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ORIGINAL ARTICLE

Mathematics home-school partnerships in diverse contexts

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Abstract

The school and the home are both influential contexts in which a child learns mathematics, and therefore schools and families should work collaboratively to achieve shared goals for children's mathematics learning. In culturally and linguistically diverse areas, schools have richness to draw on but may face additional challenges in engaging with parents from varying backgrounds. To understand these challenges, this study undertook a culturally focussed investigation of mathematics home-school partnerships within one diverse school in a low socio-economic area of Auckland, New Zealand. Teachers responded to a questionnaire, and focus group interviews were held with diverse groups of parents. Findings indicated tensions regarding differing mathematics pedagogies used at school and by parents and different desires around formal communication about mathematics learning. The diversity of the school generated further challenges because different parent groups dealt with the tensions in different ways. Knowing more about these parental approaches may help diverse schools to design programmes and craft communication that include more of their community in mathematics teaching and learning.

Keywords Home-school partnership in mathematics · Culturally responsive pedagogies · Parental agency · Communication

Introduction

The school and the home are both influential contexts in which a child learns mathematics. When schools and families start to align their practices and work

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collaboratively towards achieving shared student-focussed outcomes, a home-school partnership develops. These partnerships may be organized in ways that help to "improve schools, strengthen families, and help students succeed" (Epstein 2009, p. 1). However, effective mathematics partnerships are difficult to achieve, particularly so in schools where the community comprises people from varied cultural and linguistic backgrounds (de Abreu and Cline 2005). Parents may have different experiences, beliefs, and expectations regarding mathematics and mathematics education, creating further complexity in the development of effective partnerships.

Mathematics poses particular challenges for engaging with parents. It is regarded by many as a difficult subject (Fisher and Neill 2006), and parents may have had troubling experiences of learning mathematics themselves (Civil et al. 2005; Jay et al. 2018; Meaney 1999; Williams et al. 2016). Such experiences may contribute to findings that parents' involvement with their child's mathematics learning can be negative (Patall et al. 2008; Van Voorhis 2011). In general, however, research into the effects of parental involvement in children's mathematics education suggests that parental engagement has multiple benefits. These benefits include improvements in mathematics achievement (Chang et al. 2015; Sheldon et al. 2010; Van Voorhis 2011) and improvements in the child's motivation, attitude, and self-efficacy with mathematics (McGee and Spencer 2015; Van Voorhis 2011; Wilder 2017; Williams et al. 2017).

Furthermore, the home-school partnership in mathematics is a matter of equity. Mathematics is a gatekeeper subject for many life options, and its value cuts across cultural interests and concerns, heightening parental worries about progress in mathematics (Te Maro 2018). Explicitly working *with* cultural diversity is a central aspect of establishing a mathematics home-school partnership; to build effective and culturally respectful partnerships, schools need to know what parents believe, perceive, and practice in regard to their children's mathematics learning, and they need to be able to create reciprocal relationships. To understand the complexity of partnership in mathematics more deeply, this study undertook a culturally focussed investigation of the mathematics home-school partnership within one diverse school in Auckland, New Zealand.

Conceptual framework and literature background

To understand home-school partnerships, this study uses Epstein's (2009) two conceptual models of the *Overlapping Spheres of Influence* and *Six Types of Involvement*. There is a reciprocal relationship between these two models, and both may be considered when designing, implementing, or evaluating a home-school partnership programme. Epstein's frameworks have previously been used in mathematics education research, for example, to scaffold literature reviews (Averill et al. 2016) and to measure the implementation and effectiveness of partnership activities in mathematics (Sheldon et al. 2010).

The *Overlapping Spheres of Influence* model identifies three major contexts in which students learn and grow: the school, the family, and the community. The aim of an effective home-school partnership is to increase the amount of overlap between these contexts ("spheres"). For example, schools may consult, assist, inform, and involve parents in their children's learning, thus bringing home and school closer

together (Epstein and Sanders 2000). Effective home-school partnerships are reciprocal, with schools learning from parents as well as parents learning about the school. "Family-like schools" and "school-like families" are terms to describe positively the ideal "state of being" for a home-school partnership. This means that a home-school partnership must attempt to involve all types of families and that the school and the family must participate equally. To understand how the overlap between the spheres may be increased, Epstein's (2009) framework of *Six Types of Involvement* identifies and categorizes activities within a home-school partnership. The six categories in the framework are parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community. These are elaborated with reference to the mathematics education literature below.

Parenting is about assisting families to understand the home conditions that support children as learners and assisting schools to understand families (Epstein 2009). Within mathematics education, the "Math and Parent Partners program" (Civil et al. 2005; Knapp et al. 2017) is an example of the former that has helped parents to improve their specialized mathematics knowledge and, in some cases, to break generational cycles of "maths phobia" by building confidence about mathematics. To assist schools to better understand their families, some researchers have promoted visiting families within their homes and community settings, for example, Civil (2007), in the context of Mexican immigrant families living in the South of the USA, and Ewing's (2009, 2012) "funds of knowledge" research with Torres Strait Islanders in Australia. Such research has enabled teachers to gain insight and knowledge into how mathematics is used within the daily lives of their students and then plan meaningful mathematics units for their students. Research with Pacific learners and their parents similarly suggests that meaningful contexts for mathematics are important in developing culturally responsive teaching practices (Bills and Hunter 2015; Hunter 2010; Hunter et al. 2016). The "parenting" type of involvement works to counter the deficit discourse that often surrounds parent involvement in children's learning of mathematics (Remillard and Jackson 2006; Schnee and Bose 2010).

