Enhancing Mathematical Wellbeing With Pedagogy

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A student's experience of mathematics in their school years has a lasting impact on many students through to adulthood. How we can improve this experience is a question of significance, as it directly impacts practice and importantly the futures of our students. This paper reports on a study exploring pedagogical approaches to support an increase in students' Mathematical Wellbeing. Findings suggest when language is used to frame what is valued, and variety of pedagogical approaches are integrated into teaching and learning sequences, students can experience an increase in Mathematical Wellbeing.

Mathematics knowledge and skills form an integral part of the Victorian Curriculum with the study of Mathematics a requirement from Foundation to Year 10. A component of the rationale for studying mathematics in the Victorian Curriculum is given as "mathematics is central to the learning, development and prospects of all young Victorians" (Victorian Curriculum and Assessment Authority, 2024). Two of the aims for students studying mathematics are to "ensure that students:

- develop useful mathematical and numeracy skills for everyday life and work, as active and critical citizens in a technological world
- develop a positive disposition towards mathematics, recognising it as an accessible and useful discipline to study" (Victorian Curriculum and Assessment Authority, 2024).

In contrast to the aims of the Victorian Curriculum, a review of the number of students completing Coursework in Unit 3/4 *intermediate mathematics* studies as part of their Victorian Certificate of Education indicated a negative trend for over a decade (VCAA, 2025).

Students lack of engagement in mathematics (Attard, 2012), finding it too hard and time consuming are reasons from practice given by students as to why they change from the intermediate mathematics course Mathematical Methods to the elementary mathematics subject of General Mathematics.

When disengagement in mathematics occurs and students change to elementary mathematics, or cease studying mathematics in their senior secondary schooling it can have "significant future implications for individual life opportunities and success, as well as economic implications more broadly (e.g. employment opportunities; contribution of mathematics to the knowledge economy)" (Zorn et al., 2022, p. 571). The investigation undertaken here set out to explore the question: Can pedagogical approaches used by mathematics teachers impact students' Mathematical Wellbeing?

Mathematical Wellbeing

Mathematical Wellbeing (MWB) is defined as "the fulfilment of students' values within the mathematical learning process, accompanied by positive feelings and functioning" (Hill et al., 2022, p. 379). Students' mathematics values have been found to align with seven wellbeing dimensions: Accomplishment, Cognitions, Engagement, Meaning, Perseverance, Positive Emotions and Relationships (Hill et al., 2020). Hill et al. (2024) have developed and validated survey questions to measure students' experiences of these values. According to a study by Hill and Hunter (2024) students have different experiences of the seven values and there is a significant decline in MWB from Year 3 to Year 8 across all values. To date there are limited studies of MWB as students progress into their senior secondary years of school.

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Engagement

Learning outcomes are significantly affected by the level and quality of engagement experienced by students (Heleme & Clarke, 2001). Attard (2014, p. 2) identifies the elements of influence that teachers have with students' engagement as "the pedagogical relationships formed between teachers and their students, and the pedagogical repertoires that are employed by the teachers". Effective pedagogical practices, that incorporate development of reasoning opportunities, discourse and challenge for all learners have been found to support engagement in mathematics (Attard, 2012; Wood, 2002; Hunter et al., 2016). As reported by Zorn et al. (2022) engagement is complex with an element including emotional engagement and students' willingness to be active learners within the classroom.

Perseverance and Mindset

Learning is achieved when students actively embody a thinking disposition. Being reflective, to form connections between new and existing knowledge and experience, supports processing of learning. Encouraging persistence with mathematics tasks has been the focus of many research studies (Clarke et al., 2014; Roche et al., 2013). Brown (2024, p. 117) discusses the impact of "increasing expectations of learners as active listeners and explainers" as a change teachers can bring about through the development of a classroom culture where students focus on controllable elements of their learning such as participation and mathematical thinking. As Perkins and Ritchhart (2005) assert "having a disposition toward thinking enhances the likelihood that one can effectively use one's abilities in new situations". Within the PISA 2022 report it is noted that students with higher levels of perseverance perform "at a substantially higher level in mathematics than students in the lowest quarter of the [perseverance] index" (De Bortoli et al., 2024, p. 113).

The Study

The research reported here is a snapshot of a year-long professional learning program undertaken by the researcher in 2024, aimed at supporting classroom teachers to transform teacher practice and student learning in their school through the implementation of a project. The project focus was on using pedagogy to enhance Mathematical Wellbeing of students in Year 9, Year 10 Advanced Mathematics and VCE Units 1 and 2 Mathematical Methods. The project took place at an independent Foundation to Year 12 school on the Victorian Mornington Peninsula. Five classes at Year 9 with between 18 to 26 students per class, two Year 10 Mathematics advanced (Year 10) classes of sizes of 18 and 23, and two VCE Mathematical Methods Units 1 and 2 (Year 11) classes with class sizes of 12 and 14 students participated in the project. The researcher taught one class at all year levels involved in the project, with five further staff teaching a combination of the remaining classes. Each of the teachers had more than 15 years teaching experience.

