Talking about mathematics in two languages: Can parental views inform the development of digital games for young children?

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In this article, the results are presented from a survey of parents' views about the digital games that their young multilingual children play. Previous research has indicated that parents struggled to describe how their children were learning from playing digital games. The results from this study indicate that parents could provide information about the digital games and the mathematical language they invoked. This information could be useful in developing playful, digital games that support multilingual children to talk about mathematics. The survey also provides insights into the follow-up qualitative research studies that are needed to support the development of new digital games.

The premise for our current research is that family members, using the affordances of digital games, can be language resources for supporting multilingual children to talk about mathematics. We consider that talking about mathematics in home and institution languages supports multilingual children to become "progressively conversant with cultural forms of reflection" (Radford, 2008, p. 215). In this paper, we describe the results from an initial survey of parents whose multilingual children play digital games. The online survey asked about how multilingual children engaged with digital games/apps and what features prompted them to talk about mathematical ideas. These data provide initial insights about the sort of information that parents can provide, which then can be used in the development of new digital games. It also provides insights into those aspects that require follow-up qualitative research, in order for newly-developed games to achieve their purpose.

As elsewhere in the world, children in Norwegian early childhood institutions are expected to be provided with opportunities to develop

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their mathematical understandings as well as fluency in all their languages. For example, in the kindergarten curriculum, known as the Framework Plan, it is stated:

> Many children do not have Norwegian as their mother tongue, and learn Norwegian as a second language at their kindergartens. It is important that these children are understood and get the opportunity to express themselves. Kindergartens must support them in their use of their mother tongue, whilst working actively to promote their Norwegian language skills.
>
> (Kunnskapsdepartementet, 2011, p. 31)

Research suggests that multilingual children benefit from discussing abstract ideas, such as mathematics, when they simultaneously develop their home language(s) and the institutional language (May, Hill & Tiakiwai, 2004). Focusing only on the development of children's institutional language may result in them becoming subtractive, rather than additive bilinguals (Cummins, 1996), without the ability to discuss abstract ideas in any language. In school situations, children who have participated in mathematical interactions in two or more languages have been shown to improve their achievement in mathematics (Meyer, 2016). This is an example of additive bilingualism.

In Norway, there has been criticism of the lack of effort by kindergartens to achieve the aim of the kindergarten Framework Plan (Kunnskapsdepartementet, 2011) to develop all children's languages (Sundby, 2016). At the same time, it is acknowledged that it is difficult for kindergarten staff to do this if they are not fluent in the other languages (Otterstad, 2016). Therefore, it is important to find ways that kindergartens can work with parents to develop children's home languages, including to talk about mathematical ideas. Research has shown that parental support, along with preschool engagement, can have a positive effect on children's mathematics learning when they enter school (McCarthy, Li & Tiu, 2012).

We consider that the affordances of digital devices provides a possible bridge between parents and kindergarten staff in developing ways to discuss mathematical ideas in all the children's languages. However, research on young children's use of hand-held devices is still in its infancy, reflecting the rapidly changing digital environment in which hardware and software developments outpace understandings about how to maximise their affordances. In 2011, a study found that 62 % of Norwegian children aged between 0 and 6 years had experiences with touch screen devices in the home (Hardensen & Guðmundsdóttir, 2012). It is likely that in the six years since the survey was conducted, a higher proportion of children now have access to these devices. In addition, a Dutch study

of children aged 4–7 years old found that those who had two parents born outside of the Netherlands were more likely to use ICT at home than children whose parents were born in the Netherlands (McKenney & Voogt, 2010).

In the research by Neumann (2014), 3–5 year old children who engaged with touch-screen devices at home learnt more early literacy skills than children who did not. The amount of time spent on the touch-screen devices did not seem to affect the results, which Neumann suggested indicated that it was the quality, not the quantity, of time which increased children's learning possibilities. Similarly, Plowman, Stephen and McPake (2010) found that children's engagement with digital devices at home was richer than those in kindergartens, partly because the children asked more questions and learnt from watching other family members use the devices. However, in a survey, Plowman, McPake and Stephen (2008) found that parents did not consider that children learnt about using new technologies, nor did they learn through the technologies. This suggests that although parents may consider that digital games could provide their children with knowledge and skills, they may be unable to identify if or how it was occurring. Similarly, in a study of an ICT language learning game for preschool children, teachers were found to struggle with knowing how to engage with children (Meyer, 2013). Meyer suggested that, being a game, teachers were reluctant to intervene or if they did intervene did so by turning it into a teaching episode. Findings such as these suggest that research about interactions within family environments may provide more useful information than focusing on teachers in kindergartens. However, finding ways to gain knowledge about these interactions from parents may not be straight forward.

