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► To cite this version:

Yichen Pan, Juan Zhong, Julia L Hill, Wee Tiong Seah. Values which facilitate mathematical wellbeing of Chinese primary school students: A preliminary study. Twelfth Congress of the European Society for Research in Mathematics Education (CERME12), Feb 2022, Bozen-Bolzano, Italy. hal-03745622

HAL Id: hal-03745622

<https://hal.science/hal-03745622>

Submitted on 4 Aug 2022

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Values which facilitate mathematical wellbeing of Chinese primary school students: A preliminary study

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258 Grade 3 students from six classes taught by three mathematics teachers in a primary school located in suburban Chengdu, China were surveyed in 2021. The data reflect the values they embrace in mathematics learning as these are associated with mathematical wellbeing, namely, relationship, engagement, bliss, accomplishment, perseverance, meaningfulness, and learning. Although these values are similar to those identified in a similar and recent Australian study, the mathematics learning activities which embody the values are not all the same. Preliminary analysis also indicates that some of the seven values are embraced more than the others, and that school/teacher representation and teaching of values in China might be consistent across different classes.

Keywords: Chengdu, conation, mathematics education, values, wellbeing.

Student wellbeing in the context of mathematics learning

The wellbeing of students in mathematics education has been an ongoing concern for teachers, researchers and politicians (Clarkson, Seah, & Bishop, 2010; Hill, Kern, Seah, & van Driel, 2020). Students' general dislike of mathematics is often carried through into adulthood. In many societies, it is normal or even desirable to claim to be weak at mathematics. Also, mathematics anxiety is affecting increasingly younger children (Tomasetto, Morsanyi, Guardabassi, & O'Connor, 2021).

TIMSS 2019 (Mullis, Martin, Foy, Kelly, & Fishbein, 2020) results reaffirm the general lack of wellbeing amongst mathematics students worldwide. On average, across the participating economies, 20% of Grade 4 students and 41% of Grade 8 students “do not like learning mathematics” (p. 426). Also, 23% of Grade 4 students and 44% of their peers in Grade 8 were not confident in mathematics.

The COVID-19 pandemic – and the subsequent and sudden disruption to schooling all over the world – have affected students' wellbeing generally (O'Toole & Simovska, 2021; Schwartz et al., 2021). Thus, being able to effectively foster positive wellbeing in mathematics learning has assumed greater urgency, given that domain-specific wellbeing contributes towards general wellbeing.

Wellbeing as values fulfillment

There are traditionally two main perspectives of wellbeing, namely, hedonic and eudaimonic (Ryan & Deci, 2001). More recently, hybrid perspectives reflect how hedonism and eudemonism can both

inform wellbeing at the same time. Australian researcher Julia Hill emphasises the links between values and wellbeing, citing Tiberius' (2018) values-fulfillment theory of wellbeing. According to this theory, "well-being is served by the successful pursuit of a relatively stable set of values that are emotionally, motivationally, and cognitively suited to the person" (p. 13).

In other words, student wellbeing can be seen as a function of fulfilment of what the student values. Fostering positive wellbeing in students' mathematics learning, then, would involve the provision of opportunities for students to realise their subjective and personal values, especially those which are related to mathematics and mathematics pedagogy. This domain-specific form of wellbeing is known as mathematical wellbeing [MWB], first proposed by Clarkson, Bishop, and Seah (2010). In this original conception too, there is association with mathematical and mathematics educational values.

Mathematical wellbeing and values

Hill, Kern, Seah and van Driel (2020) conducted a combined deductive/inductive thematic analysis of 488 Grade 8 students' responses in Melbourne, which confirmed that students' sense of wellbeing with mathematics learning was associated with the fulfilment of particular values. These values were grouped into eight categories, namely, *relationships*, *engagement*, *cognitive*, *accomplishment*, *positive emotions*, *perseverance*, *music*, and *meaning*. Examples of student-nominated learning activities which reflected these values are shown in Figure 1 below.

