hours. We did not expect that this would sufficiently enable the teachers to develop mathematical tasks incorporating social justice and implement them productively in the classroom. However, this was deemed sufficient for teachers to pilot activities developed by us towards demonstrating their own scaffolding needs and those of their learners.

For the implementation of the study, the teachers were provided with three activities that had been developed by the research team. The activities (see https://bit.ly/SJMIpilotActivities) involved data about Philippine society taken from the Philippine Statistics Authority, particularly about nutrition, education, and family income and expenditure. As such, the activities fulfilled the mandate of contextualisation stipulated in the Philippine K-12 curriculum. Each activity included closed and open-ended questions for learners to answer, and the questions were categorised into: "reading the data, reading between the data, and reading beyond the data" (Curcio, 1987). Questions under the heading "reading the data" solicited learners' understanding of the actual information in the tables and what they represented (e.g., "How many food-poor children are there based on the table?"). Questions under the heading "reading between the data" prompted learners to find observable patterns in the set of data (e.g., "What patterns do you observe in terms of differences between 2015 and 2018?"). Questions under the heading "reading beyond the data" encouraged learners to reflect on the possible implications and limitations of the given data set (e.g., "What should be done to solve the problem of food-hungry children in the Philippines?"). The second and third categories of questions provided opportunities for learners to discuss emergent social justice issues. These two levels were also the questions that demanded greater critical thinking from the learners.

In recognition of teacher agency, we told the teachers that they were free to modify the activities that they had been provided with according to their lesson content, schedule, and context. The implementation of these activities took place at a time when on-site classes were still prohibited because of the coronavirus disease (COVID-19) pandemic. Therefore, the instruction in this study was carried out through online synchronous lectures and discussions – wherein teachers and learners interacted with each other in real time through video conferencing or messaging applications – and asynchronous class work – wherein learners were given materials to work on or study on their own.

Data Collection and Analysis

The two teachers were asked to note and reflect on their observations about their experiences and class interactions both across the time that they were implementing the activities as well as after they had implemented all of the activities. They were encouraged to focus on the following: the benefits of the intervention to mathematics learning, the benefits of the intervention to learning about society and social justice, pedagogical adaptations that they

made, and problems that they or the learners encountered. We then conducted separate 1-hour interviews with each teacher via videoconferencing, in which the teachers responded in a mix of English and Filipino. This choice of using semi-structured interviews is in line with IPA research (Smith & Osborn, 2003). At each interview, the teacher described how they had implemented the activities and shared insights they had gathered from their reflections. Further questions from the project team were posed to probe each teacher's experience more deeply. The teachers were also asked to comment on key issues, such as the learners' engagement in the discussion of social issues, the teacher's role in whole-class discussions, the presence or absence of disagreements among learners during the discussions, the perceived learner readiness to discuss social justice issues in a mathematics class, and the teacher's preparedness to implement social justice investigations. The interviews were recorded and transcribed. The transcripts of the interviews were independently analysed by each researcher for significant themes related to the research questions. These were then discussed by all of us and key themes agreed upon, to form the basis of the findings reported here. This is consistent with the methodology of data analysis in the IPA approach as elaborated by Smith and Osborn.

Finally, our joint and methodical analysis of the data and the number of quotations from the teachers presented below attest to our attempts to authentically portray the teachers' own experiences and views (Guba & Lincoln, 1989).

Findings

In this section we firstly provide a summary of how the two teachers implemented the social justice activities in their classes. This is followed by a report of the findings, with themes arranged according to the subordinate aims of the study.

Teachers' Implementations

Donna implemented all three activities in an advanced mathematics elective subject for Grade 10 learners (15- to 16-year-olds) that dealt with mathematics investigations and modelling. Before introducing the activities, she explained the question quadrant (Cam, 2006) and asked her learners to use this as a guide to raise questions about their previous lessons. The three activities were then assigned to the learners consecutively over the next 3 weeks. As instructed by Donna, the learners carried out the first activity individually, and the second in groups of three. Some parts of the third activity were done in groups, whereas some parts were completed individually. For each activity, learners were given questionnaires to answer asynchronously. During the online synchronous sessions, some groups and individuals were selected to present their outputs to the class, leading to whole-class discussions of the social issues raised by the learners.