Previous research into the benefit of mathematical digital games has focused almost exclusively on number knowledge (see for example Ginsburg, Jamalian & Creighan, 2013; Ladel & Kortenkamp, 2014). Nevertheless, the Norwegian kindergarten framework (Kunnskapsdepartementet, 2011) has broad mathematical objectives which are connected to Bishop's (1988) six mathematical activities: Counting, Measuring, Designing, Locating, Playing and Explaining. The Framework Plan is also clear that children's learning should occur through "play, experimentation and everyday activities" and specifically that "kindergartens have a responsibility for encouraging children in their own investigations" (Kunnskapsdepartementet, 2011, p. 41). From their research, Noorhidawati, Ghalebandi and Siti Hajar (2015) suggested "children in the age of 4–6 years old would prefer and engage more to game based apps as they are learning more through playing and pleasurable activities" (p. 394). Therefore, we consider that the digital games most likely to be in alignment with the

Framework Plan are those that involve children in problem solving as it includes aspects of play, experiementation and everyday activities (see for example Helenius et al., 2016; Lembrér & Meaney, 2016) connected to the six mathematical activities.

There also has been little research about using digital games to promote dialogue about mathematical thinking (Lembrér & Meaney, 2016). Falloon and Khoo (2014) found that five-year olds working in pairs on iPads on emergent literacy apps displayed a range of different talk types. However, the most common type resulted in children confirming rather than extending each child's ideas. Using Bernstein's ideas about classification and framing in regards to digital apps, Palmér and Ebbelin (2013) found that "the classification and the framing of applications influence the dialogues that occur and the mathematics that becomes possible to learn" (p. 431). Carlsen (2013) found in his study of the interaction between kindergarten children and teachers using ICT, that the teachers took on the role of promoting the discussions. Falloon and Khoo (2014) suggested that teachers need to learn how to support children to extend each other's ideas. In these studies, the children were speakers of the majority language, indicating that specific research with multilingual children is needed.

With so little research in the area of multingual children using apps to develop their mathematical languages, we decided to identify what parents were aware of when their multilingual children played digital games through an online-survey. As described above, the decision to focus on parents rather than teachers was because previous research suggested that immigrant children may use digital media at home more often than other children. This study forms the first stage in collecting and analysing relevant data for planning and implementing a later intervention. Our research questions were:

- What do parents show awareness of when their multilingual children engage with digital games at home?
- What do the responses indicate about the need for other research in order to develop playful digital games which promote mathematical discussions in multiple languages?

Surveying parents's views

Previous surveys of parents' perspectives on their children using technology has focused on the accessibility of the devices (Plowman et al., 2008), their usability (Neumann, 2014), or the types of tasks that children engage with when using ICT at home (Neumann, 2014; Zevenbergen &

Logan, 2008). As our focus was on parents' awareness of the features of digital games that prompted their children to talk about what was happening, especially in regards to mathematical activities, we adapted some of the questions in the earlier surveys and asked other questions specific to our focus.

We kept the survey short to encourage more parents to respond (see appendix). The survey had 8 questions which asked about the age of the children, the languages that they spoke and the digital games/apps that they played. Most questions were multiple-choice with some possibilities to add further details.

Zevenbergen and Logan (2008) had asked parents to complete a checklist of possible tasks done by four and five year old children on computers. Similarly, McKenney and Voogt (2010) asked children aged between four and eight years about a set of computer tasks that they used at home and at school. Both Zevenbergen and Logan (2008) and McKenney and Voogt (2010) surveys included similar sets of tasks as choices, such as pre-literacy and drawing. They also made a distinction between game playing and other types of tasks. In a survey on the use of hand-held devices, Neumann (2014) asked parents to list the tasks that children did on these devices and then classified the responses according to six groups: "gaming apps, creating apps, e-book apps, literacy apps, math apps and other educational apps" (p. 115). However, we consider that gaming apps can involve both game playing and opportunities for developing understandings connected to Bishop's (1988) six mathematical activities. For example, Lego and Duplo as construction games have the potential to support children's understandings about the mathematical activities Designing and Locating (Lange & Meaney, 2013). Distinguishing between educational apps and digital games could distort the possibility of some digital games being considered appropriate stimuli for mathematical language development. Consequently, we provided an open-ended question, where parents could nominate the games their children played and also asked specifically about the mathematical language they used by providing a set of choices (see table 5).

