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POINT AND COUNTERPOINT

Curriculum implications of understanding the influence of peers on the nature of young children's attitudes towards mathematics

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Introduction

Within a class setting, children's interactions with other children play an important role in their development (Kiuru et al., 2015; Leflot et al., 2011) with several researchers acknowledging the relationship between children who have supportive relationships with peers and their academic engagement, performance and motivation (Furrer & Skinner, 2003; Kiuru et al., 2015). In mathematics education, peers have been found to influence attitudes towards mathematics (Mata et al., 2012; Pepin, 2011). Given the body of research recognises that peers influence attitudes, engagement and even achievement, there is a dearth of research that explores *how* peers influence young children's attitudes towards mathematics and the implications this has on the teaching and learning of mathematics.

The purpose of this study was to investigate the attitudes of young Australian children in years 2 and 3 (7–9 year old) have towards mathematics. This investigation answered the broad question: What are the *range* and *nature* of attitudes young children exhibit towards mathematics, in both lesson and non-lesson contexts? It is essential to distinguish between the *range* and *nature* of young children's attitudes towards mathematics. In this paper, a distinction has been made to ensure clarity around the two words. The *range* refers to the scope or extent of young children's attitudes towards mathematics (YCATM), providing a broad view of the issue. The *nature* of attitude is descriptive, providing the basic qualities, structure and the essence of individual attributes of children's attitudes towards mathematics (Quane et al., 2019). In other words, the nuances or fine-grain view of attitudes. By ascertaining the nature of YCATM, themes were identified such as the influence of peers which is the focus of this paper. The term "peers" in this paper refers to children within the same class of the observed children. The influence of peers, mainly friends of the observed children, was noted to influence children's attitudes, as peers enabled both non-mathematical and mathematical conversations, providing distraction or providing assistance and encouragement and working collaboratively. The influence of peers was noted in a non-lesson context (where children drew a picture of themselves doing mathematics, provided a written description and participated in a semi-structured interview) and during the lesson context which involved observing mathematical learning experiences. An important caveat needs to be made regarding peers and friendships. The strength of friendships that existed between the children participating in the research and their peers is unknown. In the non-lesson context, some children mentioned children by name and called these children friends. In the lesson context, some of these friendships were evident when children engaged with their peers. The role peers play during mathematical learning experiences has implications for practice.

Literature review

Attitudes towards mathematics is a construct that is often left undefined or implied in research. The complex construct of attitude has previously been defined as "liking" or "disliking" mathematics (Di Martino & Zan, 2010). The dichotomous view is problematic as it fails to address the dynamic nature of attitude, how attitudes influences and impacts behaviour (Ajisuksmo & Saputri, 2017) and the critical role of values and beliefs and how these are enacted. A definition that is widely adopted is a multi-dimensional definition comprising of emotions, beliefs, and the value individuals

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place on mathematics (Hannula, 2012; Zan & Di Martino, 2007). Di Martino and Zan (2010) broaden the definition of attitude by describing three key dimensions: emotional dimension (ED), vision of mathematics (VM) and perceived competence (PC) contributing to students' attitudes towards mathematics. The three dimensions together are known as the Three-dimensional Model of Attitude (TMA). By broadening the definition of attitude, relationships between the dimensions can be described (Di Martino & Zan, 2010).

To adhere to this theme of developing a wider lens in the hope of developing a more comprehensive view of children's attitudes towards mathematics, six sub-dimensions were developed to broaden the description of the range and nature of a child's attitude. The six sub-dimensions are shown in Fig. 1 and explained in Table 1.

The original TMA framework comprised of three aspects of attitude: an emotional dimension; a vision of mathematics; and perceived competence. The modifed TMA was developed by employing an integrated approach comprising of an extensive literature review, deductive, anticipatory and inductive processes. The result is shown in Fig. 1.

Children's attitudes towards mathematics are strongly related to their receptiveness to learning mathematics, their self-confidence, enjoyment, valuing of mathematics and, importantly, their achievement (Stiles et al., 2008). Examining the TMA, we can see several of these aspects of learning integrated into the three dimensions. However, a part of being receptive to learn mathematics is prior experience and understanding.

Mathematical learning experiences vary greatly from classroom to classroom with common pedagogical practices such as group work and peer tutoring being employed. Working with others can be rewarding and beneficial, both academically and socially, for example sharing ideas, processes, mathematical thinking and understanding and developing communities of practice. However, working with others can have its limitations. Down and Choules (2017) argue "that students are more likely to engage when they have ownership and control over what, how and with whom they learn" (p. 135). During class activities, students do not always have the freedom to control who they work with or even how they work. Given that children's voice is steadily acknowledged as a significant force for transformation in schools (Lee & Johnston-Wilder, 2013), children need the means to be able to communicate their attitudes towards mathematics to develop an understanding of the factors that influence their attitudes. The factors mentioned here all influence students' attitudes towards and receptiveness to learn mathematics. A challenge remains of how to investigate the factors that influence attitudes, in particular, YCATM.