Roger implemented only the first two of the suggested activities in a course on statistics and probability for Grade 11 high school learners (16- to 17-year-olds). Prior to the first activity, Roger briefly reviewed the concept of confidence intervals with the learners and gave them related problems to work on. He then introduced the first activity. During an online synchronous session, the whole class worked on the questions under the heading "reading the data" together. Following this, the learners were asked to pair up and use Facebook Messenger (a messaging app) to discuss the questions under the heading "reading between the data." At a subsequent synchronous online session, several pairs of learners presented the results of their work. This was followed by a discussion of questions under "reading beyond the data." The implementation of the second activity was marred by limitations involving internet connectivity and time availability. Thus, Roger just asked learners to answer all of the questions asynchronously, and this was followed by a short online synchronous discussion.

Teachers' Experience

In relation to the first sub-aim of the study – to investigate teachers' decisions and actions when implementing mathematics activities integrated with social justice issues – three themes arose from the data: (1) teachers' prior experience using open-ended mathematical activities, (2) teachers' knowledge about social justice issues, and (3) teachers' pedagogical preparedness in teaching lessons integrated with discussions of social justice issues. These three factors appeared to influence how the two teachers implemented the activities with their classes. We observed similarities and differences between Donna and Roger's experiences, which we discuss below.

Teachers' prior experience with open-ended activities

As mentioned above, the subject that Donna taught was centred on mathematical investigation. Unsurprisingly, between the two teachers, she appeared to have more previous exposure to using open-ended mathematical activities in the classroom. Although the integration of social justice issues was not usual in the activities she had previously developed, we noted that, compared with Roger, she appeared more self-assured in her descriptions of her preparations for and implementation of the activities. Donna found the teacher training session at the start of the study to be very helpful, singling out the discussion about Philip Cam's (2006) question quadrant to be useful for her class. She noted that her learners consequently came up with better investigative questions than they had

in previous classes. She noted an improvement in her learners' ability to determine whether the questions they were posing were "*mababaw* [superficial]", and she said this helped them come up with better questions about the data they were looking at.

Teachers' knowledge of social justice issues

Roger expressed his recognition of his inexperience in carrying out mathematical activities with open-ended questions, and also of his limited knowledge about social justice issues. He said that he was grateful that the researchers had provided pre-designed activities for him to start with. He recognised that integrating social justice issues in mathematics was important, but also commented that, "[i]*t's not an easy job. It should be carefully selected based on* [target] *competencies* [identified for] *a particular subject*." Many terms found in the statistical tables (e.g., subsistence incidence, food-poor) were new to Roger, and this led him to undertake additional research about these concepts to prepare for the implementation of the activities. He thought that he had been "able to prepare enough", but he still found it difficult to discuss the social justice issues in class with much depth. As he explained:

> Hindi ako magaling mag-explain pag dating sa mga [I'm not good when it comes to explaining] *social issues because I'm not really used to it. ... as a math teacher, ... I'm not really that good in conversing. ... but if I will be asked to teach mathematics, I can teach mathematics.*

These comments from Roger indicate that teachers' lack of deep knowledge about social justice issues might be an initial hindrance to incorporating such topics in mathematics classrooms.

Teachers' pedagogical preparedness

Roger also felt that he lacked the pedagogical skills to lead classroom discussions about social justice issues.

> *So I'm not really sure about myself* [if I am] *prepared enough to handle this ... class, integrating social issues or social justice in statistics and probability. So I have doubts ... because I'm not trained to ... discuss how to facilitate ...* [discussions about] *social issues.*

We believed that this lack of pedagogical preparedness may have been the reason behind the limited class discussions in Roger's and Donna's classes. In their interviews, neither teacher described any elaborated classroom conversations – that is, extended exchanges of ideas in plenary discussions – about the social issues raised by the learners. This lack of pedagogical preparedness for classes integrated with social justice issues may explain some aspects of Roger's and Donna's accounts about their classes. The discussions appeared to be limited to question-and-answer exchanges in which the teacher posed a question and the learners answered them in front of the whole class, with little explanation. Any follow-up utterances were limited to affirming comments. Notably, neither Roger nor Donna described any disagreements nor any instances of learners challenging classmates' contributions.