The survey included a multiple-choice question about the features of digital games that parents considered made them attractive to children and what the parents would include in a digital game if they were designing one. The question choices were in alignment with what Falloon (2013) found were the features used by a teacher of 5-year olds to choose learning apps for her class. We wanted to determine the general features that would make a mathematical game attractive to children and to see if parents could distinguish between their own views and what they considered their children valued.

Further, we asked about the features of the digital game that seemed to prompt the children to talk, in what language(s), and what kind of mathematical language they used. Plowman et al. (2008) noted that parents in their study struggled with describing their preschool children's interactions with technology. However, they were able to indicate when children had adopted new language terms. We, therefore, included a question about the mathematical language that parents considered their children were using. The survey question about the mathematical language was inspired by Bishop's (1988) descriptions of the six mathematical activities. In the survey question, Counting and Explaining are combined as Bishop (1988) considered that classifying things was a part of the activity Explaining. For many young children, categorising by number is similar to categorising by colour (Hore & Meaney, 2008). Hence, these two activities were combined into one multiple-choice response (see table 5). The closed-choice question with examples of mathematical terms did not require parents or their children to know about Bishop's six activities.

Initially the survey was trialled with two colleagues whose children were multilingual. The trial resulted in some changes being made to the wording of the questions.

To determine what the parents were able to comment on from their experiences of being with children as they played digital games, we wanted as diverse group of parents as possible and so we made the survey available internationally. The survey was written in English, a common international language, and placed on an online website to gain the advantages of quick and easy distribution (Cohen, Manion & Morrison, 2007). The url for the survey was shared on social media with requests to share as widely as possible, resulting in a snow-balling collection sample, with the link being placed on webpages for immigrants/emigrants in several countries.

Results and discussions

Seventy-one parents completed the survey, but seven sets of answers were removed because the children were either monolingual or did not play digital games. The remaining 64 parents completed the survey on behalf of 87 children aged between one and five years. This convenience sample (Cohen et al., 2007) of parents with different language backgrounds, living in different countries is not representative of the population of parents of young multilingual children. Although we had anticipated gaining a larger sample by placing the survey on the internet for four months (December 2016 to March 2017), the results are still interesting in that such a variety of parents show awareness of several aspects of their

multilingual children's playing digital games. This provides information about what other studies may be needed before new digital games can be developed.

Table 1. *Age distribution of children*

Age	1 year old	2 years old	3 years old	4 years old	5 years old	Total
Number	7	14	27	17	22	87

Table 1 shows the distribution of children with more children in the three year age group than any other group. There were fewer very young children, which is not surprising given that children must have had experiences of playing digital games. Only two parents completed the survey on behalf of a one year old child who did not have older siblings. Usually parents did not distinguish between how their different-aged children played digital games with there being only one response, about mathematical language, where a parent made a distinction between their children based on age.

The remaining results of the survey are presented in five sub-sections: digital games played by the children; features of the games which are attractive to children and parents; children's languages and their use when playing the games; prompts for talking; and mathematical discussions.

Digital games played by the children

In the survey, the parents were asked which digital games their children played. As there was a large overlap between the games they nominated and those in earlier research, it would seem that this sample of parents did have similarities to participants in earlier surveys.

The parents made 213 nominations of 131 different games, which we categorised in three ways: type of task involved in the game; the commercial maker of the game; and the name of a specific game. Table 2 shows the number of parents who nominated the different types of tasks which included puzzles, painting/drawing, singing, constructing/building, memory, story book scenarios, imitating real-life home skills (such as going to the toilet or baking). Of these, puzzles were the most frequently nominated type of game with more than a quarter of parents mentioning it.