Communicating involves effective school-to-home and home-to-school communication about both programmes and student progress (Epstein 2009). Communicating is a vital type of involvement as it underpins all the interactions that parents, teachers, and students have within a home-school partnership. Breakdown in communication may occur from unequal power relationships and differences of language (Averill et al. 2016). Hunter et al. (2016) documented this occurring within New Zealand, describing how Pacific parents gave the impression they understood what was said to them by the school in order to avoid embarrassment. Communication between parents and teachers is complex, particularly when reporting achievement, where teachers use specialist vocabulary—"teacher talk"—that may be misunderstood by the parents (Crafter 2012). The mismatch seems to be a common experience particularly for immigrant (Jay et al. 2018) or marginalized parents (Crafter 2012). Furthermore, it has been found that parents are less likely to understand reports for mathematics than for reading (Maher 2007).

Biddulph et al. (2003) suggest that parents need clearer communication about how to use resources and why specific areas of the curriculum (such as ordinal counting) are important. Similar needs were exposed during programmes established to provide clearer communication, such as the *Mutukoroa* (Trinick 2015) and the Home School

Partnership Numeracy (Fisher and Neill 2006), both based in New Zealand in Māori and English mediums, respectively. Reviews of these programmes found that despite thorough planning, parents indicated they needed more time and explicit explanations to fully understand assessment, curriculum levels, and teaching aims (Fisher and Neill 2006; Trinick 2015). These findings demonstrate that communicating information about mathematics learning is likely to be much more complex than many teachers and schools realize, especially in the context of reform in mathematics (Averill et al. 2016; Remillard and Jackson 2006).

Volunteering is a way that families may support children and school programmes, but it requires recruitment, training, work, and schedules (Epstein 2009). Trinick (2015) suggests that when parents volunteer to attend events, such as cultural performances, the positivity of the school climate is likely to improve; however, parents must volunteer within a curriculum-based area for students to experience any academic gains. It is often challenging to find ways to recruit all types of parents, especially those that work during the day (Epstein 2009). Encouraging volunteers to assist with mathematics has an added barrier because past mathematical failures may mean parents feel they do not have enough confidence or knowledge to help (Nicholas and Fletcher 2017).

Learning at home includes homework, other curriculum-related activities, and individual course and programme decisions (Epstein 2009). Providing mathematics homework is the most common activity schools set to encourage mathematics learning at home (Sheldon et al. 2010). However, there may be differences between perceptions of teachers and parents as to who is responsible for children's learning of mathematics at home; in a study by Wilder (2017), more parents saw this as a balanced partnership with teachers, whereas teachers saw the responsibility to be mostly their own. In an interview study of 18 parents in low-income, minority communities, Schnee and Bose (2010) found parents to be agentic in both their explicit actions of homework help and their choice to allow their children to take responsibility themselves. Yet sometimes tension arises when parents hold different mathematics knowledge or beliefs than what is taught within the school, and this misalignment can cause confusion, frustration, or even "trauma" during homework time; and if the parent teaches their child the "old way," it may even lead to the child being reprimanded at school for "doing it wrong" (de Abreu and Cline 2005; Jay et al. 2018; Lange and Meaney 2011; Mistretta 2013; Takeuchi 2018). Different groups of parents may value different pedagogical strategies; for example, separate studies have found that Pakistani and Chinese parents value rote learning and repetition activities that are downplayed by the schools (de Abreu and Cline 2005; Li 2006), and another study found Filipino students in Japan learned different methods of multiplication from their parents (Takeuchi 2018).

Schools and teachers may be unaware of the extent to which mathematics learning occurs in the home. In one study where children were asked to draw themselves "learning mathematics well," only four of the 208 participants drew a classroom setting; many children drew times when they were working solely with a parent or participating in a family outing such as going shopping or counting whilst driving in the car (Ferguson et al. 2018). Chinese immigrant parents in the USA and Pakistani immigrant parents in the UK acted to remedy what they saw as deficiencies in school mathematics teaching by buying textbooks and setting extra homework (de Abreu and Cline 2005; Li 2006). Jay et al. (2018) found that middle-class parents drew on a range

of resources to address difficulties with homework, including getting help from family members, the internet, or private tuition—something particularly utilized by the immigrant families in their study.

Mathematics homework often causes more partnership challenges than literacy homework. Muir (2016) suggests this is because primary students regularly bring a reading book home each day but receive mathematics homework less frequently. Therefore, parents are less aware of what their child is learning and how they are progressing. Some studies have investigated literacy-style interventions such as sending home mathematics games (Muir 2016) or interactive mathematics storybooks (Graven and Jorgensen 2018), as ways of connecting parents with mathematics learning. The results of these studies found that participants (students and parents) increased their enjoyment of mathematics. However, the challenge in both cases was the time needed to create and manage the resources, as well as matching the academic level of the activity to the need of each child.

Decision-making includes families as participants in school decisions and governance or advocacy via parent committees (Epstein 2009). The few studies that report on this area indicate that it is challenging for a home-school partnership to reach a place where families can be involved in decision-making (Fisher and Neill 2006). When parents take on leadership roles, they begin to consider their decisions for the betterment of all children within the school, not just for their own family; however, schools and teachers may find it uncomfortable to give up the control they have traditionally held (Civil et al. 2005). Studies within *Kura Kaupapa Māori* (immersion schools) in New Zealand have documented how parents can contribute to the decision-making process within culturally homogenous communities (Meaney 1999; Meaney et al. 2012, 2013). When parents enrol their children in these schools, they commit to becoming part of the school community and have a duty to participate in curriculum planning. However, despite their willingness, Meaney (1999) indicated that parents must be thoroughly educated about the mathematics curriculum to make properly informed decisions.