When asked about this, Donna and Roger both explained this phenomenon away by attributing it to the learners' dispositions, or the nature of the activity. Roger hypothesised that the lack of discussion between learners was because they were "shy", or because they were either uncomfortable with or unaccustomed to discussing such issues in their mathematics lessons. He said, "*We usually just do computations and then we solve problems, so I think they are not used to it*." Donna, on the other hand, did not find the lack of disagreements surprising. She said that it was natural for learners to agree with each other because they were looking at the same data. She further said that she only observed learners expressing concurrence when they had classmates share observations they agree with but which they had not previously noticed.

> [S]*ince the data that they have studied are* [all] *the same, so I think ... it will just matter on* [their] *... observations ... because I asked them to list all the possible observations that they could have* [about] *this particular data and ... answer the questions presented. They can write as many* [answers] *as they can in each question. So, when they were presenting it, I think some of them ... just simply* [said]*, Ay oo nga 'no, yun nga hindi natin napansin* [Oh yeah, we had not noticed that].

While both teachers' implementation of the activities included opportunities for learners to discuss the questions among themselves, in groups or pairs, it is important to note that Donna's and Roger's observations did not extend to learner-to-learner conversations. Given the online class set-up, there was little opportunity for the teachers to observe the learners conversing among themselves, possibly using other online messaging platforms. It is thus unclear whether those learner-to-learner discussions took place and whether they displayed more depth than the whole-class ones. We surmise, however, that the online medium itself may have hindered deeper conversations about the issues.

We believe that deeper conversations and debates about social justice issues in mathematics classrooms should be encouraged, as these are opportunities for learners to hone their critical thinking skills, which can lead to deeper understanding of the issues. We consider the lack of extended conversations an indicator of the teachers' needs to reflect on their own learning environment to allow learners to engage in critical discussions about social justice issues. As Donna's comment above suggests, the teachers' failure to facilitate extended conversations about the issues may have been influenced by persistent views that questions posed in mathematics classes have single correct answers. But such a view is inconsistent with the

way mathematics is used in real life. Questions about real life are not objective, but instead, always reflect values. For example, a discussion about the reasons for the observed incidence of food-poor children may produce contrasting opinions even with statistical data: some may attribute the phenomenon to a lack of government support, whereas others may blame parents for the children's plight. Further, such extended and free discussions are likely to challenge dominant views and possible biases, either of the teacher or some learners.

Learners' Experience

Here we address the second sub-aim of the study, which was to investigate the learners' views about and experiences of working on the implemented mathematics activities. As researchers, we did not observe the classes during this pilot study ourselves; rather, what is reported here is based on the teachers' descriptions of their learners' behaviour, as expressed to us in the interviews. Two significant themes arose from our analysis of the interview transcripts: (1) the learners found the activities novel, and (2) the learners were engaged with the tasks.

Task novelty

As expected, learners found the tasks novel. They were not used to dealing with social issues in mathematics classrooms. It reflected in how the learners reacted when they saw the task. For instance, Roger said that his learners were surprised that they were talking about poverty in a mathematics classroom. He said that prior to the intervention, he had usually contextualised his discussion using the examples from statistics textbooks. Although some of these examples referred to social issues, he would not discuss the issues themselves, and instead would focus on the mathematical content and procedures. Roger noted that during the intervention, when he began discussing the social issues, learners began posting messages on the class's Facebook Messenger conversation expressing their surprise (e.g., "What is going on?"). When he raised questions about the social issues, the learners said they found it difficult to answer them and that these types of questions were new to them. However, Roger also said that the learners did not universally interpret the sense of unfamiliarity as a negative emotion. Some of his learners said they enjoyed the discussion, calling it a "breath of fresh air" and a break from their usual routine in their mathematics classes.

