

Focusing Year 8 Students on Self-Regulating their Learning of Mathematics

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This paper tells of a Year 8 intervention in a school where students are reported to typically have low engagement in learning mathematics. Aiming to help students self-regulate their learning of mathematics, a tool was developed for students to set short-term goals and select, and reflect upon, their developing command of related strategies for organisation and persistence. The results from the intervention were mixed, suggesting the tool has most potential to benefit middle and low achieving students.

The under-participation of students in learning in the middle years (students aged 10 to 14) is a phenomenon that some teachers face on a daily basis. Indeed, such under-participation in Australia is persistent and widely reported (e.g., Hill, Holmes-Smith, & Rowe, 1993; Russell, Mackay, & Jane, 2003).

In an earlier paper that addressed the issue of participation of middle years students, it was argued by Sullivan and McDonough (2007) that, ideally, to promote student engagement in learning, two sets of factors must align. The first set of factors includes that the students have the requisite prior knowledge, the curriculum is relevant to them, the classroom tasks interest them, and the pedagogies and assessment regimes match their expectations. The second set of factors relate to student goals for learning, their willingness to persist, and the extent to which they see participation in schooling as creating opportunities. While it is acknowledged that teachers of students in the middle years have the challenge to address both sets of factors, the focus of the present paper is on assisting teachers to address the second, with a particular emphasis on student self-regulation of learning through setting goals and identifying strategies related to persistence and organisation.

In earlier research, the persistence of students was studied through posing them a range of increasingly difficult problems in mathematics (Sullivan & McDonough, 2007; Sullivan, Tobias, & McDonough, 2006) and English (Sullivan, McDonough, & Prain, 2005) with the intention that eventually nearly all students would confront a task which was difficult for them. Students were asked to rate their self confidence and achievement, their persistence, their perception of the value of schooling, and what constitutes successful learning. We found that the students were surprisingly confident in their own ability, they perceived effort as important and themselves as trying hard, and saw these as linked. The students seemed to have goals focused on aiming to please the teacher by getting questions correct and scoring well on tests.

It is interesting that, in contrast to the student perceptions, the teachers of these students reported low levels of persistence and significant difficulties in engaging students in learning. Based on observations in classes, the students overall seemed neither confident in their learning nor did they try hard (Sullivan & McDonough, 2007). This disparity was perhaps due to students being willing to try harder within a one-on-one interview situation, or perhaps due to students having a different understanding from their teachers of what “working hard” in the classroom might entail. Students also may not be aware of, or may have little knowledge of, self-regulatory strategies, thus limiting their ability to use them (Ames, 1992).

It is possible also that Year 8 students are not always consciously paying attention to their type and degree of involvement and the implications each might hold. For example, as reported by Sullivan and McDonough (2007), some students indicated that while they know that mathematics is important to their future careers, they do not think about that every time they sit down in a mathematics class. The present study was designed to address the lack of engagement of students, with the aim of making them more aware of possible strategies to assist them to more actively take part in their learning. It addressed two specific areas of need identified by the teachers: organisation and persistence.

Orientation to Learning

Informed most particularly by the work of Dweck (2000) and Ames (1992), student orientation to learning provided an overarching theoretical perspective for the present study. Dweck and Ames categorised students’ approaches to learning in terms of whether they hold either *mastery* goals or *performance* goals, with each form of goal giving “different conceptions of success and different reasons for approaching and engaging in achievement activity” (Ames, 1992, p. 262).

Students with mastery goals associate effort and outcome, tend to have a resilient response to failure, remain focused on mastering skills and knowledge even when challenged, do not see failure as an indictment on themselves, and focus their attention on the intrinsic value of learning. Students with performance goals focus on ability and self-worth. They are interested predominantly in whether they can perform assigned tasks correctly as defined by the endorsement of the teacher, seek success but mainly on tasks with which they are familiar, avoid or give up quickly on challenging tasks, derive their perception of ability from their capacity to attract recognition or do better than others, and feel threats to self worth when effort does not lead to recognition.