Finally, *collaborating with the community* coordinates resources and services in the community, such as local businesses (Epstein 2009). Community collaboration within a home-school partnership is studied far less than any of the other types of involvement. One study (Sheldon et al. 2010) found that only six out of 39 schools connected businesses and community leaders with students as mathematics mentors, despite all these schools being involved in a home-school partnership improvement programme.

To summarize, it is evident that the rich body of research into home and school partnerships incorporated each of Epstein's (2009) *Six Types of Involvement*, albeit to varying degrees. Furthermore, the literature considers immigrant and indigenous parent groups as important stakeholders from whom to gain perspectives of productive partnerships. However, more research is needed in diverse settings (Crafter 2012). Auckland, like many international cities, is "superdiverse" (Spoonley 2017), and with diversity, there is a greater challenge as the differing needs of various groups need to be considered. Policy documents in New Zealand are aimed at addressing the issue of diversity by positioning home-school partnerships as a key part of culturally respectful and appropriate practices for improving learner outcomes (e.g., Ministry of Education [MOE] 2007, 2011, 2013a, 2013b, 2018a, 2019). Yet how successful are schools in forming productive partnerships, particularly in a subject like mathematics that carries

additional partnership challenges? Often a school's parent body is seen as one group, despite the linguistic and cultural diversity present amongst the student body. Plans for home-school partnership, and even the term home-school partnership, identify two players: "the parents" as a group and "the school." It is clear mathematics education would benefit from more knowledge about mathematics home-school partnerships within settings that have diverse populations, in order to further develop an asset-based view of parental perspectives in these often marginalized settings. This study is aimed at taking a more nuanced look at partnership in mathematics, by inviting different groups of parents to share their ideas in a manner that acknowledges their cultural background.

Two research questions were posed. (1) How do different groups of parents perceive their children's learning of mathematics at school and at home? (2) What challenges do parents and teachers experience in partnering around mathematics learning?

Methods

The research took place in a large multicultural primary school catering for students from years 0–6, in South Auckland, New Zealand. The school was chosen for the research because the principal expressed an interest in establishing better home-school partnerships in the subject of mathematics. The roll was composed of 642 students who identified as follows: Tongan (30%), Indian (19%), Samoan (16%), and Māori (13%). The remainder included students of Cook Islands Māori, NZ European, Niuean, Vietnamese, Fijian, African, Cambodian, Chinese, Middle Eastern, Tokelauan, Filipino, and Sri Lankan descent. Of the students at the school, one-sixth were born overseas, and one-third were English language learners. The school was in the 2% of schools in New Zealand with the highest proportions of students from low socio-economic backgrounds. This rating implies that a community is more likely to have low levels of both education and employment, be receiving income support, and experience household crowding (MOE 2018b).

In addition to obtaining and following university ethics approval, all procedures were designed in consultation with staff from the school who were members of the Tongan, Indian, Samoan, and Māori school communities. Aspects of cultural expectations and requirements (such as meeting protocols, prayer, food, and language) were discussed and planned for. A colleague advisor, specializing in Biliteracy and Pacific education, then checked this advice to finalize the research protocols (see also Anae et al. (2001) for more information about research with Pacific peoples). The study is composed of two separate procedures: an online survey for teachers and focus group interviews for parents.

Participants

The study had 35 participants in total, approximately equal numbers of teachers and parents. All 30 classroom teachers were invited to complete the survey, and 18 responded. Classroom teachers in the school were all female, and 19 identified as Pākehā/NZ European, four Māori, two Fijian-Indian, two Indian, two Samoan, and one Tongan. The teacher survey was made anonymous because two of the researchers had a

professional relationship with the school. Parents were invited to participate via posters in the school, the school Facebook page, and at an afterschool reading programme. There were 17 parents who volunteered to participate: one father, 14 mothers, and two grandmothers. Four of the participants self-identified as Tongan, three as Samoan, three as Māori, one as Niuean, and six as Indian (either born in India or Fiji). All parent participants were assigned a pseudonym.

Teacher survey

To collect teacher perceptions of parent interest and involvement in children's learning of mathematics, a link to an online survey was sent to all classroom teachers using the school's email list. Participants volunteered by completing the survey, which contained a total of ten open-ended questions. These questions were as follows:

1. In general, how do you think families in the school community feel about mathematics?
2. What barriers do you think prevent families from engaging with their children's learning of mathematics?
3. What sort of mathematics activities do you think parents do with their children at home?
4. What sort of mathematics do you think families in the community use in their everyday life?
5. What do you believe the school does to engage families in the students' learning of mathematics?
6. What do you as a teacher do to engage families in the students learning of mathematics?
7. Do you think families understand the written mathematics report? Please explain.
8. During the latest student-led conference, how did your students show to their families their mathematics learning?
9. Do you have any ideas about how the school community (school, teachers, students, and parents) could work together to share knowledge about mathematics?
10. What do you think families will say they need in order to develop a more collaborative mathematics home-school partnership?

Questions for teachers did not differentiate between different parent groups by ethnicity; they were left open-ended to allow for teachers to consider and comment on differences as they saw fit. However, teachers were explained the cultural focus and methods of the parent focus group interviews.