The commercial brands of the games were most often identified with a television or book character, such as Pippi Longstockings, or with a well-known toy-maker, such as Fischer Price. Some digital games, originally

Table 2. *Categorising digital games by type of tasks*

Type of game	Numbers
Alpha-bet/ read and write	14
Construct Build	14
Drive cars/ trucks/ trains	8
Fashion Design	3
Home life skills	13
Maths/ Number/ Shapes	9
Memory	6
Paint/ draw/ colour	9
Puzzles	17
Songs	9
Story-book	7

designed for older people, such as Angry Birds and Pokemon Go, were in our list as they had been in Neuman's (2014) examples. Many of the specific instances of digital games were only mentioned once but could be connected to types of games or to a commercial brand. For example, Lego could be connected to generic construction tasks, but different kinds of Lego games, such as Star Wars, were categorised by their brand name. Lego, with the related Duplo, was the most commonly mentioned commercial game with 12 parents nominating it. Nine parents also nominated the digital games of the Swedish company, Toca Boca, perhaps indicating the high proportion of Scandinavian parents who completed the survey. Toca Boca games usually have no identifiable language connected to them and involve children playing with different ideas related to a specific topic, such as hair-dressing or cooking.

With the commercial brand or specifically named digital games, there were some references to pre-reading/writing or early numeracy activities (see also table 2). These games would most likely be considered by parents as educational in the sense used by Zevenbergen and Logan (2008) and McKenney and Voogt (2010).

The international sample of parents means that specific digital games were likely to differ. Toca Bocca digital games did not appear as examples in Neuman's (2014) list, which is not surprising given that her research was conducted in Australia. Nevertheless, the types of tasks described by parents are similar to those identified in Neuman's (2014) research. This suggests that parents of multilingual children in our sample shared similar experiences with parents in other Western countries. As well, the types of tasks can be considered as indicators of the digital games young children, multilingual as well as monolingual, would be interested in. As such, these types of tasks indicate what kind of new tasks should be

developed to support conversations about mathematical activities. Existing commercial games, which are popular with multilingual children, could be used in pilot studies to determine how parents and children discuss mathematical activities.

Features of the games, which are attractive to children and parents

In designing new digital games, we considered it important to know what features make them attractive to children. Therefore, we needed to find out if parents could distinguish between features they thought children found attractive and those that they themselves felt were valuable. This gave us insight into the knowledge that parents could contribute to designing new digital games that could contribute to multilingual children developing their mathematical languages. Consequently, we asked them to nominate the features from a list. The results are shown in figure 1 as a percentage of the total number of parents who responded to each question. All parents responded to the question about the features that made the children want to play the game and 62 responded to the question about what they would include in a digital game if they designed it for their child(ren). The questions were at different points in the survey and because of the nature of the online environment, parents were not able to go back and check on their answers to the previous question when answering the one about the features that they would include.

Figure 1. C*omparison of the results between the features that the parents considered made the children want to play the digital game and the features that the parents would include if designing a digital game*

The feature that the parents thought made a digital game most attractive to their children was that it was bright and colourful. However, they also

considered that children liked digital games that allowed them to explore different actions and provided the right level of challenge. In the open-ended questions, one parent commented that their child enjoyed having "various levels to choose from or advancing from easy to challenging". Similar views have been expressed about young children's use of literacy apps. For example, Kucirkova, Messer, Sheehy and Fernández Panadero (2014) stated that "our findings thus further underscore the importance of apps having features which are easy to use, but also scaffold children's learning and in doing so, do not undermine children's creativity" (p. 182). Another parent in our sample reinforced the idea that creativity was important to children as the digital games needed to "support pretend play, they are fun and engaging".

The differences between the features that the parents considered the children liked and the ones that they would include in a digital game that they designed suggests that the parents could distinguish between their children's preferences and their own, at least to some degree. The physical features of bright and colourful displays and fun noises were considered by the parents as being attractive to children, but fewer parents would include these features in digital games that they designed themselves. In contrast, the features that more parents valued when designing digital games, than what they thought the children would like in a game, were to do with developing the children's imagination, providing the right challenge, allowing them to explore different actions. One parent in our sample stated that the child needed to think about the solution. Falloon's (2013) research indicated that these features supported children's possibilities to learn. In his research, sometimes children gave up on a game if the challenge was too hard but at other times choose an easier level or became distracted by other features of the game which did not engage them in learning outcomes connected to literacy or numeracy. He highlighted the need for appropriate feedback and this came up in some of the comments by the parents. This suggests that parents of multilingual children were aware of the features that induce children to engage in learning opportunities.