Dweck (2000) also distinguished two perspectives on intelligence: a fixed perspective termed *entity* theory that refers to students who believe that their intelligence is genetically predetermined and remains fixed through life; and an *incremental* perspective in which students believe that they can change their intelligence and/or achievement by manipulating factors over which they have some control. Students with incremental perspectives tend to hold mastery goals, while an entity view can result in performance goals.

Self-Regulated Learning

Patrick, Ryan, and Kaplan (2007) stated that “an orientation to mastery goals involves a focus on personal improvement and gaining understanding or skill, with learning seen as an end in itself” (p. 85). Students giving attention to self-improvement for learning through continuous self-reflection are self-regulating learners (Van Grinsven & Tillema, 2006). Where learning is viewed as an activity in which students are proactive, “self-regulation refers to self-generated thoughts, feelings and behaviours that are oriented to attaining goals” (Zimmerman, 2002, p. 65). According to Zimmerman, self-regulating students personally set goals and task-related strategies, are aware of their strengths and limitations, and monitor behaviour and undertake self-reflection. Component skills within this process include students re-structuring their physical or social context so that it is compatible with their goals, self-evaluating their methods, managing their time more efficiently, and adapting future methods. Self-regulation has also been described as a “multi-component, iterative, self-steering process” that implies student choice of goals (Boekaerts & Cascallar, 2006).

As self-regulation includes planning and monitoring (Patrick et al., 2007; Zimmerman, 2002), and orienting oneself before starting a task (Boekaerts & Cascallar, 2006), a tool that helps students set goals for their learning of mathematics and identify potentially helpful strategies, as well as facilitating reflection and further strategy identification, has the potential, at least in some respects, to help students become more self-regulating of their learning.

Research Context and Data Collection

This study involved the development and use, over two iterations, of a tool that allowed students to record goals they developed for one unit of work in mathematics, select strategies related to organisation and persistence to address those goals, reflect on the effectiveness of their efforts, and identify future foci related to organisation and persistence skills. The tool thus addressed Zimmerman’s (2002) three phases within the self-regulatory process: forethought, performance, and self-reflection, and promoted self-regulation as an on-going cyclical (Zimmerman, 2002) or iterative (Boekaerts & Cascallar, 2006) process.

The study reported in this paper is part of a larger project related to the engagement and motivation of students in the middle years. Data collection for the present study occurred in one Victorian regional city government secondary school which serves predominantly lower socio-economic families. The regional city is prosperous, overall community infrastructure is good, and there are ample further education and employment possibilities for school leavers. Data for the case study are drawn mainly from work with one Year 8 class, taught by Teacher A, as described below. Two lessons were observed, six students were interviewed individually (three males and three females: two high, two middle, and two low achievers in mathematics), and Teacher A was interviewed. Feedback from some other users of the tool is also reported briefly where relevant.

As part of a larger study of student engagement in learning⁷, the Year 8 teachers identified persistence and organisation as two aspects that they believed had potential for further development, could assist students to be more self-regulating in their learning, and could lead to a less teacher-centred learning situation. Their views are in line with those of a range of researchers who identify mastery orientation, persistence, self-management, and planning among helpful characteristics for student learning (e.g., Dweck, 2000; Martin & Marsh, 2006). Inspired by the work of a fellow researcher that was shared with the teachers as part of the larger project (Drane, personal communication), the teachers also expressed interest in a practical tool that gave some structure to the students, that allowed the students to write responses, and that facilitated reflection. As a result, the researcher developed a two-stage version of a recording and reflection tool. While this tool was used by more than one teacher within the school, Teacher A agreed to have the researcher visit Wellbeing lessons with his Homeroom class in which he used the tool asking the students to focus on their learning of mathematics. Teacher A was also able to meet with the researcher to reflect upon the value of the tool. The 17 students involved in this case study joined with another class for mathematics lessons and were team-taught by Teacher A and Teacher B. Teacher C, another Year 8 teacher who team-taught mathematics, but to a different group, had also offered to be part of the study but due to other commitments could only offer his and his students' feedback in the first iteration.