Parent focus group interviews

To collect parent perceptions of their child's experiences learning mathematics, focus groups were formed. The focus groups were arranged with consideration of parent availability and the language in which parents wished to participate. Following the preferences of the volunteer participants, five focus groups were offered. The first four focus groups (Māori, Samoan, Tongan, and Indian) were each culturally homogeneous

and participants were offered the support of a translator (which was taken up in the Samoan and Indian focus groups). The fifth focus group had a diverse range of ethnicities and cultures (Niuean, Tongan, and Fijian-Indian), and these participants indicated they wished to attend an English language focus group with no other preference given.

A list of starter prompts was prepared, including the following:

- Please introduce yourself and tell us about your children.
- Can you tell us about your experiences of maths when you were growing up?
- What do you do at home to help your child with school mathematics?
- Do you understand the school report for mathematics? Are there ways it could be improved?

These starters were intentionally broad (as will be explained further below). The first author conducted the focus group interviews with a view to allowing the conversation to unfold naturally wherever possible whilst being mindful of the aims of the study, intervening only to redirect the conversation back to mathematics if it wandered too far.

Culturally appropriate practices for each focus group setting were determined by seeking advice from members of the community and reading research advice from the literature. For Tongan and Samoan participants, the two focus groups aligned with a *Talanoa* method (an inclusive, transparent, and participatory dialogue). Vaioleti (2006) argues that *Talanoa* allows people to share their true stories, which results in more authentic data than in other methods. The main difference of a *Talanoa* focus group compared to a traditional focus group is that the precise nature of questions is not decided in advance; instead, an opening statement determining the nature of the conversation is prepared that will indicate the purpose and topic of the *Talanoa*. Such an open technique is "congruent with the main tenets of qualitative inquiry" (Hesse-Biber and Leavy 2011, p. 184) because the participants' own agenda may then emerge in the dialogue. The Ministry of Education recognizes the importance of this method and has used it in "Pasifika" schooling improvement research aimed at gathering information about the anxieties, desires, and stories of Pacific parents (Amituanai-Toloa et al. 2009; Anae et al. 2001). The fifth focus group, being made up of Pacific peoples, also followed these methods.

The focus group involving Māori parents followed appropriate methods, namely, that it addressed a collective need, aimed at benefitting Māori and used a consultative process (Tolich and Davidson 2011) whilst adhering to the principle of *whakatuia* (integrating and making links). Advice on how the research should be conducted was gained from a respected Māori staff member in the school. *Mihimihi* (introductions), *waiata* (song), and *kai* (food) were included during the focus group. As the interviewer had a relationship with the school, her long-term commitment to the community and the well-being of Māori learners was recognized. The focus group process was designed to honour Māori as *tangata whenua* (indigenous people) and to understand more deeply what it means for Māori to enjoy educational success as Māori (MOE 2013a).

Research concerning Indian communities in New Zealand is lacking; with no formal reference for guidance, the design of a focus group for the Indian participants was made through consultation with an Indian staff member who was a respected member of the

local community. In line with the advice received, participants brought food to share at the conclusion of the focus group.

In each focus group, the conversations lasted approximately 40–70 min. These were audio-recorded and transcribed by the first author.

Data analysis

An iterative process of thematic analysis (Braun and Clarke 2012) was used to analyze the data. The first author completed the first analysis steps, taking each type of data (teacher surveys and five focus groups) to generate themes within these groups. The responses to each survey question were categorized and counted; each question generated between four and eight categories. Secondly, the transcripts of each parent focus group were coded inductively to find themes within each group; typically, around three key themes emerged from each focus group. Notably, the conversation generated in the mixed focus group was less cohesive and it was more challenging to identify coherent themes in this group. Next, all three authors met to discuss the results of these first waves of analysis and they developed a codebook to encompass the themes that were evident across the whole data set. The codes were as follows: mathematics curriculum, mathematics knowledge, mathematics pedagogy, mathematics vocabulary, mathematics home learning, online mathematics learning, school-led activity, parent-initiated activity, communication, honesty, student-led conferences, and school reports. Then, the second author applied these codes to all survey responses and focus group interview transcripts. In many cases the responses were given more than one code; examples may be seen in Table 1. Finally, all three authors met again to check this coding process and to collapse and refine the themes (as per the methods of Braun and Clarke (2012)) to create two broad meta-themes that encompassed the previously mentioned themes and that were evident across all data sources: *mathematics knowledge and pedagogy* and *issues of communication*. Mathematics knowledge and pedagogy included the codes of curriculum, knowledge, pedagogy, vocabulary, homework,

Table 1 Examples of coding

Questionnaire response/focus group excerpt	Themes coded
"You know what happens when the kids get the homework book at home, and when they want to work they will say 'oh I do not feel like writing it down' but when it comes to the internet they will say 'oh yeah I want to go and do my homework online.'" (focus group interview)	- Mathematics home learning - Online mathematics learning
"[You are] getting all the parents coming in at once and seeing the teacher, the teacher does not have much time to explain where your child is lacking." (focus group interview)	- Student-led conferences - Communication
"They may not have the understanding to help their children with more complex maths concepts." (teacher survey)	- Mathematics knowledge - Mathematics home learning
"We provide workshops to equip families to teach their children." (teacher survey)	- School-led activities - Communication - Mathematics pedagogy

and online learning. Issues of communication included school-led activities, parent-initiated activities, student-led conferences, honesty, and school reports, in addition to communication. The two themes will be presented and explored in the section to follow.