The feature with the largest difference in results was to do with providing the child with useful knowledge and skills. 80 % of parents considered that digital games should provide children with useful knowledge and skills but only 30 % of parents thought that their children would find the digital game attractive because it taught useful knowledge and skills. Parents, in describing the digital games that their children played, included many which could be considered educational using the definition of Zevenbergen and Logan (2008) and McKenney and Voogt (2010). This may be connected to them situating themselves as good parents

who want to ensure that their children learnt their letters and numbers from a young age or learnt about social skills, such as going to the toilet. However, more research is needed to discover whether this is the case.

Children's languages

Table 3 provides information about the 24 languages spoken by the children whose parents completed the survey.

Table 3. *Languages spoken by the children*

Languages	Number of parents whose children spoke these languages	Number of parents whose children only spoke one language when talking about the digital games
Albanian	3	
Amaric	1	
Arabic	1	
Catalan	1	
Danish	4	
Dutch	1	
English	38	13
French	13	1
German	12	2
Indonesian	2	
Italian	4	
Malay	1	
Mandingka	1	
Norwegian	17	5
Polish	5	
Portuguese	1	1
Russian	2	1
Sami	3	1
Serbian	1	
Slovak	1	
Spanish	12	1
Swedish	26	7
Thai	1	
Turkish	1	

As can be seen in table 3, of the 64 parents who responded to this question just under 60 % (38 of 64) indicated that their children had English as one of their languages. Swedish was the second most common language spoken by the children (40 % or 26 parents said their children spoke Swedish), while Norwegian was the third most common language (27 % or 17 parents). There were 15 parents (23 %) who indicated that their children used both Swedish and English, seven of whom (11 %) stated that their children spoke a third or fourth language as well. Overall, 25 parents (39 %) parents reported that their children spoke at least three

languages, suggesting that many young children come to early childhood institutions with different degrees of fluency in a number of languages.

Half of the parents (32) indicated that their children moved between languages when playing digital games. Many of the parents provided details about what influenced the language choice of the children. The factors included: the language of the game; the language(s) of other discussants and their fluency in those languages; fluency of the child; home policy; and other contextual features.

The language of the digital game could affect the language the children used. One parent, who had a Norwegian/Swedish bilingual child, stated, "the same [language] as in the game. Norwegian in Fantorangen and Swedish in Babblarna". As well, the language of the people who the child was speaking to affected the child's choice of language. A parent of Swedish/English bilingual children stated "Both. They usually stick to one language but they use both languages equally. Unless we have company, then they speak whatever language they would speak with their friend." Such responses were common and showed the children's flexibility in changing languages to meet the needs of their discussants. The fluency of the discussant was mentioned by parents, but the fluency of the child was not, although a parent of a Norwegian/English bilingual child stated "mostly Norwegian with some English words if he speaks to me". This comment suggests that this child was not fully fluent in English. Children also chose to use a particular language for no particular reason, "Depends on the language of the game, his mood and the day. Mixed."

In some cases, parents suggested that the children only used one language, the language of the home or the mother tongue of the child. This often seemed to be connected to a home language policy, which could be extended when the child was expected to use one language with one parent and the other language with the other parent. This can be seen in the following example "In Sami with their mother, in Norwegian with the father".

The parents were aware of their children's language choices when playing digital games. In developing new games which would provide opportunities for the children to swap between languages, it would seem that the games themselves should not emphasis the use of only one language but provide opportunities for children to adapt their choice of languages to the people who they were talking with, either at kindergarten or at home. If the game only uses the language used in the kindergarten, children may be discouraged from using their home language to discuss mathematics with their parents.

Prompts for talking

To gain information for designing new digital games which would promote parents and multilingual children discussing mathematical ideas, we wanted to know if parents could provide input on what prompted children to talk about what they were doing. All the parents responded to the question, which had three multiple choice answers and the results can be seen in table 4. Parents could choose more than one response.

