A MODEL OF STUDENT MATHEMATICAL WELLBEING: AUSTRALIAN GRADE 8 STUDENTS' CONCEPTIONS

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To support academic performance, many schools are increasingly focussed on supporting student wellbeing. Yet the high incidence of mathematics anxiety and disengagement suggests that many students experience poor wellbeing in many mathematics classrooms. This paper proposes a seven-dimensional model of student mathematical wellbeing. To test this model, 488 eighth grade students responded to one open-ended question; responses were analysed using a combined deductive/inductive thematic analytic approach. Findings supported the model. The study illustrates the importance of focusing on wellbeing within specific subjects, provides a model for studying student wellbeing specific to mathematics education, and points to areas to target to improve and develop student mathematical wellbeing.

BACKGROUND

Complementing the traditional focus on developing cognitive skills such as numeracy and literacy, schools worldwide are increasingly considering strategies for supporting holistic student development, including the development of non-cognitive skills and student wellbeing. The United Nations includes wellbeing as one of 17 goals for sustainable development to achieve by 2030 (United Nations, n.d.), and student wellbeing is increasingly included as a key priority within policy and practice (NSWDET, 2015; VICDET, 2018).

Mathematics is a foundational subject within education, as the benefits of attaining competence within the subject accrue over the lifespan; enhance employment opportunities; inform choices about the environment, health, and wellbeing; and correlate with longer life expectancy (Plunk, Tate, Bierut, & Grucza, 2014). However, despite significant global financial investments to improve mathematics education, student engagement in mathematics generally has remained low, with negative emotions and attitudes towards the subject persistently reported by students (Clarkson, Seah, & Pang, 2019). Many students experience 'mathematics anxiety', and perceive mathematics to be boring and unenjoyable (Grootenboer & Marshman, 2015). In Australia, the proportion of secondary students taking advanced mathematics has steadily been declining over the past three decades (Kennedy, Lyons, & Quinn, 2014). These trends all point to poor student wellbeing in mathematics education.

Despite the growing focus in education policy and practices on student wellbeing, there has been little attention exploring student wellbeing within

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individual subject disciplines, including mathematics. The current study addresses this gap, proposing and testing a model of mathematics wellbeing.

THEORETICAL FRAMEWORK

Wellbeing – also termed as 'flourishing' or 'thriving' – can be defined and operationalised in a number of ways. We focus on subjective wellbeing, in which wellbeing is defined based on a person's subjective perception of the extent to which they are feeling and functioning well across a number of dimensions (e.g., physically, mentally, socially, cognitively). Drawing on research and theory from the field of positive psychology, a number of frameworks have been applied within schools over the past decade within Australia to operationalise student wellbeing (Slemp et al., 2017; White & Kern, 2018). For instance, the PERMA model includes five dimensions that together support wellbeing: positive emotions, engagement, relationships, meaning, and accomplishment (Seligman, 2011). The EPOCH model suggests five positive psychological characteristics that support positive development: engagement perseverance, optimism, connectedness, and happiness (Kern et al., 2016).

These various models and frameworks identify *general* student wellbeing, rather than wellbeing within specific subjects. To our knowledge only two studies have specifically explored 'mathematical wellbeing'. Clarkson and colleagues (2010) proposed a three-dimensional model: cognitive, affective/values and emotions. Part (2011) includes an individual's functioning's and capabilities. Both frameworks ignore social aspects of wellbeing and mathematics learning and lack discrete measurable entities.

We propose an updated seven-dimensional model of mathematical wellbeing (Table 1), which includes seven dimensions that have been linked to positive mathematics learning outcomes (e.g., Grootenboer & Marshman, 2015). The model integrates the five aspects of Seligman's (2011) PERMA model, four aspects of Kern and colleagues' (2016) EPOCH model; and two dimensions of Clarkson and colleagues' (2010) mathematical wellbeing model (MWB).

METHODS

Our research question was: To what extent do students' conceptions of wellbeing in mathematics education align with our updated mathematical wellbeing model? To test this question, we compared our theoretical model with students' experiences of mathematical wellbeing based on the open-ended question: *What makes you feel really good or function well in maths?*

Participants included 488 grade eight students (223 females) aged 13 - 14 years, from nine urban and regional secondary schools (3 private; 4 Government/public; 2 Catholic) located in Melbourne and surrounding cities in Australia. Students self-identified their ethnicities as Australian (71%), Asian (14%), European (6%), Indian/Pakistani (6%), Indigenous Australian (2%),

Middle Eastern (1%), or North/South American (2%). Schools serviced socioeconomic neighbourhoods ranging from low to high.