Findings

The two themes presented below emerged from both teacher and parent data and were evident in all of the focus groups and the teacher surveys. Included in this section are responses that explicate these themes and highlight contrasts between the different participant perspectives.

Mathematics knowledge and pedagogy

Teachers appeared to consider parents as lacking mathematical knowledge or lacking confidence in their knowledge. For example, when asked about how parents in the community feel about mathematics, seven teachers indicated a belief that parents may feel they do not have the knowledge to help their child with mathematics, for example, "They may not have the understanding to help their children with more complex maths concepts." This perspective was particularly evident in a subsequent question asking about barriers to engaging with mathematics; 17 of the 18 teachers mentioned parents' lack of knowledge of, or confidence in, mathematics, for example, "Families may think that they do not know enough about the subject to assist their children's learning." Finally, there were comments that "Parents need to upskill their own knowledge and ability" to explain mathematics information evenings held at school.

However, whilst the teachers may have thought parents lacked mathematics knowledge, the parents spoke more about the mathematics *pedagogy* used within the school as the area in which they lacked understanding. This became a topic of conversation in all five focus group interviews. For example, Sione was a high school mathematics teacher in Tonga before he immigrated to New Zealand with his family. He was clear about his desire to be better informed of the curriculum and mathematics strategies used within the school.

> Sione: I think the better way is to give them the, the syllabus of every person's class and then show them what's the, the exact math that you want them to use. … I can use a different kind of method. But when [my son] came to do school[work] he says "no that's wrong." I remember this. So, I can't change his mind, once he says, "no! My teacher is right! But you're wrong."
> …
> Sione: It doesn't matter if we, we get the same answer. He, he really needs the teacher's way. Oh, that's why if they give any homework or something… I think they should uh … tell us what kind of math they use. (*Tongan focus group*)

Sione's methods of mathematics were different from those his son learned at school, and his son only viewed the teacher's methods as correct. The differences in

mathematics strategies used by parents from those used at school were also mentioned in every other focus groups, for example,

> Kahurangi: … but I've noticed in schools today they're quite different. Like […] when you're adding and you've got 52, and you add 52 plus 6 they're using the - (shows horizontal action with hands) … back in the days we used to go the long way (shows vertical action with hands) which is much easier. Yeah, so you hear from the teachers you know, you don't teach the children like that. (*Māori focus group*)

Kahurangi was referring to recording addition using either a horizontal format (preferred by the school) or her preferred vertical format. Kahurangi's strategy was called the "algorithm" by teachers at the school and was not considered an appropriate one to use.

> The strategies that we used in high school – it was, for me it was easier, but now, like in school now… you know even having my children come home and they try and work out something, a maths problem and they do it differently – the strategy. And I'm thinking, you know, what I did back then is a much longer process of getting the answer. But now I still find it confusing, like - is that right? Even the new strategies that the kids have picked up now, it's very hard. So yep, I find it hard that they come home with new strategies and I can't help: because I still have this old way of working it out! (*Leilani*, *Samoan focus group*)

In short, it was clear that parents within the study had their own strategies for solving mathematics problems; however, these strategies did not align with the school's preferred approach. This finding strongly mirrors the research literature (de Abreu and Cline 2005; Jay et al. 2018; Li 2006; Takeuchi 2018). In contrast, all participating teachers perceived parents not having enough mathematical knowledge as the main barrier preventing effective engagement. This may highlight teachers' lack of knowledge of their learners' families, and this deficit view of parents is also supported by the literature (Schnee and Bose 2010).

Such a deficit view framed some teachers' responses to the question of mathematics partnership, which outlined ways the school engaged with parents as providing resources (7 responses) or holding information evenings (7 responses), for example, "[We] made maths packs for them and invited them for a meeting to show them how it is to be used." Such comments evidence the opinion that parents need to learn the school way of doing mathematics, rather than finding value in the strategies held by parents.

> [They need to] understand how we teach maths at school (mental strategies versus vertical algorithm) and what we cover in the curriculum. (teacher questionnaire response)

Yet whilst teachers reported providing resources and workshops as common ways the school engaged with parents in mathematics, the parents did not mention these. This

suggests that they either were not part of the school's regular practice or were not known/valued by parents.

Different interpretations were also evident regarding homework. The teachers saw mathematics done at home exclusively in terms of school mathematics such as basic facts practice (9 responses) or homework (6 responses) rather than considering other cultural and family practices that may have included mathematics (c.f. Civil 2007; Knapp et al. 2017). Additionally, some parents remedied what they felt to be a lack of school homework.

> Mathura: I think their homework is [too] little, so only a few months ago I joined them to Kumon classes, have you heard of Kumon? So, my kids go to Kumon extra classes and they have [homework] for every day: they do their homework, school homework…once it's done they have lots of Kumon class. I think it's a matter of practice, everyone has booklets and the kids practicing it every day. (*Indian focus group*)

Kumon tuition provided a style of teaching more in line with this parent's own valued pedagogical practice, rather than that of the school. Here, rather than wishing to learn about the schools' methods, as expressed clearly by Sione, this parent reinforced her own pedagogical practice and found support for it outside the school, similar to some families in Jay et al.' (2018) study. In general, the parents in the Indian focus group expected more repetition and drill-style homework, as this was how they had been taught at school, and to receive mathematics homework daily. This echoes that of de Abreu and Cline (2005) and Li (2006) in which Chinese and Pakistani parents reported trying to remedy faults that they perceived with the westernized mathematics curriculum at home.