Table 4. *Features of the digital games which prompted children to talk about them*

	Uncertainty	Pride	Surprise
Number of parents	27	48	33

Of the three options provided in the questionnaire, uncertainty about what to do with the game seemed to prompt the least amount of talking, nevertheless 27 parents (42 %) nominated this. In Falloon's (2013) research, five year old children who did not understand what they were supposed to do with an app, just used it for another purpose. This would suggest that participant parents would not notice their children asking questions when they were uncertain because the children had either quit the digital game or found another purpose for playing it. Nevertheless, one parent added that it was when the child was unhappy with the game, that they were more likely to talk about it.

Forty-eight parents (75 %) nominated pride as a prompt for children talking about what they were doing. Noorhidawati et al. (2015) noted that some children reacted in noticeable ways when they had accomplished something in an app. The parents in our survey also provided similar examples from watching their children.

Over half the parents nominated that something surprising in the digital game prompted the children to talk. In Lange and Meaney's (2013) research, interactions with a six-year old were initiated and maintained when the child commented on something unusual or unexpected happening in a digital game. In the open comments, some parents indicated that something funny in the digital game prompted talking, which had also been noted in Noorhidawati et al.'s (2015) research. It may be that something funny could be equated with something surprising.

Parents also suggested that talk happened when their multilingual children wanted to involve the parents in what was happening in the digital game and/or wanted some sort of social relationships in their play. In contrast, two parents noted that children did not talk without prompting if they were concentrating on a game.

Mathematical discussions

As our aim is to develop playful, mathematical, digital games that promote talking, it was necessary to find out whether parents were aware of the mathematical language used by their multilingual children. The results from the sixty parents, who nominated from a list the sorts of terms and expressions that the children used when discussing the digital games, are shown in table 5.

Table 5. *Children´s talking and Bishop's six activities*

Survey question	Bishop´s activity	Number of responses	Percentage
Size, using terms like "big", "small", "tall", "short", "heavy", "light" to compare amounts of something	Measuring	27	50
Location, using terms like "on", "beside", "between" to describe where something is	Locating	27	48
Shape, using terms like "round", "corners", "triangle" to describe what something is like	Designing	19	33
Different possible actions, using terms like "if", "because", "so" to explain possibilities	Playing	28	42
Different attributes, using terms like "blue", "three" to classify or count things	Explaining and Counting	36	65

The responses show that almost twice as many parents identified that their children used different attributes to classify or count things as they did to talk about shapes. This is interesting given that the most common activity was doing puzzles. However, in a study of preschool children engaging with iPad apps, Kucirkova et al. (2014) found that when children were working together on construction and puzzle apps "there was little evidence of critical evaluation or extending verbally what a child was doing with the app" (p. 181). This was in contrast to when children were working together on a story telling app. They speculated that it was closed nature of the puzzle/construction apps, with an expected correct answer, which resulted in less discussion between the children.

In the open-ended question, parents suggested that the choice of language was dependent to some extent on what the child was interested in or what the game promoted: "Anything but depends also on where she is in the language development: if she is interested in learning numbers, colours, letters, then these are the things she usually picks up in this phase of development" and "describing what he means is "sweet", "cute", what

does he need to reach his goals, what does he have from before, and what does he just get, how many of the same kind does he own?". These kinds of responses indicate that parents are aware of how the child's own interests and the digital games themselves affect the mathematical language that children are likely to use when playing these games. This also suggests that in developing new digital games to support multilingual children to talk about mathematical activities, particularly connected to Designing, then the games need to be open-ended, with multiple possible responses.

Conclusions

In our study, we wanted to find out the type of information parents of multilingual children showed awareness of through a survey about how digital games might support discussions of mathematical activities in multiple languages. We also wanted to know if this could help us to determine what further qualitative studies are needed before new digital games are designed. As this was a convenience sample, no generalisations can be drawn about the perceptions of the population of parents of young, multilingual children who play digital games. Almost all of the languages spoken by the children in this survey were European languages and so specific results are limited to this sample.

Nonetheless, the results suggest that parents of multilingual children can contribute information about how their children interacted with the digital games. For example, comparisons of our results with the results from earlier surveys suggest that types of games are more likely to be useful, than specific digital games, as models when designing new games, because of differences in common digital games across geographical and language regions. In certain circumstances, such as when a digital game is open-ended and does not lead a child into using a specific language, it may be that a commercial digital game could be used in future qualitative research studies about how a digital game could prompt and support parents and children to talk about mathematical activities. Similarly, the results indicating that parents considered that children used less language connected to the mathematical activity Designing seems to be in alignment with previous research. However, more research is needed to investigate whether or not open-ended digital games connected to puzzles or constructing might promote children to use more mathematical language connected to Designing.