Ascertaining attitudes towards mathematics have primarily been conducted quantitatively through attitudinal scales. Instruments such as *FSMAS* or *Fennema-Sherman Mathematics Attitude Scale* have been widely used (Grootenboer

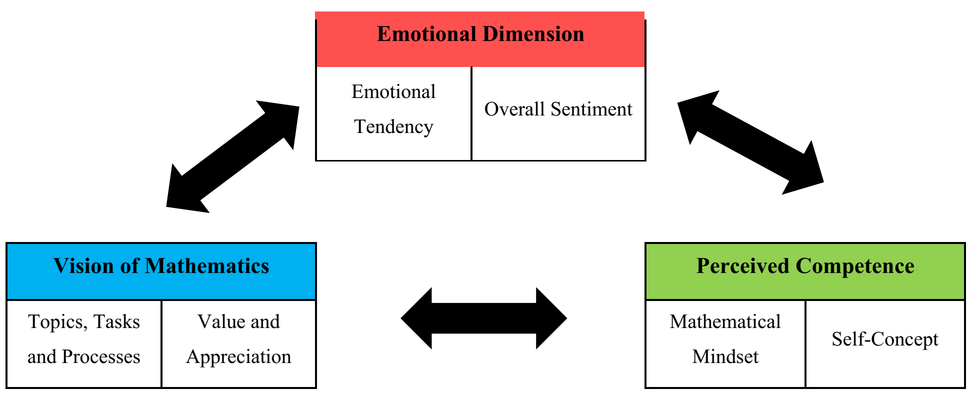


Fig. 1 Modified TMA (original model by Zan and Di Martino)

Table 1 Description of the six sub-dimensions of TMA (adapted)

Dimension	Sub-dimension	Description
Emotional dimension	Emotional tendency	Children's feelings and emotional responses towards mathematics
	Overall sentiment	Children's reactions to mathematics, including posture, gestures and body language
Vision of mathematics	Tasks, topics and processes	Types of mathematical learning experiences and processes identified by children; number of mathematical topics and how children communicate their mathematical understanding and learning
	Value and appreciation	How and what children view as important and acknowledge worth about mathematics
Perceived competence	Mathematical mindset	Children's perceptions of themselves related to their ability to do mathematics
	Self-concept	Children's beliefs in their own mathematical ability and expectancy for success

& Marshman, 2016) to ascertain the range of attitudes. Instruments such as the FSMAS provide methods "whereby the distribution of attitude of a group on a specified issue may be represented in the form of a frequency distribution" (Thurstone, 1928, p. 529). Further, scaled instruments can be valuable tools, providing a broad view or the identification or prevalence of particular attitudes, including mathematics anxiety. However, instruments such as FSMAS are not without their criticisms, for example motivation to complete a survey (Chapman, 2003; Eklöf et al., 2014; Grootenboer & Marshman, 2016; Lim & Chapman, 2013); ambiguous statements (Triandis, 1971); participant distortion (Edwards, 1957) and the inability to make comparisons between responses and actual experience (LaPiere, 1934). These criticisms have been known for decades, with several researchers advocating for classroom observations and other child-focused methods (Aiken, 1996; Attard et al., 2016; Hannula et al., 2018).

The use of children's drawing in educational research and even mathematics education is by no means new. Children's drawings have been used to gain insight into students' conceptual understanding and experiences of various aspects of mathematics. Drawings are a reliable and valid method for ascertaining attitudes towards mathematics (Pehkonen et al., 2016; Solomon, 2012; Stiles et al., 2008). For example, McDonough (2002) used creative interviewing techniques and Pupil Perceptions of Effective Learning Environments in Mathematics (PPELEM) to gain insights into children's perspectives. Creative interviewing involved asking a small group of children to draw a picture of a time when they "were learning maths really well" (McDonough & Ferguson, 2014, p. 447). The prompt "learning maths really well" only accounted for positive mathematical experiences. Other prompts such as "Draw yourself doing mathematics" have been used to document a range of experiences (Bachman & Neal, 2018; Quane et al., 2019). Findings from research using children's drawings indicate that drawings inform effective teaching and provide insights into "affective aspects of learning mathematics" (McDonough, 2002, p. 19), in particular children's feelings about mathematics, "their values and beliefs about themselves doing mathematics" (Quane et al., 2019, p. 111).