Themes & nodes	Student examples
Relationships	
Teacher support	<i>A supportive or good teacher</i>
Peer support	<i>Having friends to help me</i>
General support	<i>When I get help with my learning</i>
Engagement	
Interesting/hands on	<i>Learning interesting stuff</i>
Focused working	<i>Being absorbed in my work</i>
Independent/quietness	<i>When it is quiet and I'm by myself</i>
Music (engagement)	<i>Music helps me concentrate well</i>
Cognitive	<i>When I understand the material</i>
Accomplishment	
Good marks	<i>When I do good in a test</i>
Accuracy	<i>When I get the answers right</i>
General mastery	<i>When successful at learning something</i>
Completing tasks	<i>When I complete my work</i>
Confidence	<i>When I'm really confident</i>
Positive emotions	
Enjoyment/fun/happy	<i>If the maths class is enjoyable</i>
Relaxed/no pressure	<i>When there is no pressure</i>
Music (emotions)	<i>Music to listen to, to enjoy it more</i>
Perseverance	
Challenge	<i>Having work I find challenging</i>
Working hard/practice	<i>When I work hard</i>
Music (no reasoning)	<i>Listening to music in class</i>
Meaning	
Future skills	<i>Knowing these skills will help me in life</i>
Real world relevance	<i>I like when problems relate to real life</i>

Figure 1: Values and learning activities associated with mathematical wellbeing

More recently, further analysis has allowed for the valuing of *music* to be subsumed under the other seven values (Hill, personal communication). Nevertheless, the authors had called for further research to be conducted to assess the stability of this MWB framework. This includes the “extending [of sources of student input] to other year levels and populations” (Hill, Kern, Seah, & van Driel, 2020, p. 279). It is in this context that the current study has been set up, and it examines the following research questions in particular:

- (1) What values related to mathematics learning do primary school students in Chengdu, China associate with positive mathematical wellbeing?
- (2) To what extent are these values similar to the 7 values in the mathematical wellbeing framework constructed by Hill et al (2020)?

China as research context

China was chosen to be the research context for the current study, given that the East Asian cultural setting would be a contrast to the Australian mathematics classroom. Chinese students (and their parents) have been experiencing tremendous pressure and stress in schooling, including in mathematics, in part due to the high-stakes ‘gaokao’ national examinations which determine student access (or not) to prestigious universities around the most populous nation on Earth. In fact, the Chinese central government has introduced several measures in mid-2021 to reduce the negative wellbeing experienced by students in mathematics and other school subjects (The Economist, 2021).

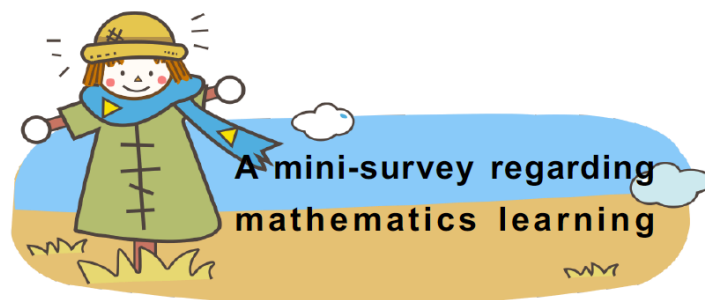
As a preliminary study, only one school was chosen as data source. Since the Australian data were collected from secondary school students, the current study sought to gather data from a primary school. The volunteer school is a mid-size government school located in suburban Chengdu, reasonably popular amongst parents in the community. 258 Grade 3 students from six different classes taught by three mathematics teachers from the school provided the data for this study. Chengdu is the capital city of Sichuan province, located in southwestern China. With a city population size of more than 16 million occupying some 14,000 square kilometres, it is one of the 6 largest cities in the world by population or land area. Putting this in perspective, Chengdu has double the population and nine times the area of London.

Data collection

Data were collected via an anonymous student survey, completed during class time in 2021. Instead of using the learning moments such as those in Table 1, which would have been too leading, we listed 22 learning moments which were representative of Grade 3 Chinese mathematics classrooms, such as ‘when you cooperate with friends to complete a mathematics task’ and ‘when your mathematics teacher praises you’. An ‘others’ item also allows for respondent-generated learning moments.