Staff Professional Learning and Student Workshops

Teachers participated in a professional learning (PL) session run by the researcher at the beginning of Term 3, introducing the key principles of MWB and the objectives of the project. Subsequent shorter meetings and PL occurred during Semester 2 consisting of the team of teachers or the teacher researcher meeting one-on-one with staff to discuss implementation of the series of workshops designed for staff to run with their classes and discussion of pedagogy to support students' MWB.

A series of three workshops were developed for the teachers to run with their classes to co-construct a common language and explicitly outline behaviours for engagement, perseverance and learning habits. Each workshop had a focus on one objective of the project: *Workshop 1 Developing Mathematical Wellbeing – Engagement* (objective to establish a common language

for engagement and associate student behaviours); *Workshop 2 – Perseverance* (objective to frame behaviours of perseverance); *Workshop 3 – Developing learning habits* (objective to embed a focus on the impact of mindset on learning). An objective through all workshops was casting a spotlight on student agency in the learning process. Workshops 1 and 2 were delivered during double period lessons, lasting for 30 to 45 minutes of a 100-minute double period, in July in Term 3, on a day that suited each teacher's lesson schedule. The duration of Workshop 3 was approximately 40 minutes and was delivered during August in Term 3, each teacher selected the most suitable lesson to conduct it in based on their individual class schedules.

Pedagogical approaches used within the project included, metacognition, through making time within lessons for goal setting by the students for their learning objectives within mathematics, supporting the MWB Values of *Accomplishment, Engagement* and *Meaning,* with students identifying behaviours that may advance the likelihood of attainment of their goal, developing a motivation for learning and path to follow. Starter questions were used by teachers to activate learning within the first five minutes of class, increasing neural links to reduce cognitive load (Newman, 2023) to enhance the MWB Values of *Cognition, Engagement* and *Relationships*. Custom designed reward stickers were used to reinforce behaviours of engagement and perseverance to enhance students' MWB Value of *Positive Emotions*. Learning opportunities that supported collaboration between students were drawn upon, scaffolding behaviours to promote effective communication for collaboration during the starters, or as part of the main lesson sequence occurred. The use of collaboration as a pedagogical approach by teachers was designed to build opportunity for students to experience alignment of the classroom pedagogy with the MWB Values of *Relationships, Positive Emotions and Perseverance.* Spaced-recall activities (Cooney-Horvath, 2019; Newman, 2023) were a pedagogical tool used to support and promote transfer of learning and enhancement of the MWB Values of *Accomplishment* and *Cognition*. Incorporating mathematical games to develop learning supported teamwork, competition and the MWB Value of *Positive Emotion*. Flexibility and variety in pedagogy was drawn upon to cater for the diverse learning needs of students from Year 9 to Year 11.

The use of Vertical Non-Permanent Surfaces (VNPS) (Liljedahl, 2020) provided a mechanism for collaboration, for students to explain, reason and justify their mathematical thinking. VNPS were utilized in Year 10 and Year 11 classrooms and embedded into practice with four to six non-permanent vertical whiteboards accessible within each of the classrooms. Use of VNPS promoted connections between students through group work, focussed time on task, development of knowledge mobility and high-quality talk in mathematics (Evidence for Learning, 2023). The use of VNPS supported the MWB Values of *Engagement, Positive Emotions* and *Relationships.*

Data

At each stage of data collection, student participation was via in an opt-in survey accessed through the school intranet. Baseline data of students' MWB was collected in May, Week 7 of Term 2, 2024, using the MWB survey developed and validated by Hill et al. (2024). The survey questions drew on a 10-point Likert scale from 1 ('Not like me at all') to 10 ('Completely like me'). A composite score for each Ultimate Value was achieved through calculation of the means of the three or four survey items.

As close as possible to Week 7 of Term 3 and Term 4 the MWB survey was again distributed to students. Week 7 was selected as the school has a whole school focus on wellbeing during this week of each term, each year. Semester examinations were completed one week after the administration of the survey in Term 2 and 4.