Accepting the view that attitudes are learned predispositions obtained through experience (Aiken, 1996), factors contributing to an individual's attitudes towards mathematics can be broadly categorised into four areas: significant others, engagement, cognitive demand and pedagogical practice. As stated previously, studies have shown that significant others can influence a child's attitude towards mathematics, for instance teachers, parents, siblings, peers and the media. The focus of this paper is the influence of peers on YCATM. A form of peer interaction is peer tutoring and can be classified as fixed or reciprocal tutoring. Alegre et al. (2019) found "peer tutoring has shown promising results and may be considered an effective instructional method for mathematics in primary education" (p. 785). Brown et al. (2008) researched attitudes of adolescences and found peers feeding negative views about mathematics. However, little is known how peer tutoring and peers in general influence YCATM.

Method

A mixed-methods approach was used to gain multiple perspectives about the *range* and *nature* of YCATM. The research approach was interpretive, in order to "understand the subjective world" of children's experiences providing "multifaceted images" of children's attitudes "as varied as the situations and contexts supporting them" (Cohen et al., 2011, p. 18). The research employed four different research techniques for data generation, examining YCATM in two different contexts to identify and describe possible relationships between the two contexts.

The first two research techniques involved the use of children's drawings and asking children to write about what they have drawn in order to generate data about their attitudes in a non-lesson context. The third technique used a semi-structured interview to provide children with the opportunity to explain and clarify elements within their drawings and to reduce any potential misinterpretation by the researcher. Children's drawings, written descriptions and interview responses constituted the data for the non-lesson context. Utilising the work of Bachman and Neal (2018), the prompt "Draw yourself doing mathematics" was given to individual participants ($N = 106$) on an A3 piece of paper. The researcher read a prompt (see Quane et al., 2019), to children with no time limit given to children to produce their drawing. Children provided a written description of their drawing and then participated in a semi-structured interview. The interview utilised findings from the literature review to design a series of open-ended questions. Using the three research techniques is viewed as "complementary methods" to "understand children's lived experiences" (Macdonald, 2009, p. 48).

The fourth research technique used classroom observations of mathematics learning experiences to document children's attitudes in a lesson context. An observational framework was used, comprising of three levels. The first was a descriptive observation documenting space, planned activities, actors, objects, goals and times (Spradley, 2016). Second, focused observations were used to observe three children on a rotational basis using Spradley's (2016) nine variables. Third, selective observations were implemented when one of the three children displayed overt behaviour or when a significant event occurred. The observations were conducted by the author. Observing interactions during mathematical learning experiences can be complex. To address the complexity, the observations focused on interactions between children and teachers, response and initiation (Flanders, 1965); social discourse analysis (Mercer, 2004); social communication (Fraser, 1983) and non-verbal communication (Pease & Pease, 2006). Observations of mathematics learning experiences were conducted after the non-lesson data was analysed. Children ($n=27$) were observed on the basis of their attitude classification from the non-lesson context, with three different attitudinal classifications selected for each class observation. Three children from each class were observed over three mathematical learning experiences with children being observed on a rotational basis until a significant event occurred. An initial exploratory study ($n=25$) was conducted to determine the feasibility of the research techniques before launching a larger study ($n=81$). Specifically designed instruments were developed to analyse the non-lesson and lesson contexts, with the non-lesson data and rubric from the exploratory study undergoing inter-rater reliability analysis with two raters. The results from the inter-rater reliability indicated strong agreement for all TMA dimensions.

Table 2 Interval classification for attitudes towards mathematics

Interval	Attitude classification
< 5	Excluded from analysis
6–10	Extremely negative
11–15	Negative
16–20	Neutral
21–25	Positive
26–30	Extremely positive

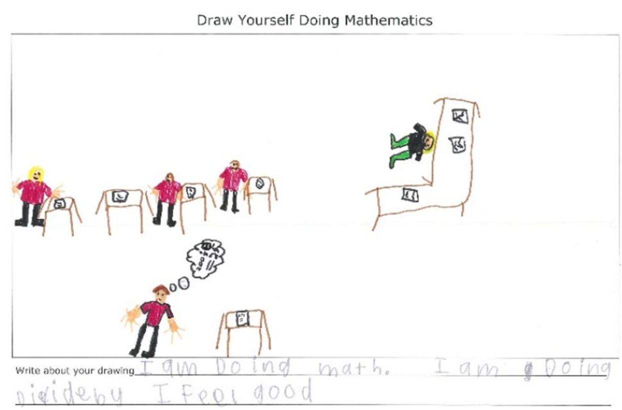


Fig. 2 A2, male, year 3 (8 years 1 month)

Participants

The research was conducted at multiple sites with each group displaying characteristics of a "cultural sharing group" as recommended by Creswell (2012). In other words, each group interacted regularly and was representative of year 2 and 3 Australian students; they had adopted shared patterns of mathematical thinking and talking and had been together since the beginning of the school year. Participants were aged between 7 and 9 years and a mix of female (47%) and male (53%) and included children from diverse language, cultural and geographical backgrounds. The three schools participating in this research have been conveniently selected as they were available and willing to participate. One school was located in a major city and two schools located in an inner-regional locality.