Describing the Development and Features of the Tool

The initial two-part tool was developed for use at the beginning and end of a school week but, following input from Teachers A and C, was changed in the second iteration to a three-part tool and to apply to a topic. Thus Sheet A was designed for use at the beginning of the topic, Sheet B mid way through, and Sheet C at the end of the topic, having the potential to help students reflect in a more focused way on their growing development. The description in this paper will now focus mainly on use of the three-part tool.

To assist students in identifying goals for the topic, three spaces titled "A summary of what I will be doing" were provided on Sheet A for students to fill in as directed by the teacher. In preparing students to think about possible goals, they were also asked to identify on a 1 to 7 scale how much they presently knew about the topic and how confident they felt. This was repeated on Sheets B and C. Scales regarding knowledge and confidence were included to bring students' attention to the progress they potentially would be making.

Students then recorded a goal or goals that they developed for their learning of that topic in mathematics. The decision to include this resulted partly from reports by some Year 8 teachers at the school that although students had at the beginning of the year identified goals for the whole year these were quite general and had not given the students sufficient direction. Thus a need for short term goals had been identified. Such an approach concurred with the view of self-regulation in the literature discussed above. The identification of goals was also included in an attempt to make the focus on organisation and persistence strategies meaningful in that they were directed towards a purpose. It was also hoped that students would associate reasonable effort and a willingness to apply the effort with the task of achieving their goal (Ames, 1992). To facilitate the writing of goals the following prompt was included in the tool: "My Goals: What I most want to accomplish or achieve in this topic (Try to be as specific as possible. For example, to be able to ... ; to understand ... ; to complete ... ; to feel ... ; to)". This definition of goals was adapted from that used by Bernard (2003) as a result of feedback from Teachers A and C and students following use of the first version of the tool.

Practical strategies related to organisation and persistence were then listed for students to choose from with the heading "How I will help myself to achieve my goal/s" and the instruction "Choose the strategies you most need to work on". These were informed by ideas from the *PEEL Project* (Baird & Mitchell, 1987) a later related project (Corkill & Mitchell, 2002), and the *You Can Do It* program (Bernard, 2003), and most importantly, from feedback from students and Teachers A and C in the first iteration of the tool. These included: Have all my materials ready; Make good notes; Make a plan and spread out the work; Try not to get distracted by others; Listen even when I am tired or bored; Look at the previous question; Ask someone who can explain it simply. An "Other" option was also provided and space was also included for listing places to find help and for self-talk for when one loses focus.

7 The WHOLE project is the result of a collaboration between three schools, and three universities (Monash, La Trobe and Australian Catholic) and is funded by the Australian Research Council LP 0668937. The views expressed are those of the authors.

On Sheet B students were asked to tick as appropriate for “Have been very helpful” and “Focus for next week” for each of the same strategies as on Sheet A. Students were also asked to write responses “Why or in what way did the strategies help?” and “How I can improve working towards my goal/s”.

Sheet C built on the previous sheets by asking students to identify strategies they had tried, those they were now good at using, and those they still needed to develop. Thus the intention was that the three-part tool (Sheets A, B, & C) would help students choose foci, recognise what they had achieved, and continually look to further development. The list of strategies would also bring student attention to ways in which they could play a role in regulating their own learning of mathematics in relation to organisation and persistence to help meet their goals.

Teacher A added a further step to the procedure, asking students in his class to write a reflection on the strategy choice, effectiveness of the strategy use, and whether they had achieved their goal.

Key Findings

When I visited the school to observe use of Sheet C in the second iteration of the tool, the students gave some, but limited, positive responses about its value. However, the students who were interviewed later that day were generally more positive about its use and adaptability although they had not communicated this in class. Findings are illustrated below by reference to a selection of student responses.

Within the whole class group, Teacher A asked his students to reflect upon the value of the tool after the second iteration. When asked why they had used this procedure, responses were that it allowed them to know their goals and to plan out ways to achieve a goal.