Donna noted that even prior to the intervention, her learners were already accustomed to applying mathematical concepts to real-life contexts; what was novel, however, was the specific inclusion of social issues. In addition, they voiced their recognition that the intervention demonstrated the applicability of the statistical concepts and procedures to real life. Donna quoted a learner as saying: "*Ito pala yung application nitong statistics na ito sa buhay* [So this is how to apply statistics in real life]." She also quoted another learner as saying, upon realising that mathematical methods are used in the social sciences, "*Ay, may Math pala sa AP* [Oh, so there's math in social studies]."

Learner engagement with the task

Both Roger and Donna reported that their learners were very engaged with the activities. Both of them also noted increased engagement among some of their learners who usually demonstrated low engagement in conventional mathematics tasks. They were both also pleasantly surprised by the depth of the learners' responses to the questions posed.

Roger reported instances of significant engagement during the discussions of both the mathematics content and the social justice issues. In particular, he shared that when he asked the class what "a 90% confidence interval" meant, almost all of the learners used the virtual "raise hand" function of their online platform to volunteer to answer the question. Roger also said that he was impressed by the wide range of responses that learners gave to the questions regarding possible remedies to the country's problem of hunger: one group said that it was important to elect good government leaders; another mentioned the importance of education; and another referred to parents' responsibility for making sure that their children did not go hungry. Roger also noted the increased engagement among some learners who had previously demonstrated lower engagement in his class; he attributed this change to their ability to see the relevance of mathematics problems to their contexts.

Comparing the classroom sessions that included the intervention with her previous teaching sessions with the class, Donna noticed a change in the quality of her learners' contributions, in that their questions and insights appeared to be more sophisticated during the intervention. She attributed this change to her introduction of the question quadrant in her class, as discussed above. Using the terms from Cam's (2006) question quadrant, she said that they did not limit themselves to questions that began with what, but also came up with questions that resorted under other quadrants. She also noted more evidence that they had analysed the issues referred to by the given data.

> [In] *their interpretation or in their answers, ...* [the learners] *looked into the data ... really carefully. They tried to exhaust all the observations that they could have in the following or in the given data. ... The way of presenting their observations is ... somewhat different compared to the first quarter.*

These observations from the teachers indicate that the contextualisation of the mathematics concepts in the suggested activities made them relevant and interesting for the learners. However, the learners'

engagement with the lesson did not necessarily mean that they were thinking critically about the social justice issues. As we mentioned above, the teachers' descriptions of classroom discussions indicated that the lessons did not include classroom conversations about the issues.

Discussion

In this section we address the main research aim of this study – to investigate the scaffolds that teachers needed to engage in mathematics activities integrating social justice issues – in light of our analysis above. Whereas the above sections are based on the teachers' views expressed in the interviews, in this section we discuss our observations as informed by the literature and by our goal in the main study, which is to cultivate teachers' ability to develop and implement activities integrated with social justice issues. Our analysis uncovered two themes that indicate that scaffolds were necessary to attain this goal: (1) the need to cultivate teachers' ability to craft contextualised mathematics activities integrated with social justice issues, and (2) the need to cultivate teachers' knowledge and pedagogical skills for implementing such activities in their class sessions.

Cultivating Teachers' Agency to Incorporate Social Justice in Mathematics

For this pilot study we designed a sample of mathematical activities based on the Philippine context for teachers to implement in their classes. Both teachers were able to establish connections between these activities and the mathematics curricula that they were teaching. However, for social justice issues to be successfully integrated into the curriculum, teachers need to acquire their own agency to develop their own activities that are appropriate for their learners.