Individual meetings occurred with the Principals of the three schools to outline the research, teacher and student involvement and the logistics of the research. All three principals gave consent for the schools to participate. Principals then discussed the research project with year 2 and 3 teachers within each school. A total of 10 teachers volunteered to participate. The research was discussed with each teacher on an individual basis, and mutually agreed times were arranged for the non-lesson and lesson data collection to occur. Teachers agreed to the date and time of observations and were reminded that they had the right to withdraw on the day. One teacher decided not to participate in the observational component of the project. Following the research ethics guidelines, parental written consent was sought and was orally obtained from each child. All children were allocated a code in the form of school (A, B or C) and number (1, 2, 3 etc.) to deidentify the data.

Findings

The findings are discussed in terms of the non-lesson context (drawings, written descriptions and interviews) and the lesson context (observations of mathematical learning experiences) data. The findings reported in this paper are based on the interval classifications shown in Table 2

Non-lesson context

Eleven children (10%) drew other children in their drawing, with each drawing depicting all children working on the same tasks. For example, Figs. 2, 3, 4 and 5 show children working on the same task as individuals. Some children, such as C1 (Fig. 5), depicted other children who had a different VM to their own VM, indicating that some children were aware of the possibility that other children can view mathematics differently to them. C1 describes the scene

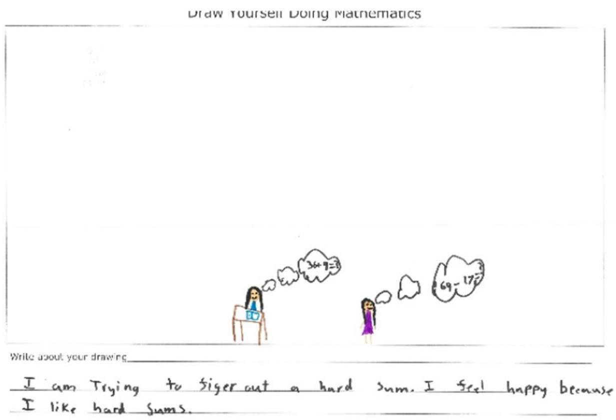


Fig. 3 B33, female, year 2 (8 years 21 days)

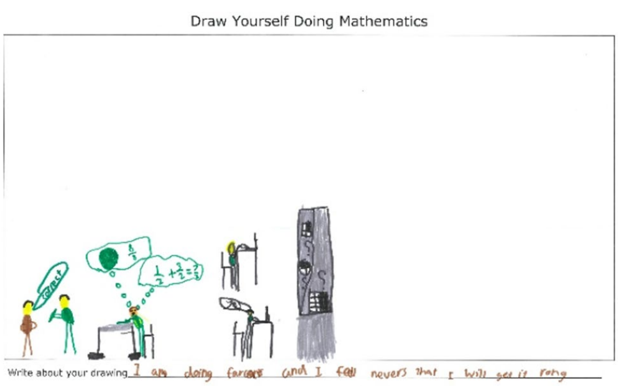


Fig. 4 B52, male, year 3 (9 years 4 months)

that she has drawn as "it's quiet cause [sic: because] everyone's concentrating". C1 elaborates, providing the following description:

> so I drew me doing, mm un division, taking away, times and adding and I drew my teacher saying 'try your best' and I drew some of my friends and I drew a whiteboard which has what we're supposed to be doing on it and I drew um me saying, me thinking 'maths is fun' and I love maths um, one of my friends saying 'that was great', random person saying 'hmmmm' cause they're thinking and one of my other friends saying 'maths is hard'

Other children depicted peers that provided support and encouragement and were a source of external motivation (Fig. 6 and Fig. 7). For example, A24 (Fig. 7) is sitting at his desk, concentrating on his work, with four others providing encouragement. In the child's words, he feels "great about myself; everybody is making me feel awesome". While A24 has written that he feels "awesome", his facial expression appears to be negating this statement. A24 explains that he feels "serious" when he does mathematics and sometimes, he feels "like a mathematician". A24 enjoys "doing maths on the iPads", but even with this type of task, A24 provides an exception, explaining "I don't like doing hard stuff on the iPad".