Results and Discussion

The number of students who completed the anonymous survey in Term 2 was 125, in Term 3, 111 students and 121 students completed the survey in Term 4. A One-way ANOVA test, using EXCEL was used to determine if the mean differences in the combined composite survey score for each MWB Value between Terms 2, 3 and 4 were statistically significant. Table 1 presents the combined composite scores for each MWB value and p-values, with $p \leq 0.05$ shaded grey to indicate statistical significance, for all classes and year levels involved in the project. The data indicates statistically significant differences between the means of the MWB Values experienced in Term 2, 3 and 4 for the values of Accomplishment, Engagement, Meaning and Positive Emotion. Across all seven MWB Values students experienced their highest MWB in August, Term 3. Factors that may be attributed to this August increase in MWB values may include, student's participation in the workshops with the use of language to frame engagement, perseverance and learning habits, the fidelity of the project related to teacher's use of pedagogy to enhance MWB, focussed learning time with reduced interruptions to the school learning program as occurs in Terms 2 and 4 and the absence of examinations within Term 3.

Table 1

Combined composite scores

Ultimate value	May (125)	August (111)	November (121)	Min	Max	p-value
ACCOMPLISHMENT	6.22000	6.88063	6.45248	1	10	0.03409
COGNITION	6.56800	7.12913	6.73003	1	10	0.08969
ENGAGEMENT	5.50933	6.41441	5.95868	1	10	0.00740
MEANING	5.56800	6.34234	5.85675	1	10	0.03490
PERSEVERANCE	6.06400	6.48649	6.34160	1	10	0.25770
POSITIVE EMOTION	4.57600	5.45946	4.96694	1	10	0.02618
RELATIONSHIPS	7.29600	7.67267	7.55647	1	10	0.23606

To explore the data further, the data collected relating to only Year 9 is reported in Table 2. A One-way ANOVA test, using EXCEL was used to determine if the mean differences in the combined composite survey score for each MWB Value between Terms 2, 3 and 4 were statistically significant. Table 2 presents the combined composite scores for each MWB value and p-values, with $p \leq 0.05$ shaded grey to indicate statistical significance. The data indicates statistically significant differences between the means of all MWB Values experienced in Term 2, 3 and 4 except for the Value of Perseverance. Some of this variation is likely to be related to less students completing the survey in August as all surveys were opt-in. Students in Year 9 sit their first examinations in secondary school in May, their second experience of examinations occurs in November, this may a confounding variable influencing students' MWB. Fidelity to the project by all teachers was likely to be at its highest in Term 3. Table 2 shows, however, an increase in all MWB Values between May to November.

The MWB Value with the greatest change from the baseline data in May to the end of year data in November was observed in the Value of Engagement, suggesting that the development of a common language, explicitly teaching behaviours of actively engaged learners and drawing on variety in pedagogy can support the enhancement of this Value.

Table 2

Mathematical Wellbeing Values combined composite score for Year 9

	Combined composite scores					
Ultimate Value	**May (80)**	**August (59)**	**November (73)**	**Min**	**Max**	**p-value**
ACCOMPLISHMENT	5.79375	6.91102	6.19863	1	10	0.00505
COGNITION	6.10417	7.10169	6.39269	1	10	0.01626
ENGAGEMENT	4.82500	6.12429	5.42009	1	10	0.00244
MEANING	5.02917	5.97175	5.23288	1	10	0.04526
PERSEVERANCE	5.65000	6.38418	5.97260	1	10	0.10193
POSITIVE EMOTION	3.80000	4.96045	4.27397	1	10	0.02332
RELATIONSHIPS	6.73750	7.58757	7.22374	1	10	0.02431

The data collected shows that it is possible to reverse the trend of declining MWB as students progress through their secondary years of school, this is in contrast to other research on MWB (Hill & Hunter, 2024). The Value of Relationships was rated the highest by students in each survey cycle and the Value of Positive Emotions the lowest. Numerous opportunities were made available for the students to collaborate on mathematical activities in classes throughout Terms 3 and 4 during the project. Increasing students' capacity to work with others was a feature of collaborative pedagogies, this is likely to have supported the increase in the Relationships and Positive Emotions Values. Goal setting and discussion of individual goals between the teachers and their students became an embedded component of pedagogy, motivating students and providing additional alignment between student's experience of mathematics and the Value of Meaning.

Conclusion

In this study a focus on developing a repertoire of pedagogical practices and a series of workshops that highlight student agency in learning mathematics has been discussed to investigate the question, 'Can pedagogical approaches used by mathematics teachers impact students' Mathematical Wellbeing?' The primary objective was to increase the fulfillment and experience of students in learning mathematics, through pedagogical practices that may enhance MWB. It has been shown that with intentional use of practices that are valued in the learning environment including, goal setting, and variety in pedagogical practices that facilitate collaboration, reflection and connection building can correlate to the enhancement of MWB.

The findings provide further insight into the potential benefits of the emerging field of MWB and the contributions that a values-based lens of pedagogy may bring to student's experience of mathematics. Further research over a longer time frame, exploring a correlation between MWB and senior secondary enrolments is recommended.

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