The development of such an agency is enhanced by teachers' engagement with several curriculum resources, textbooks, and other curriculum materials that use social justice in mathematics teaching. However, making such material available to teachers is not sufficient. Opportunities for teachers to re-examine their assumptions about the purposes of mathematics teaching (à la Biesta discussed above) and development of deep understanding of social justice issues in their community are also necessary. This finding echoes Gutiérrez's (2013b) argument that it is important for mathematics teachers in the USA urban context to cultivate their political knowledge. Lastly, teacher's agency and professionalism should be respected in the education system allowing their commitment to social justice to modify their teaching towards incorporating social justice in their mathematics classes.

Cultivating Teachers' Agency in Implementing Social Justice Pedagogy

Finally, our analysis indicates that the successful implementation of mathematics activities that integrate social justice issues requires a re-examination of the pedagogical approaches used in the classroom. The official government curriculum documents in the Philippines contain references to a variety of learning theories, such as constructivism, cooperative learning, and discovery and inquiry-based learning, that encourage learners' engagement and open discussions in mathematics classrooms. It goes beyond the scope of this article to comment on how and how wide these pedagogies are implemented in mathematics classrooms in the country. However, from the data discussed above, we argue that a social justice pedagogy calls for additional demands on the type of discussions and classroom environments that allow such discussions to promote learners' agency in the learning of mathematics and learning about social justice **through** mathematics learning. In addition to discussions about different solution methods to problems presented by the teachers, as may happen in many mathematics classrooms, the social justice pedagogy calls for open discussions about, possibly controversial, topics in society that raise questions of values, where different opinions should be confidently expressed and respected. Also, it allows questions about the assumptions behind the given information and identifies the limitation of mathematical solutions.

Implementing these kinds of mathematical activities require teachers to foster classroom atmospheres where in-depth discussions and open debates are common. It also requires teachers to encourage their learners to raise questions about sets of data shown to them and interrogate these themselves, thereby leading to the cultivation of their critical-thinking skills. This echoes Hargreaves' (1994:251) argument that learners' voice must be guided by vision to avoid pandemonium: "Voices need to be not only heard, but also engaged, reconciled [when possible] and argued with." In the Philippine cultural context, this may require teachers and learners to overcome presumptions that voicing disagreement is rude or impolite, especially in classroom settings, where teachers are regarded as authority figures.

Limitations and Conclusion

As a pilot study conducted during online settings that merely involved two teachers, we are well aware of the limitation of this study to make generalisations about the incorporation of social justice in the mathematics classrooms in the Philippines. As a first study of its kind in the country, it helped to identify two main areas in

which teachers needed support to develop their agency to incorporate social justice in their mathematics teaching, namely, in crafting suitable activities and in employing pedagogies to use them. Here, we have not taken into consideration the effect of such social justice pedagogy on the learners' learning of the mathematics and about social justice. Nor have we investigated the trajectory of the teachers in the development of their understanding of and commitment to social justice. These are important shortcomings that future research can shed light on. Using larger samples of teachers in different contexts and a larger variety of data collection methods are necessary to learn how to incorporate social justice effectively in the Philippines. Similarly, longitudinal studies would demonstrate other issues in terms of teacher growth and negotiation with the educational system.

Social justice in mathematics lessons makes mathematics more meaningful and relevant to learners, and helps them to understand the uses of mathematics in everyday life. When implemented well, it can foster learners' critical-thinking skills. It can also help them develop a greater awareness of social ills and prepare them to be citizens who may contribute to a more just society. However, integrating social justice in school mathematics involves much more than a set of abilities that many teachers currently lack. It should aim at furthering teacher agency including knowledge of and commitments to social justice and to quality mathematics teaching.

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Authors' Contributions

All authors were involved with the conceptualisation of the research and during the actual implementation of the pilot study. During the analysis, each author independently reviewed and analysed the transcripts. A collaborative discussion followed which was where the emerging themes were identified. In terms of writing the paper, Atweh led the writing for the background, literature review, study aims, and theoretical framework. Guzon wrote the methodology. Punzal and Yap arranged and drafted the findings. Azada-Palacios led the writing for the discussion and conclusion. Everyone read the different written parts of the paper as a whole and then made suggestions on how the parts would align better. Punzal did the formatting for the final submission. Yap coordinated and oversaw the subsequent revision processes.

Notes

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