Each of these phrases was accompanied by a geometrical shape, which student respondents were asked to shade in yellow if it is associated with extreme happiness and wellness, and green if the happiness and wellness are not as intense. Given that ‘mathematical wellbeing’ might not be easily understood by the young children, the survey asked them to consider ‘happiness and wellness’ instead. The survey was presented in the Chinese language, and Figure 2 shows part of it with the content translated into the English language.

Of course, the survey items could have been presented in the form of a Likert scale. However, given that the student respondents were only 8 years of age, we had decided to design the survey so that it is aesthetically attractive, and such that it would be fun responding to the items through colouring in. The Chinese teacher researcher in our team was personally present in all the 6 classes when the survey was administered, so that student queries were attended to on-the-spot.



Class:

Which of the learning moments below are associated with you feeling good and functioning well when you are learning mathematics?
 (Colour in **yellow** the shapes corresponding to mathematics learning moments when you are **feeling extremely good and functioning extremely well**, and colour in **green** the shapes corresponding to mathematics learning moments when you are **feeling good and functioning well**)




-  When your mathematics teacher praises you
-  When you cooperate with friends to complete a mathematics task
-  When your parents or other family members help you with mathematics learning

Figure 2: Part of the student survey (translated into the English language)

Data analysis

The 258 student responses on the hardcopy survey were entered into a Microsoft Excel spreadsheet, with the numerals 2, 1 and 0 used to represent yellow, green and no shading respectively. In other words, a score of 2 represents a strong association between the learning moment concerned with MWB, while a score of 0 represents the absence of any association.

Discussions within the research team were held to associate each of the 22 learning moments with an underlying value. For example, ‘feeling relaxed during mathematics lessons’ is regarded as reflecting the valuing of *bliss* or positive emotions. This discussion took place over several virtual, online meetings, given the prevailing ban on international travels resulting from the COVID-19 pandemic. Whenever general agreement could not be achieved for any learning moment, the team privileged the views of the Chinese teacher researcher, acknowledging that she possessed the relevant insider, cultural funds of experience to interpret the learning moments more accurately.

106 of the 258 students had shaded the ‘others’ item, with 84 of them nominating learning moments which were not amongst the given ones. During these discussion sessions, the research team also examined these nominations, allocating them to agreed-upon values. For example, ‘interacting with my mathematics teacher’ is associated with the valuing of *relationships*, and ‘helping my mathematics teacher out’ is associated with *accomplishment*. By the end of the discussion, seven value categories emerged. Based on these allocations, mean scores for the seven dimensions were

computed for each student, as well as mean scores for the seven dimensions for the entire student sample. A paired sample t-test was conducted with SPSS version 27 to determine if the differences in means between pairs of values were statistically significant.

Results

The seven value categories that emerged from the in-depth discussions are, namely: *relationship*, *engagement*, *bliss*, *accomplishment*, *perseverance*, *meaningfulness*, and *learning*. Comparing this list with the values in Hill, Kern, Seah, and van Driel (2020), correspondence could be observed for the two sets of seven values. In particular, the valuing of *relationship*, *engagement*, *accomplishment*, and *perseverance* are named similarly in the two lists. Whereas the Australian list has the value *meaning*, this is considered to be the same as *meaningfulness* listed in the current study. Similarly, *positive emotions* in the Australian list can be considered to be the same as *bliss* in the current study with Chinese data. We decided to adopt the term *bliss*, since it may be confusing for some people when considering (*positive*) *emotions* as a value. Last but not least, *cognitive* in the Australian list is regarded as being similar to *learning* as it is named in the current study. Similarly, we were concerned that considering *cognitive* as a value may interfere with people's understanding of the three aspects of mental processes, that is, cognition, emotions, and motivation (see Hannula, 2012).