To summarize, teachers thought the parents lacked mathematical knowledge, whereas the parents explained that they either did not understand or agree with the schools' mathematics pedagogy. Correspondingly, some parents wanted more information about the schools' methods, whereas others outsourced other forms of instruction. Whilst the teachers mentioned resources and information evenings as ways to learn about school pedagogy, the parents did not—indicating a possible breakdown in communication.

Issues of communication

Issues relating to communication included the formal school reports on mathematics progress and achievement and the practice of holding "student-led conferences" (in place of traditional parent-teacher interviews). It was clear that the teachers and the parents held contrasting views on the effectiveness of these communication methods.

The majority of teachers (15 of 18) thought that parents understood the system for reporting mathematics achievement, notwithstanding language difficulties. Yet this was not so evident in parents' responses. Participants in the Samoan focus group in particular spoke about the need for *honesty* in reports and communication from the teacher. The following excerpt from the Samoan focus group demonstrates what can occur when the teachers are not transparent about students' progress and achievement.

> Daniella: I think they should be honest about the report … don't say to me "oh he's good" but you know, to be honest to the parents, and tell the parents the truth and say that he's failing, you know - he's heading to that. You know what I mean! He's heading to fail and not achieve. You know to be honest and say. So, I can work, and I can know what to do with him … So, what's his [areas of mathematics that are] like "not good at" or "good at"? They should put that on the report and tell you the truth. Yeah. So, like you go "oh he's so good," but he's not, cause at the end of the year, report comes and exam, and then you know that he's not! (*Samoan focus group*)

Daniella described how her elder son's mathematics achievement at high school was misreported by the teacher who said he was "good" whereas, in reality, her son was "failing" and she was never informed. It may be that there was a breakdown in communication caused by teachers using a specific, euphemistic vocabulary or "teacher talk" (Crafter 2012) in the reports. Daniella implied that, had she known about the lack of progress, she would have been able to give extra support at home. Later in the conversation, Leilani and Faith also expressed a desire for more honesty from the teacher. Such comments are consistent with findings of *Ua aoina le manogi o le lolo* (Amituanai-Toloa et al. 2009), where parents wanted teachers to identify their children's areas of weakness and let them know immediately if they were falling behind.

Other evidence that parents did not understand the school report came from the mixed focus group; Rita described how she had to take the written report and discuss it personally with the teacher in order to understand it. Other parents in the group suggested the reports should be presented and discussed with them personally rather than just being sent home. Parents in other focus groups also expressed the desire for a clearer indication of how their child was achieving in comparison to the rest of their class and according to expected levels. Parents in the Indian focus group reminisced about their own school reporting experiences of being given a ranking (e.g., 2nd in class) or a percentile/stanine on a graph. They thought this information would be useful in understanding their child's achievement. These ideas appear to align with those teachers who suggested that a visual representation of achievement (such as a graph) may be easier for parents to understand; however, it is unlikely the teachers would support the notion of a ranking system for children within the class.

In general, parents wanted more specific information from reports: how they could improve their child's mathematics and what areas in which their children were lacking—as opposed to a description of what the child had learnt that year. In an interesting contrast, parents communicated that they understood the reading report, as their child was given a specific reading age and reading level, which indicated relatively simply if they were at the expected level. This finding aligns with other studies (Maher 2007; Muir 2016).

The other main form of formal communication was the student-led conferences, and teachers gave a number of examples of how students shared their mathematics understanding with their parents at this event, for example, "They completed an equation on a whiteboard and explained to their parents how they solved it." This suggests a perception that student-led conferences were a valuable time for communication about mathematics and pedagogy. Parents, however, reported either not liking the student-led conferences or feeling they did not give sufficient information. Their concern mainly

arose from the "student-led" aspect. Parents gave descriptions of how their children skipped over mathematics in preference for other curriculum areas or only showed minimal examples of their work.

> Rita: Instead of student-led – [the conferences] should be more parents and teachers. Because the teacher is the best person who can explain us how our child is doing at class instead of the children, because you know how they can … anytime they can skip… they won't tell you that oh mum I'm not really good at English… mum I'm not really good at maths. They won't come and tell us. They will just say that yeah, we are perfect. We won't know. (*mixed focus group*)

Clearly, Rita felt the teacher to be the best person to explain her children's mathematics learning. In all focus groups, parents reported wanting to speak to the teacher directly about mathematics during the student-led conference yet felt unable to do so due to the format.

In some cases, parents again demonstrated agency in developing better communication with the teacher. The following two examples illustrate this:

> Rita: what I was doing last year with my son's teacher, you know how he was quite poor with his maths and stuff, so we had a little diary. We had a little diary, everyday what the teacher does, especially for the ones she thinks she has to write it, so she used to fill out how he was doing in maths and what he needs to do the improvement, so when the book comes home I just go read through it and then I work on the same problems, and what he needs to do. (*Mixed focus group*)
> Meera: ... don't know how to teach maths - it's a different way. I ask the teacher, I ask the teacher what you do? Can I give tuition or anything? I ask for the tuition, she said "no, you come and sit for a few hours [to learn] how I teach. You learn. Then you go and teach. (*Indian focus group*)

Rita and Meera both took a proactive approach to improve communication by, respectively, using a daily diary and attending mathematics classes. In this way, Rita was able to properly understand her child's progress and Meera was able to learn the school's pedagogy for mathematics. In these two examples, we see some evidence of the teachers listening to the parents' needs and accommodating them.