During the non-lesson context, several children discussed working in groups or with their friends. The interview responses indicated positive interactions with peers

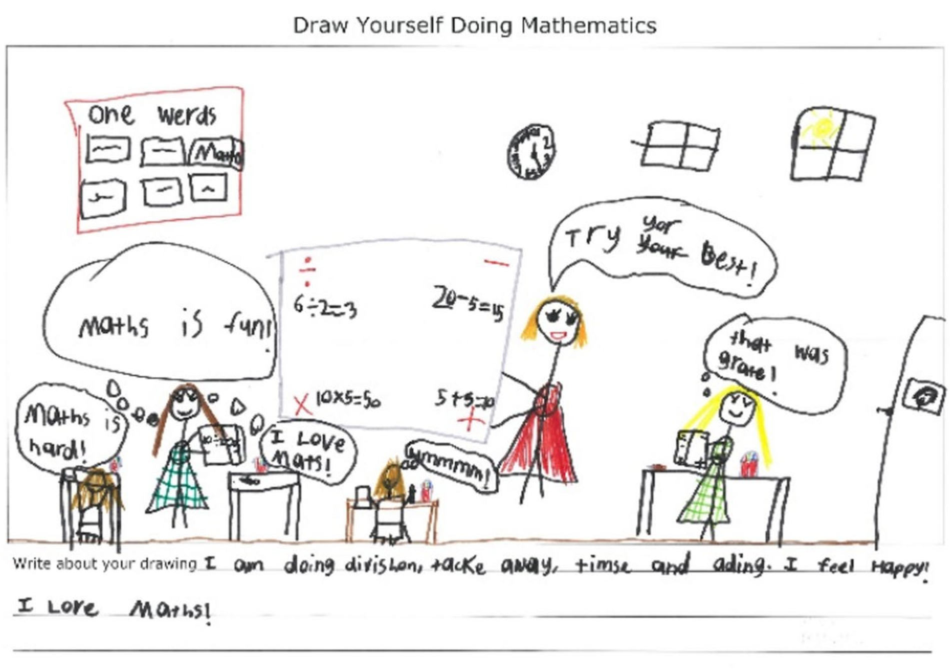


Fig. 5 C1, female, year 3 (8 years 7 months)

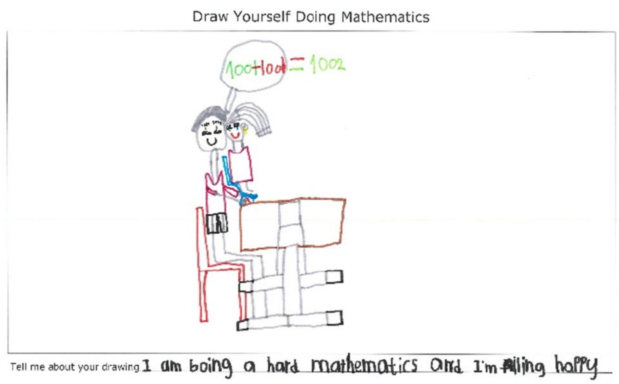


Fig. 6 A21, male, year 2 (7 years 5 months)

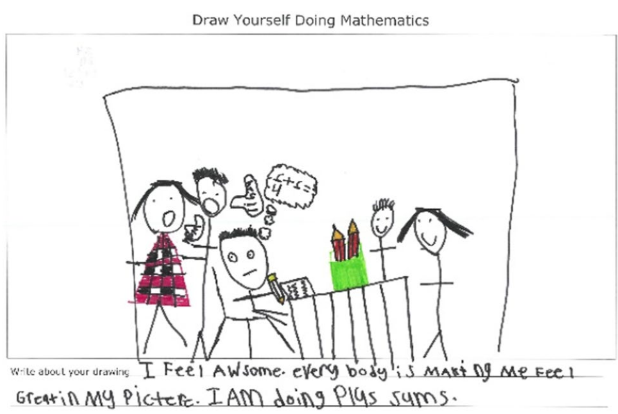


Fig. 7 A24, male, year 2 (7 years 2 months)

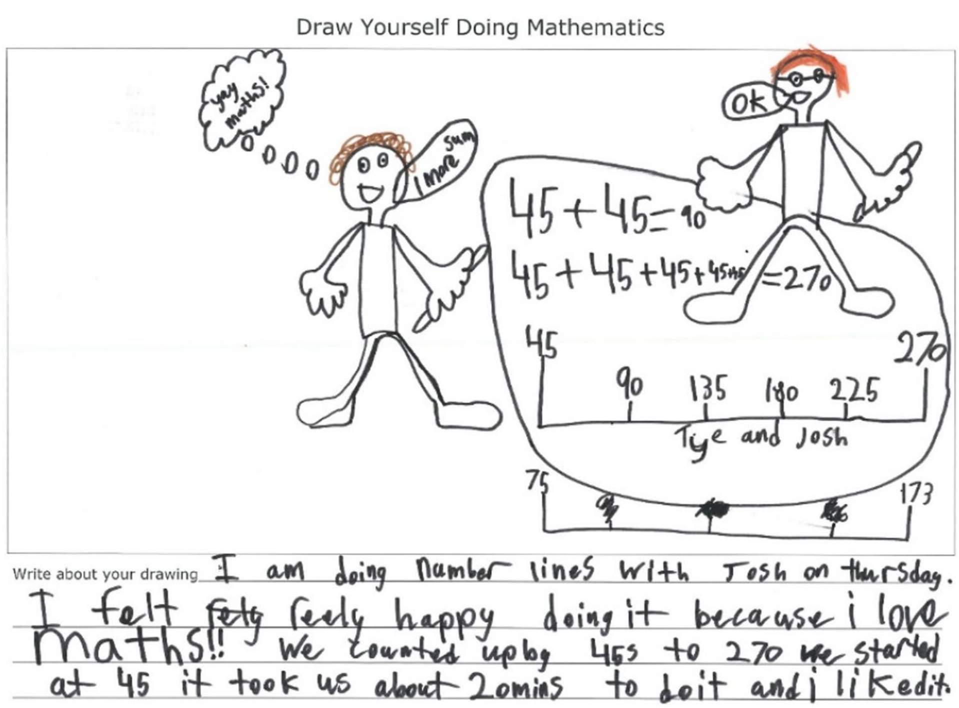
involving collaboration and teamwork. For example, A13 is working with his friend on an open-ended task involving skip counting using any magnitude and representing these numbers on a number line (Fig. 8). The learning depicted in A13's drawing was from an outdoor experience.