It is important to note, however, that even though the same values might relate to MWB amongst Australian and Chinese students, the learning moments that operated in one culture may or may not be seen in the other culture. For instance, 'when my mathematics teacher gives us less homework' might be a learning activity that is hard to find in a typical Grade 3 Australian classroom. The same may be said of 'helping my mathematics teacher assess my peers' oral computation'. At the same time, we also looked out for learning moments which appeared to be unique to China, but which actually is due to the fact that the study has been designed to collect data from primary (instead of secondary) students. Thus, 'helping my group earn achievement stars' and 'interacting with my mathematics teacher' which are learning moments in the Chinese data may well be observed amongst Australian primary school students too, had the Australian study been conducted in primary schools.

The seven values are not equally associated with MWB. As shown in the radar chart (Figure 3), which maps how each of the 258 students valued the 7 dimensions, the arcs are concentrated away from the centre of the circle for *engagement*, *relationship*, *bliss* and *accomplishment*. Given that distance from the centre represents greater valuing, we can see that the Chinese students' MWB was more often associated with these four dimensions.

Indeed, results of the paired-samples t-test show that:

- *engagement* and *bliss* are valued differently at the .05 level of significance ($t=4.964$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference 0.076 to 0.176). On average *engagement* was about 0.13 point more valued than *bliss*,

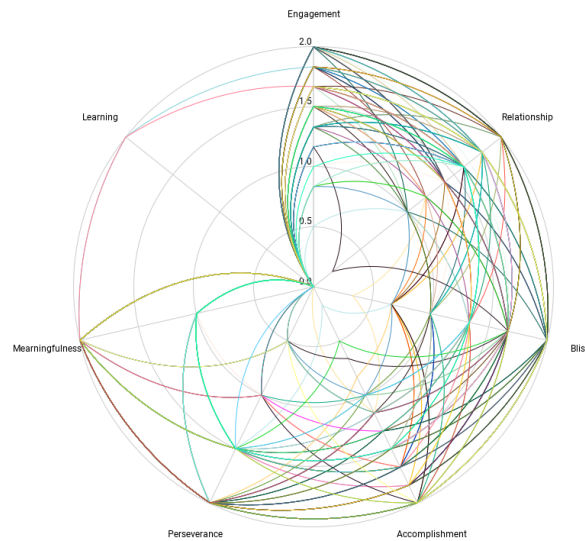


Figure 3: Differential valuing amongst Chinese primary school students

- *engagement* and *accomplishment* are valued differently at the .05 level of significance ($t= 2.075$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference 0.002 to 0.094). On average *engagement* was about 0.05 point more valued than *accomplishment*,

- *engagement* and *meaningfulness* are valued differently at the .05 level of significance ($t= 2.442$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference 0.018 to 0.165). On average *engagement* was about 0.09 point more valued than *meaningfulness*,

- *relationship* and *bliss* are valued differently at the .05 level of significance ($t= 3.244$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference 0.036 to 0.148). On average *relationship* was about 0.09 point more valued than *bliss*,

- *bliss* and *accomplishment* are valued differently at the .05 level of significance ($t= -2.675$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference -0.135 to -0.020). On average *bliss* was about 0.78 point less valued than *accomplishment*,

- *bliss* and *perseverance* are valued differently at the .05 level of significance ($t= -4.097$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference -0.209 to -0.073). On average *bliss* was about 1.41 point less valued than *perseverance*,

- *accomplishment* and *perseverance* are valued differently at the .05 level of significance ($t= -2.136$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference -0.123 to -0.005). On average *accomplishment* was about 0.06 point less valued than *perseverance*,

- *perseverance* and *meaningfulness* are valued differently at the .05 level of significance ($t= 2.754$, $df = 257$, $n = 258$, $p < .05$, 95% CI for mean difference 0.030 to 0.183). On average *perseverance* was about 0.11 point more valued than *meaningfulness*.