The class was also asked whether they had changed the way they worked because of filling out the sheets. One student stated that he tried to listen more, another student referred to doing less talking, and another said she sat away from others and did her work more. For one student for whom the goal was to not be distracted, the strategy of not sitting next to people she talks to “did not work so well” as she “did not really think about it and still sat next to those people”. Interestingly, this high achieving student achieved nonetheless, but acknowledged that her talking may have made learning difficult for others. However, another student who had essentially the same goal gave herself a success rating of 7 out of 10.

A related goal, “to not talk as much”, was identified by the low achieving female who was interviewed individually. She stated that when she found she was having some success with that goal she set a further goal of sitting away from people who talk a lot. She chose to sit next to a certain person “because she does her work as well and she already knew what my goal was and she knows that I’m a really bad talker and so she tried to help me as well to try and do my goals”. This low achiever in mathematics thus demonstrated that she could reflect on what was hindering her learning and take some control over her learning of mathematics. She also had chosen a person who would be supportive of her efforts: “I talked to her and then she’d just sort of zone out from me and keep on doing her work”. As a result this low achieving student found she could

figure out a lot of things in algebra ... I actually got to know a bit about the topic and I actually got to understand what to do. ... I would usually get the sheet and go, these letters, I don’t understand this, and just talk to my friends and wouldn’t bother asking the teacher for help or anything but after I set myself the goal and got the sheet I would ask for help or ask my friends for help or something and then I would complete it. [The most helpful thing in learning algebra was] probably sitting there and listening to what the teacher had to say about how did you get the answer and all that sort of

She believed she could potentially be a good student like her friend but that when she talks she does not achieve well. She said that while she used the goal in a lot of other subjects, she focused most on algebra. She felt she would also remember this for the next year at school and stated that her next goal might be “to get a certain amount on tests and study a lot more”.

Unlike the high achieving student in her class who reported that she did not think about her goal, this low achieving female demonstrated that she could focus on what she wanted to achieve and work at implementing strategies to assist her learning of mathematics. Her conclusion that she could potentially achieve better suggests an incremental perspective on intelligence and her response suggests a “hardy, can-do mentality”, associated by Dweck (2000, p. 3) with mastery goals.

The middle achieving male who was interviewed identified his goals as “to be able to learn more about algebra” and “to be confident”. In his written reflection he stated that he chose three main strategies: “Try not to get distracted by others; Aim to finish my work; and Listen even when I am tired or bored”. On whether his strategies helped, he wrote:

I listened alot (*sic*) more and I was understanding it well because I was listening. Instead of giving up when it got hard I kept going and I always got my work done. It was hard not to get distracted but when I ignored everyone I did nothing but my work.

He wrote that he had achieved his goal as he could “successfully do an algebraic sum or expression”. Although he had not spoken up in the whole class discussion because he is “not really a talkative one”, he did give further insights in the interview. He spoke of achieving by moving away from his friends: “I’d sometimes go off and sit by myself so I didn’t have anyone to talk to. So I just sat there and did all my work and that helped.” He added, “I sort of did have a bit of a plan because sometimes we get more than one sheet and I thought well do the hardest sheet first and if I’m sitting by myself I can get through that fast enough and the rest of them are going to be easy as”. He recalled not being successful with algebra in Year 6 but felt that in Year 8 it was very important that he did not get left behind in his learning of algebra “because you knew it was going to be a big thing”.

Interestingly, he spoke also of setting goals at home: to practise his musical instrument daily and to exercise regularly. He was inspired to do this after hearing of another student in his class who had set personal goals as a result of the focus on goals in mathematics at school. In addition, he said

I’ve written up my own sort of plan like that and I’ve stuck it up on my corkboard so it’s there for me to look at so if I do encounter something bad or hard I can go home, I see that, I think alright I can set a goal. So that’s always there to remind me that I can set goals... I wrote what I wanted to do, how I could achieve it, places I could find help, ... self-talk – Don’t lose focus.

The tool not only had short term impact both in this student’s learning of mathematics and for other non-school activities, but also potential to empower him for future learning.