The results indicate that children use peers in a variety of ways including:

- *enablers:* providing assistance, modelling processes or use of materials
- *motivators*: seeking external praise or approval
- *collaborators:* sharing ideas and completing tasks together
- *distractors:* providing opportunities to disengage and avoid completing tasks.

In addition, children also recognised that peers have different mathematical ability, interests and skills to themselves. The data from the non-lesson context was analysed resulting in attitudinal classifications ranging from extremely negative to extremely positive. In general, children with a negative attitude classification tended to compare their abilities to the abilities of their peers. In doing so, their comparisons were favourable to their peers and unfavourable towards themselves. For example, in comparing herself to her peers, C17 stated: "I think it's very hard and I can't do it and then other people in my class they're really smart and know lots of stuff and um I'm down here still learning some stuff". The child gestures with her hand to indicate the perceived level of her peers (hand up high) to her own level (hand down

Fig. 8 A13, male, year 3 (8 years 6 months)



low). The children were cognisant of their ability in relation to their peers within their classes, impacting their own attitude towards mathematics.

The non-lesson data was used as a baseline for observing mathematical learning experiences.

Lesson context

Class observations ($n = 27$) provided the opportunity to collect live data from "naturally occurring" situations (Cohen et al., 2011, p. 456) and comprised of descriptive, focused and selective observations. In this study, observations could also be checked for corroboration with data collected from non-lesson contexts. An observational framework was used to explore interaction, social discourse and communication and non-verbal communication. A selection of vignettes is shared to report the type of interactions children had with peers and how these interactions influenced their attitudes.

Peer support

Many of the mathematical learning experiences were a hubbub of activity, where students were given tasks to complete as individuals but opted to work with their peers. Each of the ten classrooms was configured differently, but all classrooms had children sitting at adjoining desks. Children used their peers to consolidate their learning and sought help on how to use a particular manipulative, to clarify task instructions and to share ideas. Most children were happy to seek the help of their peers and were often the first more knowledgeable other sought by children.

However, while children were willing to seek help from their peers, accepting help was a different story. For example, C11 was observed during a game of shape and solid bingo. C11 is seen playing with the counters, arranging the counters in a circular pattern. He does not participate in any conversations about the solids but appears to be listening to other children. On one occasion, C11 seeks help from the children at his table but does not do anything with the assistance that he receives. The game continues with some issues that children encountered about some unknown solids. C11 stands up and looks at the other children's bingo cards and engages in disputational talk and expressing negative evaluations using gestures to indicate his frustration with another child about whether he has made a bingo. It appears that C11 was unwilling to participate in the bingo game and at the same time unhappy for others to experience success. The vignette of C11 helps answers the question "how do peers influence young children's attitudes towards mathematics?" Observing children during mathematical learning experience provides greater insights into their attitude towards mathematics and provides contextual factors that influence individuals' attitudes. The case of C11 is interesting as in the non-lesson context, C11 drew himself sitting alone at a desk stating, "I don't like this".

Peers as distractors: non-mathematical conversations

During the learning experiences, C1 did engage in non-mathematical conversations, contributing an idea to the conversation and then refocusing on her work. The non-mathematical conversations that are happening around C1 do not appear to take her focus off her own work for long periods of time, showing signs that the child is able to self-regulate her behaviour so that she can complete the required work.