The extent to which a student valued the seven values can be represented by the sum of the seven mean value scores, ranging from 0 (i.e. embracing none of the seven values) to 14 (i.e. embracing all

seven values extremely). Given that students indicated their respective classes in the survey, and that the surveys were administered class by class, the 258 student data sets could be arranged according to class groups. When plotted against total mean value scores, we obtain the representation as shown in Figure 4. The graph suggests that the students' valuing has not been particularly strong (or weak) in particular classes (and taught by possibly different teachers). Thus, school/teacher representation and teaching of values in China might be consistent across different classes.

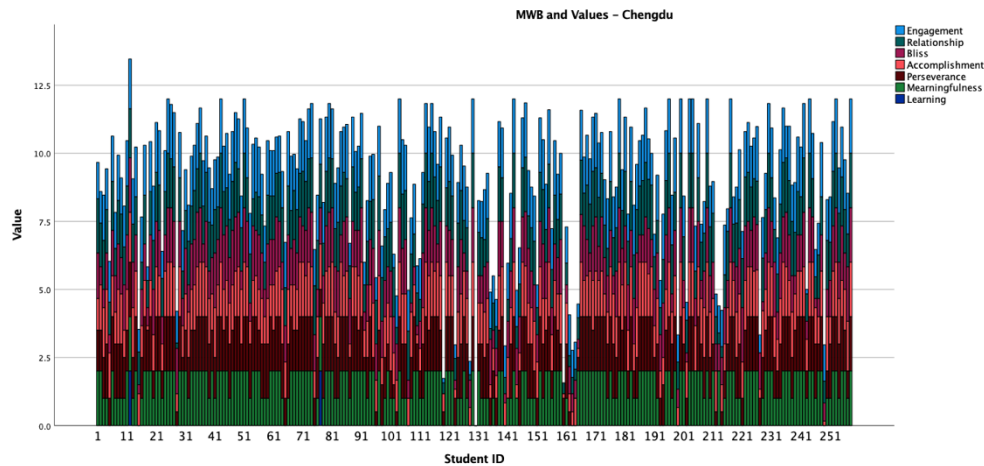


Figure 4: Total mean value scores for the Chinese student sample

Discussion

The current study responds to the call by Hill, Kern, Seah and van Driel (2020) to extend the investigation of values related to MWB to other grade levels and populations. The data collected from Grade 3 students in Chengdu suggest that MWB is associated with the students' fulfillment of the values of *relationship*, *engagement*, *bliss*, *accomplishment*, *perseverance*, *meaningfulness*, and *learning*. This thus answers Research Question 1.

Considering Research Question 2, the seven values identified in this study are similar to the seven values listed in Hill, Kern, Seah and van Driel (2020). The current study thus reaffirms the stability of the MWB framework proposed by the Australian study that was led by Julia Hill, in terms of the seven values which underpin it. However, these values could be expressed through different culturally specific mathematics learning moments in the two different contexts. It is important that teachers are aware of this attribute of values as they are embraced across different sociocultural settings.

It appears from our data that some of the seven values were embraced more than the others. Whether this was due to the nature of the local cultural traditions, of the mathematics education system and/or of MWB is unknown from the quantitative data. Further, qualitative research planned with selected students should be able to shed light on this observation. In particular, the paired samples t-test results suggest that *engagement* and *perseverance* were valued by the Chinese students more than they did with *relationship*, all of which were valued more than *accomplishment* and *meaningfulness*. *Bliss* is next, which the Chinese students appeared to value more than *learning* only.

Considering the extent to which the seven values as a whole were embraced by the 258 students across six classes taught by three different teachers, there was no evidence of class-level variations.

This suggests that values representation / teaching across different Chinese mathematics classrooms (in the same school) was consistent. This might facilitate values associated with positive MWB to be promoted amongst – and fulfilled by – students as they engage with mathematics learning.

Next steps

The intention of this paper is to report preliminary results and findings, providing teachers with some approaches to enriching mathematics teaching further with affective and conative considerations. The next stage of the study will be to both deepen our understanding of the available data and broaden the data sources, thus contributing to existing social theories of mathematics pedagogy.

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