To summarize, it is clear that parents and teachers have differing perspectives on the formal methods for communicating about mathematics learning and progress. Teachers thought parents understood the reports and valued the student-led conferences, whereas parents felt the reports were not sufficiently direct or honest, and they were frustrated by the student-led aspect of the conferences because they did not get the information they wanted from the teacher. However, some of the parents demonstrated agency in initiating more productive communication with some teachers who accommodated their needs.

Discussion

The results highlight a number of tensions between parents' and teachers' perceptions and expectations regarding home-school partnerships in mathematics. In this section, these aspects will be teased out in relation to the literature. Following this, Epstein's (2009) home-school partnership model will be used to explore implications from the findings.

Areas of tension

Congruence between home and school is promoted as being optimal for students' mathematics learning (Epstein 2009). This study, however, revealed tensions rather than congruence around teaching and communicating mathematics. Tension is evident firstly between the contrasting mathematical pedagogies that parents use and those that teachers are directed to teach in their classrooms (see also Wadham et al. 2019) This tension is commonly reported in studies internationally (de Abreu and Cline 2005; Li 2006; Mistretta 2013; Takeuchi 2018). Furthermore, the tension indicates that communication from school to parents about significant curriculum changes within the past decade has been insufficient or ineffective (Averill et al. 2016; Remillard and Jackson 2006). Embedded in this tension are deficit views of parents held by teachers, which are likely to have impacted the way in which they attempt to address the issue. The impact of this tension on the learner is also significant but perhaps neglected; caught between pleasing parents and pleasing teachers, learners are left with confusing messages about "right" and "wrong" that particularly work against understanding the mathematics that underpins their often arithmetic-based homework.

Whilst the parents in this study frequently expressed issues with homework, the nature of these issues varied amongst the cultural groups. For the school, this presents a challenge: what does homework look like that would satisfy the range of community groups and the school's perception of valued mathematics? Some parents wanted the homework to reflect the teaching in their child's classroom, with examples of how it was taught (especially if using specific computation strategies promoted in the classroom). Such requests resonated with the aims of Epstein and colleagues' homework programme (Epstein et al. 2001; Van Voorhis 2011), which required teachers to set homework tasks that clearly explained the methods as they were taught in class. Epstein (2009) suggests that schools need to tailor their practices to meet the needs and interests of all their students—and part of this is aligning with parents, to prevent students from being caught in the middle of misunderstandings. Yet other parents instead supplemented the school methods with outside tutoring that was more in line with their own pedagogical approach, as was similarly found by Jay et al. (2018). Such a range of approaches by parents means that the school's plans to change homework need to consider the varied parental perspectives, and this adds to the challenges faced by teachers.

Secondly, there was tension regarding the formal methods of communication between home and school. In general, the confusion faced by parents over school reports has been found in other studies (Crafter 2012; Maher 2007) that report many parents are unsure of their child's progress and attainment in mathematics. Notably, the curriculum levels used within mathematics reporting are broader and less definitive

than levels reported in reading. Reading ages provide an easily understood point of comparison for parents (see also Muir 2016), but there is no equivalent for mathematics. The Ministry of Education recommends having students actively involved in the learning and reporting process, a "fundamental shift away from the one-way transference of information from teacher to parents" (MOE 2018c, para. 2), justifying the school's use of student-led conferences. Yet this choice may not sufficiently consider the needs or desires of parents. Linked to the themes of honesty and clarity in school reports, parents in this study felt that their children would not know enough about what they "should" be doing to give adequate information about their progress in mathematics. Here, the tension is between the Ministry guidelines, as followed by teachers, and the desires of parents. In this case, all the parents were in agreement that they did not want their children to lead parent-teacher conferences. Teachers spoke of the way children were able to share with their parents the school's pedagogical approach to computation, but perhaps the student-led conference is not the best time for this. At the core of this tension are the differences as to who is seen to be responsible for student learning of mathematics. In Wilder's (2017) study, differences were found between parents and teachers regarding who had the ultimate responsibility for children's learning; by contrast, in this study, it appears the teachers gave significant responsibility to the students, and there were differences amongst the different community groups regarding the degree of parent versus teacher responsibility. Some parents were left frustrated by the lack of information about the school's way of teaching, whereas others demonstrated agency to redress this.

Implications for future home-school partnerships

Epstein (2009) argues for the creation of "school-like families" and "family-like schools," which requires a two-way flow of communication; schools need to listen to their parent community to learn their needs, and they need to be able to adequately communicate their information about mathematics learning to the parents. This challenge is significantly greater in diverse contexts. If schools are to become "family-like," then the question may end up being which family? In New Zealand, Māori perspectives must be considered first under the Treaty of Waitangi, but it is possible the community group with the loudest voice may exert the greatest influence, and this has considerable implications for equity. This study heard a variety of voices, which were at times harmonious and at other times discordant. To understand the messages better, we can consider the results in terms of the *Six Types of Involvement* in home-school partnerships: parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community (Epstein 2009).

At the heart of the parenting type of involvement is an understanding of the parenting community. Before even considering the various communities in the home, the teachers in this study did not seem to realize the parents held adequate mathematical knowledge to help their children; instead, they read the lack of understanding of new pedagogy as a lack of understanding in general. This deficit view of parents is evident in the research literature (Remillard and Jackson 2006; Schnee and Bose 2010) and points to a crucial first step in building effective home-school partnerships. A second step may be a greater acknowledgement of diversity, as the teachers did not distinguish different community groups at all in their survey responses. Learning about

communities (e.g., Civil 2007; Civil et al. 2005) may be a way forward here. However, further research may be needed regarding ways to approach this task in the context of "superdiversity" (Spoonley 2017).