In contrast to C1's ability to self-regulate is A24. In the preceding non-lesson context, A24 drew four peers (see Fig. 7), and also indicated that he would be rather participating in other activities. Reflecting this, during the mathematical learning experiences, A24 was frequently observed engaging in non-mathematical conversations with his peers. The most predominant activities the child engaged in during the learning experiences were non-mathematical conversations, which arose from the child's frustration with completing the set task. These conversations are an indication of all three dimensions of the modified TMA. First, the feeling of frustration is an indication of the child's ED and is contextualised in the type of mathematical tasks, topics and processes. An example of how the child's frustration manifests is discussed and analysed using the modified TMA. The examples provided here provide evidence to how peers influence YCATM.

Reluctance in participating in group work

In one observed learning experience of a year 3 class, B52's (Fig. 4) interactions with his peers are observed. The experience involved children representing fractions through a creative body-based learning approach akin to playing musical statues—when the music stops, children are required to form groups and complete a task. During the teacher instruction, B52 is seen biting his nails, a possible sign of his ED. During the music, B52 joins other groups when prompted or encouraged by other children. He does not instigate the formation of group or what fraction to represent. When it comes time to organise himself in a group, B52 takes a long time to find a group and when he does, he initially does not take an active role. B52's behaviour of being a passive participant is repeated during the second part of the learning experience where children have to represent fractions in groups. When the other children explain their thinking, B52 is observed watching and listening, but not contributing. The case of B52 demonstrates the interplay between the dimensions of attitude which is further highlighted in the following vignette.

B52's reluctance may be a result of the cognitive demand required to actively participate and engage in the experience and possibly what had transpired in the previous observed experience where a peer snatched an iPad that B52 was using as part of a task that was to be completed in pairs. During the task, B52 is observed disagreeing with his partner and they were seen squabbling over the iPad. The partner that B52 is working with appears to be unhappy with the way that B52 is recording the task and snatches the iPad from B52 who dictates and his partner types what B52 is saying. B52 leaves his partner to get his workbooks and a mini whiteboard, and then returns to his partner. B52 starts to draw a number line on the whiteboard and then asks the teacher's permission to go to the bathroom. B52 leaves the room. He returns shortly after and is observed organising objects and representing these objects as fractions of a whole. His partner takes a photograph of the group of objects. B52 appears focused. Later in the observation, B52 has accurately represented the fractions on a number line that he has drawn on the whiteboard. From the case of B52, we can see that the influence of peers impacts on how B52 engages in the set mathematical tasks (TTP) and his emotional sentiment towards these tasks. As a result, it appears that these interactions have an impact on B52's self-concept and mathematical mindset.

The results from the lesson context augment the results from the non-lesson context, supporting the findings that peers enable, motivated, collaborated or were distractors in children's learning of mathematics. In addition, results from the lesson context identified peer interaction, particularly peer support, as both positive and negative.

Discussion

In this current study, peers influenced children's attitudes not by feeding their perceptions of mathematics as being difficult as found in studies conducted with adolescence (see Brown et al., 2008). Rather young children attempted to provide assistance, positive encouragement and support. Peers were aware of their friends when they encountered difficulties in mathematics. The peers of the observed children offered to share how they were approaching a particular problem and to demonstrate how to use a particular manipulative, such as the Polydrons, or how to access a particular task on a device. Sometimes, the children took this assistance and would try to follow it, but would immediately stop at the next sign of challenge. However, for some children, the offering of help from their peers appeared to confound the situation and the offer of help was declined. The difficulties that children experienced in this current study were from real struggle and not from anticipation. The challenges that the children experienced were indicators of their mathematical mindset.

Children with a neutral attitude classification from the lesson context had mastered the art of looking busy during mathematical learning experiences. Non-mathematical conversations were prolific and could almost be viewed as the norm. The conversations ceased when the children sensed the teacher was approaching and they would quickly return their attention to the given task. However, the children's attention returned to non-mathematical activities as soon as the teacher left. This process is an example of overt, active disengagement (Finn & Zimmer, 2012).

Additionally, children with a neutral attitude appeared happy for more knowledgeable peers to direct and dominate learning experiences, showing an unwillingness to contribute and participate in the learning experience, as well as a lack of perseverance. These indicators highlight a concerning materialisation regarding children's mathematical mindset and their self-concept and appear to be a core factor in the formation of a neutral attitude. In identifying the range of attitudes, it was evident that previous research used a variety of terms to describe an attitude that divides the positive and negative attitude dichotomy, including neutral and mixed attitudes (Fabian et al., 2018; Hannula, 2002). The generalisations made here indicate that there is a spectrum of attitudes within the neutral attitude classification, including generally ambivalence about mathematics, mixed responses and emotions, and boredom. Children with negative and neutral attitude classifications tended to avoid mathematics either actively or passively, using their peers as a mechanism to disengage. Children who avoided doing mathematics completed less work which appeared to impact their SC and OS towards mathematics.