Dimension	Description	Source
Positive Emotions	Positive emotions in mathematics e.g., fun	PERMA; EPOCH; MWB
Engagement	Concentration, absorption, deep intertest, or focus when learning/doing mathematics	PERMA; EPOCH
Relationships	Supportive relationships, feeling valued/cared for, connected with others, or supporting peers in mathematics	PERMA; EPOCH
Meaning	A sense of direction, feeling mathematics is valuable, worthwhile or has a purpose	PERMA
Accomplishment	A sense of achievement, reaching goals, or mastery completing mathematical tasks/tests	PERMA
Cognition	Having the skills, and understanding to undertake mathematics	MWB
Perseverance	Drive, grit, or working hard towards completing a mathematical task/goal	EPOCH

Table 1: An updated mathematical wellbeing model

Responses were imported into NVivo 11 and analysed using a combined deductive/inductive thematic analysis adapted from Braun and Clarke (2006). Initial nodes/themes were generated inductively. For example, "*having friends in my class to support me"* was coded as *peer support*. Nodes were then categorised deductively into common themes based on our theoretical model. For example, the nodes *peer support* and *teacher support* were categorised as *relationships.* As students often mentioned multiple themes, the response for each student could be categorised into multiple nodes and themes (for students mentioning the same theme multiple times, the theme was only counted once).

RESULTS

Table 2 summaries the final categorisation of nodes into themes and how student responses aligned with our theoretical model. Most students associated their mathematical wellbeing with positive classroom relationships followed by a sense of engagement, mathematical cognitions, accomplishments, positive emotions, perseverance, and meaningful mathematics learning. In addition, music was mentioned several times, with numerous students suggesting music

facilitated engagement and positive mood. As such, music appeared to contribute to the other themes, rather than being a separate dimension of wellbeing.

Themes & nodes	Student examples	N (%)
Relationships		**200 (32%)**
Teacher support	*A supportive or good teacher*	94
Peer support	*Having friends to help me*	83
General support	*When I get help with my learning*	38
Engagement		**126 (20%)**
Interesting/hands on	*Learning interesting stuff*	55
Focused working	*Being absorbed in my work*	37
Independent/quietness	*When it is quiet and I'm by myself*	27
Music (engagement)	*Music helps me concentrate well*	15
Cognitive	*When I understand the material*	**96 (15%)**
Accomplishment		**86 (14%)**
Good marks	*When I do good in a test*	31
Accuracy	*When I get the answers right*	24
General mastery	*When successful at learning something*	17
Completing tasks	*When I complete my work*	13
Confidence	*When I'm really confident*	3
Positive emotions		**60 (9%)**
Enjoyment/fun/happy	*If the maths class is enjoyable*	47
Relaxed/no pressure	*When there is no pressure*	12
Music (emotions)	*Music to listen to, to enjoy it more*	4
Perseverance		**31 (5%)**
Challenge	*Having work I find challenging*	21
Working hard/practice	*When I work hard*	13
Music (no reasoning)	*Listening to music in class*	**24 (4%)**
Meaning		**10 (2%)**
Future skills	*Knowing these skills will help me in life*	5
Real world relevance	*I like when problems relate to real life*	5

Table 2: Results, with coded student responses by theme and node

DISCUSSION

Despite a growing focus in schools on student wellbeing, existing models focus on general student wellbeing rather than considering how wellbeing might depend on the context or specific subject. Extending existing theoretical models developed within positive psychology and mathematics education, we proposed a seven-dimensional mathematical wellbeing model. Based on qualitative data from 488 Australian Grade 8 students that asked students about what helps them feel and function well in mathematics classes, we found that students' responses generally aligned with the seven proposed dimensions. Student responses also pointed to the importance of music in promoting positive emotions and a sense of engagement. Thus, our model offers a useful starting point to explore the factors that might promote student wellbeing, specifically within mathematics.

Most students pointed to the importance of supportive classroom relationships with both teachers and peers. Previous mathematical wellbeing frameworks (Clarkson, Bishop, & Seah, 2010; Part, 2011) did not include a relationship dimension, pointing to the benefits of drawing on models developed through other disciplines. The impact of supportive social relationships on wellbeing and academic achievement is well recognised (e.g., Allen & Kern, 2017; Hattie, 2008). Within mathematics education, supportive teachers are associated with improved student mathematical achievement; positive emotions, academic enjoyment and effort; and mathematical engagement (OECD, 2019; Sakiz, Pape, & Hoy, 2012). Interestingly, a similar proportion of students referenced peer and teacher relationships. In many countries, mathematics classrooms are teacher led, with limited opportunities for peer-collaboration (Geist, 2010). Peer collaboration can also greatly impact on student mathematical learning outcomes, especially students from minority cultures (Hill, 2018). The prevalence that students noted the importance of positive relationships for helping them feel and function well suggests that greater attention to the social aspects of mathematics learning could be beneficial.