There were many examples of communication between home and school identified by both parents and teachers, but it was problematic. School reports may have used too much "teacher talk" (Crafter 2012) as the parents did not feel they gained adequate understanding of their children's progress. Additionally, parents did not gain the information they required from the student-led conferences and would have preferred parent-teacher conferences. Information about new mathematics pedagogies was given at these conferences, via student demonstration and via information evenings and workshops. Yet the fact parents claimed they wanted to know more about these pedagogies implies that the venues for sharing this information were not appropriate.

This study has shown that when teachers welcome parents' questions and visits to the classroom, parents are better able to understand their child's mathematics learning. Schools should find ways to support teachers and parents to develop this confidence and agency. Parent support for reading in classrooms is a commonplace literacy practice in New Zealand schools; it would not be too great a leap to develop this into occasions of volunteering in mathematics (see Trinick 2015). This may simultaneously address some of the tensions in communicating pedagogy.

Learning at home was encouraged via homework, yet the opportunity to consider cultural and community mathematics practices was missed. Perhaps homework activities that required children to teach their parents the new pedagogies and parents to teach children their own methods would be a way to value the knowledge of parents (Civil et al. 2005; de Abreu and Cline 2005; Takeuchi 2018). This could also provide a more appropriate moment to share this information than at student-led conferences. Furthermore, teachers in any context need to be mindful of how they respond to mathematics strategies that students bring into the classroom from home and to consider any messages they give about the value of home learning.

Whilst evidence of collaboration with the community and parent involvement in decision-making did not emerge from the data, there is certainly space to consider these types of involvement. For the study school, and likely other diverse schools internationally, it would be worth consulting with the community about the needs and desires around formal information sharing via school reports and conferences. As the key stakeholder in these events, arguably parents should lead such decisions. Averill et al. (2016) discuss the inconsistencies and lack of direction in policies that expect the involvement of families; here, we see this played out in the challenge to manage the concurrent Ministry directives of involving students in the reporting process (e.g., MOE 2007, 2018c) and being responsive to the needs and desires of families (e.g., MOE 2019).

Limitations

The results of this study must be considered in light of its limitations. The use of surveys for teachers meant that the data gathered from the teachers was not as in-depth as the parent data. Our intention was to foreground the parents' voice, but the results indicate the value in future research that aims to take the findings from parents back to teachers to then capture their response. The parents who volunteered were perhaps

those who had greater interest and self-confidence in either mathematics or communication with the school. Given the reported negative stigma of mathematics for some parents (Civil et al. 2005; Fisher and Neill 2006), it is possible the results do not represent the broad range of views held across the parent community. The use of focus group interviews meant that parents were likely to have been influenced by what others said within their group. This is at times a strength of the focus group method, but at other times, one parent may dominate the discussion. Such aspects, in addition to the small scale of the study, limit the generalizability of the research and we do not claim that our findings would be replicated in every diverse school in New Zealand. However, the study has raised a number of avenues to explore regarding catering for diversity in practice, policy, and future research internationally.

Conclusions

This study has a number of implications for the wider research and policy context, in addition to those that are specific to the study school context. Firstly, this study has shown that rich and useful data can be gathered from parents, especially through qualitative (focus group and *talanoa*) methods, and that many parents are open to sharing their ideas and concerns about mathematics, particularly when considerations are made regarding the participants' cultural backgrounds. The sensitivity to cultural practices and the use of home languages with translation in this study meant that information was obtained from parents whose participation is usually constrained by feeling uncomfortable or being unable to contribute because of language barriers. Parental silence should not be taken by schools as parental ignorance or disinterest (Schnee and Bose 2010). Parents in this study had expertise in mathematics, and in mathematics teaching, that the school was unaware of. Teacher assumptions that parents would not be confident with mathematics were not supported by the data.

The findings of this study show tensions between the perspectives of parents and the school, and these reflect well much of the home-school literature, particularly research in marginalized, immigrant, or indigenous communities. But the diverse context of the study demonstrates the greater challenges when parents differ in opinion from each other as well as from the teachers/school. Some tensions are shaped by policy directives that do not sit well with the parent communities involved in this study, posing difficulties for schools as they make choices about how to communicate with parents.

In sum, the study highlights the importance for schools to solicit parent input by utilizing culturally sensitive methods that are modelled in the study, to enable each community voice to emerge. Harmony of voices provides a strong indication of the direction a school should take to improve home-school partnerships in mathematics learning. In the case of the study school, this would be to change the practices of communication regarding both pedagogies and student learning in mathematics. Such ideas would improve the flow of information from school to home and should improve students' experience of mathematics learning and impact positively their achievement. What remains unaddressed, however, is reciprocal sharing from home to school. Teachers and parents in this study emphasized the school "telling" parents more as representing an improvement in home-school partnership. Whilst this might be a first step, the more complex work of bringing home mathematics into the school might shift

conceptions of mathematics as something "useful" and "necessary" to something that is seen as integral to daily life and part of being a culturally located human being.

Compliance with ethical standards The study was approved by the University of Auckland Human Participants Ethics Committee on 7 May 2018 for 3 years (Ref #021127).

Conflict of interest The authors declare that they have no conflict of interest.

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