The children who were classified as having a positive attitude during the lesson context were willing to help their peers, being able to communicate their mathematical thinking and work. These children tended to listen attentively during the mathematical learning experiences and saw opportunities to contribute their ideas and thinking. They exuded confidence in responding to the teachers' questions and in their approach to the various learning tasks. The confidence that children displayed was also evident when helping their peers. Children with a positive attitude classification embraced the notion of helping peers, assisting "understanding in ways that teachers may not be able to" (Siemon et al., 2015, p. 96). Confidence in one's ability, according to Bruner (2007), is when learners begin to enjoy the challenge that mathematics has to offer and the processes involved in doing mathematics. Additionally, children's drawings were also an informative source to identify positive attitudes towards mathematics and the type of peer interactions (recall A24 and the depiction of his peers providing encouragement).

A key difference in the way peers influenced children's attitudes towards mathematics is evident when comparing the two contexts. In a non-lesson context, children only mention peers positively influencing their attitude, for example giving encouragement and using the language associated with a growth mindset. In contrast, the lesson context revealed that peers both attempted to support their peers and were enablers in children's task avoidance. In particular, children with a negative attitude used their peers as a "coping strategy" (Petronzi et al., 2019, p. 91). The reasons for using peers as a "coping strategy" are generally unclear; however, Petronzi et al. (2019) suggest that the strong emphasis placed on peers by "highly apprehensive" children is due to the reliance of support and input from their peers. An unknown that still needs to be explored is whether children recognise the influence of peers, particularly during mathematical learning experiences and how children describe the influence of peers on their attitudes towards mathematics. The influence of peers affected all dimensions of attitude.

Children responded to the influence of peers by exhibiting their emotional tendency at the time of interaction which in turn impacted children's overall emotional sentiment. Peers had a higher level of positive influence on the children's attitudes during game-based and collaborative learning tasks. Group work and game-based learning were found to positively increase children's attitudes, particularly their confidence. This finding is supported by Smith et al. (2014) who reported that grade 8 US students' attitudes "were significantly increased" when working with peers in group tasks (p. 239). Similarly, in the current study, the influence of peers impacted on how children engaged in mathematics in the lesson context, particularly in group tasks.

Learning mathematics "takes place in a social context through interactions" with others (Andrà et al., 2020, p. 124). The types of interactions that were observed to impact YCATM positively were learning experiences that allowed children to initiate conversations during group work situations with their peers and teachers. This study provides support for the contention that opportunities to question, discuss and debate material presented during learning and to share understandings with peers were instrumental in generating positive attitudes towards mathematics. It was found that children with a positive attitude initiated conversations that were predominantly in the form of exploratory talk (Mercer, 2004), where children made suggestions, and their mathematics reasoning was shared with the group. Generally, children with a negative or neutral attitude engaged in more disputational talk regarding their commitment to and evaluation of a given task (Mercer, 2004). From these generalisations, it would appear that children engage in different types of classroom discourse and talk depending on their attitudinal response to a given task.

The above finding suggests that children need explicit teaching in how to participate in mathematical conversations to provide all children with opportunities to engage in exploratory talk. It is recommended that educators make themselves aware of who is contributing to mathematical conversations and devise methods to support and enable all children to contribute to the exploratory conversations occurring during mathematical learning experiences.

The notion of challenge is an important aspect of "doing mathematics" and speaks to the notion of perseverance. Peers either enabled or distracted children from doing mathematics and were seen to be pivotal in whether children preserved, dismissed or avoided a particular task. Children appear to either embrace or reject the level of cognitive demand required to complete a task, to develop a mathematical understanding for a topic or to use different mathematical processes. Some children associated the level of cognitive demand with an emotional and sometimes a physical response which in turn impacted their MM and SC. This was particularly evident when children discussed or were observed problem-solving.

Attitudes exhibited in a non-lesson and lesson context do vary and this variation can be attributed to the nature and the quality of learning experiences and the way that children interact with their peers.

Conclusion

Sharma-Brymer et al. (2018) argue "that more regard must be given to children's voices and learning preferences in the development of school curriculum". The research presented in this article highlights children's attitudinal response to particular learning experiences. It was evident that peers played a pivotal role in the way that children engaged in mathematics. The influence of peers emerged initially during the non-lesson context and was confirmed during the lesson context. Peers were classified as either enablers, motivators, collaborators or distractions and the type of peer interactions influenced children's attitudes. Further, peers were seen to dominate less confident children impacting their attitudes towards mathematics.

These findings of this study are not without limitations. The study has been delimited to three South Australian schools and further study is warranted. The observations focused on overt behaviours that were observable and did not attend to small actions or reactions. It is not that these small actions, reactions or behaviours are considered inconsequential, rather, they are hard to detect in a classroom situation. Unknown circumstances may have impacted on what the children were experiencing on the day they completed their drawing, and on the days of the observed mathematical learning experiences. The extent that these small actions or reactions have on the peer-to-peer interaction and consequently attitudes towards mathematics is unknown.

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