The second most common theme was engagement. Much research attention has focused on the impacts of engagement on student academic performance (e.g., Attard, 2013). Our findings illustrate that engagement also contributes to mathematical wellbeing. Notably, the comments by students pointed to factors that make the classroom more disengaging (e.g., distracting peers, repetitive pedagogy) or engaging (e.g., listening to music, quietness). Many students find mathematics boring, disengaging and repetitive (Grootenboer & Marshman, 2015), especially when teachers rely on textbook focused pedagogies (McPhan, Morony, Pegg, Cooksey, & Lynch, 2008). Our findings support the incorporation of "fun" pedagogies that have been supported in other countries to increase engagement and enhance wellbeing (Clarkson et al., 2019; Hill, 2018).

The progressive yet linear nature in which mathematics is often taught can contribute to fears or anxieties about being left behind in a fast paced mathematics curriculum, resulting in greater anxiety and poor learning outcomes (Geist, 2010). Poor performance can result in greater pressure to perform well, at the expense of student mental health. Yet recent studies suggest that strategies to develop student wellbeing and academic performance can be complementary, rather than competing (White & Kern, 2018). Our findings support this, pointing to reinforcing spirals in which wellbeing supports performance and performance supports wellbeing. Students indicated that aspects such as understanding the problems, successfully completing tasks, and correctly solving problems resulted in positive feelings and greater confidence, whilst pressure to not make mistakes and to perform in tests promoted negative emotions.

The low prevalence of perseverance was surprising, considering that perseverance is central to student academic achievement and mastery of goals (Duckworth & Gross, 2014). As mathematics involves reasoning and problem solving skills, perseverance is particularly important for mathematical accomplishments (Sullivan et al., 2013). The low prevalence could mean that perseverance is more relevant to achievement than to wellbeing, or as the data were based upon qualitative responses, other dimensions may have been more obvious. Future studies might use quantitative approaches to test the importance of this theme to wellbeing

Meaning similarly was only mentioned by a small number of students. Meaningful, real world or useful mathematical pedagogies are associated with greater student interest and motivation, improved effort and engagement, and improved mathematical performance (Dobie, 2019). In Western countries, studies point to students desiring meaningful learning experiences (Hill, 2018). The sample included a number of non-Western participants, who might not value meaningful learning in the same way. Alternatively, as a required subject, meaningful learning may be considered less relevant by students. Future studies might further explore the role that meaning plays in mathematics education for both academic and wellbeing outcomes.

Pointing to strategies for supporting student's wellbeing, some students indicated that listening to music promoted their mood or engagement. Thus, music appeared to be something that supports other themes of our mathematical wellbeing model, rather than as representing a separate dimension of wellbeing. Other studies similarly find that adolescents often strategically listen to music to enhance their wellbeing, motivation and concentration (Papinczak, Dingle, Stoyanov, Hides, & Zelenko, 2015). Future studies will benefit from identifying other strategies for promoting the seven wellbeing dimensions proposed by our model.

IMPLICATIONS AND CONCLUSION

While wellbeing is often considered as a global construct, a key message of this paper is that wellbeing is domain specific. Thus, student wellbeing should be explored in individual subjects. Using insights from positive psychology to inform mathematics education, this study provides a seven-dimensional model that aligns with aspects that help students feel and function well within mathematics. Necessary extensions of this research include the development of a measure to assess mathematical wellbeing, and understanding what factors enable students to thrive in mathematics education.

Our mathematical wellbeing model points to areas to target to improve students' experiences in mathematics. The model might not apply to students' experience of wellbeing when engaging in other subjects, but the methods proposed in this study can be adapted to explore student wellbeing in other academic subjects. Future studies might test the relative importance of each dimension, using quantitative methods and extending to other year levels and populations. Cultural, school and gender differences in students' conceptions of their mathematical wellbeing should also be explored.

The widespread negative reactions experienced by students in mathematics education are well publicised, pointing to a poor sense of wellbeing in many mathematics classrooms (e.g., Attard, 2013; Fielding-Wells & Makar, 2008). Providing a balance to the considerable research and media attention in mathematics education focused on the negative aspects, the 'gaps', and what is going wrong in the subject, our study offers a glimpse of the aspects of students mathematical learning that are working well and enable students to thrive in mathematics education. Considering the somewhat global preoccupation with student mathematics (under)achievement (e.g., OECD, 2019), this study makes a timely contribution offering a sense of hope that there is more to mathematics education than merely achieving academic benchmarks.

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