As noted earlier, the parents were able to distinguish between what their children found attractive about a game and what they thought a game should include. The parents considered that digital games should provide their children with useful knowledge and skills, but that their

children may have found the game attractive for other reasons. In working with parents on how to use digital games to support children's learning of their home language for discussing mathematics, it may be important to describe explicitly what children could learn as valuable skills and knowledge. In projects, such as our wider study, where parents will be situated as language resources, it will be important to discuss the sorts of conversations they could have with their children and why these could be important. Falloon and Khoo (2014) indicated that the teacher's role was essential if apps were to result in appropriate learning. However, parents are not teachers and the sorts of role they could have needs to be investigated further. In particular, there is a need to know how parents can maintain a conversation, through including, introducing or reinforcing the use of terms and expressions for mathematical reasoning in the multiple languages that the children speak at home.

The results of this survey suggest that more research is also needed on what prompts children to talk while playing digital games and in what languages. There is a need to know what kind of conversations occur, particularly related to children discussing an accomplishment or something surprising. Parents, and earlier research (Falloon, 2013), suggested that if something funny happens in the game, children could be prompted to talk about it. It may be that the kinds of conversational possibilities differ according to the prompt, which initiates them. Falloon and Khoo (2014) considered that children needed to be taught how to engage in conversations around digital games in order to expand on each other's ideas. It would be interesting to know whether children taught how to do this in one language can transfer these skills to engaging with adults and other children in another language. Certainly, the results from this survey suggest that multilingual children do change their language use to match different contextual features, so using the same game at kindergarten and at home may prompt them to talk in two or more languages.

The results from this research provide some insights into what parents of multilingual children are aware of. It also raises points about what they may not be aware of and what may need to be made explicit to them, in order for them to talk with their children about mathematical ideas. The results also indicate what further research in this area is needed. Although only a small study, hopefully it will contribute to discussions about how parents can be situated as language resources in supporting their children to use two or more languages to talk about mathematics.

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Appendix

Questionnaire about digital games/apps and young children

This questionnaire is for parents and family members who have children between 1–5 years old, who are bilingual and who play digital games or apps on hand-held devices, such as phones or tablets. If this is your situation, please complete the 8 questions in this survey. If not, thank you for your time, you do not need to do the survey.
Tamsin Meaney
Professor, Bergen University College

1. How old is your child?
   If you have more than one child you can choose more than one answer.

   1 year old
   2 years old
   3 years old
   4 years old
   5 years old

2. Which digital games/apps does your child(ren) like to play?

3. Why do you think that your child enjoys playing them? You can choose more than one response.

   They are bright and colourful
   They support your child to explore different possible actions
   They allow your child to do things they are not supposed to do in real-life (like cutting someone´s hair)
   They make lots of fun noises
   They support your child´s imagination
   They teach your child useful knowledge and skills
   They provide the right level of challenge for your child

   If appropriate, please provide more information:

4. What languages does your child(ren) speak?

5. When the child talks about what they are doing in the game, which language do they use:

6. What is it about the digital game/app that makes your child want to talk about it? You can have more than one response.

   Uncertainty: They have to do something they are not sure how to do.
   Pride: They learn how to do something and they want to show you
   Surprise: The app/game does something which is unexpected to your child
   Other _____

7. When your child talks about the digital game/app, what do they discuss? You can choose more than one answer.

   Size, using terms like "big", "small", "tall", "short", "heavy", "light" to compare amounts of something
   Location, using terms like "on", "beside", "between" to describe where something is
   Shape, using terms like "round", "corners", "triangle" to describe what something is like
   Different possible actions, using terms like "if", "because", "so" to explain possibilities
   Different attributes, using terms like "blue", "three" to classify or count things

8. If you were to design a digital game/app for your child, what features would you include:

   It is bright and colourful
   It supports your child to explore different possible actions
   It allows your child to do things they are not supposed to do in real-life (like cutting someone´s hair)
   It makes lots of fun noises
   It supports the children´s imagination
   It teaches the children useful knowledge and skills
   It provides the right level of challenge for your child(ren)

   If appropriate, please provide more information

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