In contrast the high achieving male interviewee commented on the procedure: “My reaction is that I don’t like it because I find goals hard to set”. This does bring to mind Dweck’s (2000) discussion of students with performance goals who seek success mainly on tasks with which they are familiar and avoid or give up quickly on challenging tasks. He felt the procedure could be helpful “if you are struggling in some subject and you want to set a goal to accomplish something you can do it to help you”. But he did not see himself as usually struggling in subjects. So it appears that he saw goals as more relevant to others. He felt he could work on “try[ing] not to get distracted by others or distracting others which I do a lot” but did not plan to set such a goal as “I’ll just wait for it to happen”. This student’s reaction is clearly different from those of the low achieving female and middle achieving male interviewees.

From this discussion of just a small number of student responses it becomes evident that there was mixed reaction and commitment to the use of this procedure. It is noteworthy that some positive assessments of its value or potential to stimulate further goal setting that had not been shared in the class discussion became apparent in the interviews. Analysis from all six interview students indicated that themes included not wanting to fall or be left behind in a mathematics topic, wanting to remain focused, thinking about who to sit next to so as to minimise distractions, and associating with peers or a teacher who give good motivational messages. It is clear that some students consciously made changes, and indeed the impression is that the procedure not only brought strategies into focus for the students, but in a sense gave them permission to use such strategies for learning mathematics and even adapt, privately, for school-related and personal goals.

The majority of the students felt that the procedure was worthwhile and could be used with the following Year 8 class but not too often; suggestions included once a term or a couple of times a year.

Teacher A and a number of the students felt that it would be worthwhile to paste a sheet at the front of one’s mathematics workbook to be reminded of one’s goal/s and strategies. Teacher A thought this would be easier as it would show the students some of the things they could try. It is possible also for additional strategies to be listed on such sheets, perhaps targeted at the particular mathematics topic.

In making suggestions for future use, Teacher A stressed that he thought the tool would best be integrated into one curriculum area, and as one small part of a total approach to giving students more control of their learning: “I think it needs to be smaller and subtle and tied in with something you are doing in class, not something you pull out and do for a long time”.

Discussion

Initial impressions from the teachers, prior to use of the tool was that it had potential for use with these Year 8 students who are generally considered less engaged in their learning of mathematics than desirable. Positive comments included “It is specific, not nebulous and gives quick feedback” and “It’s simple: what I will do; how I will do it”. It was seen to have potential for use at a parent interview, and could assist reflection for students as “at the end of the year on the report [they] have to be able to reflect”. There was the comment also that “Too often will kill it” and indeed, that sentiment was repeated after the use of the two iterations of the tool. It was recommended that it is best used within one curriculum area, giving the students a clear focus for their goals and application of strategies.

As an aside, an interesting outcome of the use of the tool occurred within a reflective conversation in Teacher A’s Homeroom group where students spoke of their need for briefer explanations in mathematics, particularly from Teacher B (who team-taught mathematics with Teacher A). When this was shared with Teacher B he stated that the students with whom he had used the tool had given the same feedback:

We talked about it, it was really good. But then [student] put her hand up and said “Gee, Mr [Teacher B] sometimes you tell us too much. I had a handle on everything with zero the other day when you were talking about it in maths and then you mentioned this thing about measuring zero. It just confused me, too much information”.

So while not necessarily a direct purpose of the tool, reflection on its use provided the opportunity for students to express views regarding what they perceived as their needs in learning mathematics. It also caused Teacher B to reflect upon the approach he took in wanting students “to make bigger connections” in mathematics.

Self-regulated learning is multi-dimensional (Boekaerts & Cascallar, 2006; Zimmerman, 2002), and organisation and persistence for mathematics learning are just two small aspects. However, the results from this intervention suggest that for at least some of the students in this Year 8 class, this was an appropriate place to start as the tool allowed students to address goals that they saw as relevant and gave practical strategies that they could implement and adapt. Students also experienced success and saw the possibility of setting further goals. Student awareness, participation, and decision making for learning mathematics were enhanced for at least some members of this Year 8 class. The tool also gave an opportunity for teachers to reflect on their teaching of mathematics.

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