

STUDENTS' PERCEPTIONS OF FACTORS CONTRIBUTING TO SUCCESSFUL PARTICIPATION IN MATHEMATICS

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This is a report of a project investigating students' perceptions of the extent to which their own efforts influence their achievement at mathematics and their life opportunities. We conducted two hour interviews with over 50 students, as well as collecting other data. Even students who were confident, successful and persistent exhibited short term goals. It also seems that classroom culture may be an important determinant of under participation in schooling.

INTRODUCTION

This is the report of an investigation of some possible causes of the malaise that characterises much of the experience of school for many students between the ages of 10 and 15 (termed the middle years) in Australia, a period that coincides with the transition from primary school (the first seven years) to secondary school. The key focus of the research was the students' perceptions of the extent to which their own efforts contribute to their success in, and enjoyment of, school. We see such research as critical because under participation in schooling is connected to missed life opportunities, high drop out rates, and reduced employment prospects, the economic cost of which has been estimated at over \$2.5 billion to Australia (King, 1999).

Researchers have noted a decline in school engagement of young adolescents as compared with their engagement in primary school (Hill, Holmes-Smith, & Rowe, 1993), increased truancy, and greater incidence of disruptive behaviour, alienation and isolation (Australian Curriculum Studies Association, 1996). Hill et al. (1993), for example, reported that, in the middle years, there is a noticeable arrest in the progression of learning observed through the primary years.

The alienation seems to be most acute in the case of disadvantaged students. Lokan, Greenwood and Cresswell (2001), for example, argued that recent reforms have failed to address the obvious disadvantage of particular groups of students, and have not resulted in significant gains in engagement, especially in the middle years of schooling. Hill et al. (1993) noted that the bottom decile seems not to progress academically beyond Year 4.

Hill, Mackay, Russell and Zbar (2001) summarised a range of initiatives to address participation of students in schooling in the middle years. Predominantly the projects they summarised sought to address the decline in the level of students' engagement and liking of school, to promote a sense of identity and self esteem, and to develop in students the confidence to foster autonomous learners. Our focus is on the perspectives of the students to seek to identify the causes of the difficulties they

experience. Without a clear understanding of these factors, structural or teacher professional development initiatives are unlikely to be successful.

Anticipated sources of pupil alienation

We believe that identifying the nature of pupil alienation and possible avenues to solution rest in coming to understand the perceptions or beliefs that students have about themselves and the opportunities that schooling offers. In particular, we examined perceptions that students' in the middle years have of their capacity to influence their own achievement.

The research framework is based on work by Dweck (2000) who identified two views of intelligence which she saw as being fundamental to understanding the way that people view themselves. One is a fixed view of intelligence entitled *entity theory* in which people believe that their intelligence is predetermined at birth and remains fixed through life. Dweck suggested that students who believe in the entity view require easy successes to maintain motivation, and see challenges as threats. The alternate perspective is where students see intelligence as malleable or *incremental* and they can change their intelligence and/or achievement by manipulating factors over which they have some control. Students with such incremental beliefs often choose to sacrifice opportunities to look smart in favour of learning something new.

Directly connected to these views of intelligence are the ways that people describe their own goals. Dweck suggested that some people have *performance* related goals, and rely for success on tasks that offer limited challenge. When experiencing difficulties, such people lose confidence in themselves, tend to denigrate their own intelligence, exhibit plunging expectations, develop negative approaches, have lower persistence, and deteriorating performance. Such students particularly seek positive judgments from others and avoid negative ones.

There are others, according to Dweck, who have *mastery* oriented goals who tend to have a hardy response to failure and remain focused on mastering skills and knowledge even when experiencing challenge. Mastery oriented people do not blame others for threats, do not see failure as an indictment on themselves, rather they hold learning goals which are to increase their competence when confronted with difficulty. Confidence in their own ability and success are not needed to build mastery oriented objectives.

Dweck argued that an *entity* view of intelligence leads students to focus mainly on *performance* goals whereas the *incremental* theory allows students to focus on *mastery* oriented goals.

It is interesting to consider the implications of this for teaching. Students who believe in the entity theory of intelligence could be a direct result of significant adults such as parents and teachers who tended to exaggerate the positives and protect them from negative information. Dweck claimed that, by their actions, some teachers teach students that they are entitled to a life of easy low effort successes, and argued that this is a recipe for anger, bitterness and self doubt. Dweck suggested that some

teachers respond to students experiencing difficulty by providing easier tasks, the net effect of which is to create a climate in which challenges are feared rather than addressed.

Dweck (2000) argued that teachers can teach specific behaviours such as decoding tasks, perseverance, seeing difficulties as opportunities, and learning from mistakes. This emphasis is directly compatible with quite separate research strands on self fulfilling prophecy (e.g., Brophy, 1983), and motivation (e.g., Middleton, 1995).

Our key research questions were:

- To what extent does the students' orientation to mastery or performance relate to their confidence and achievement?
- What are students' perceptions of the extent to which their own effort contributes to their success at school?

SOURCES OF DATA

Data were collected from one year 8 class in each of four schools in a regional Australian city. The data sought students' responses to questions and tasks relating to both English and Mathematics. The surveys were administered to, and interviews conducted with, over 50 students.

The interviews took the form of a teaching conversation. Two sets of six hierarchical tasks on a similar topic were constructed in both English and Mathematics, ranging from very easy to very difficult. In the case of Mathematics, we posed a set of six tasks on the area of figures ranging from counting squares to a sophisticated task requiring interpretation of a scaled drawing. For each task the interviewer posed the task, sought the student's explanation of their strategy and their perception of whether they were correct. If correct, the interviewer instructed the student to attempt the next task. The intention was that eventually nearly all students would confront the challenge of a task which was difficult for them. The students were asked how they felt about the challenge they experienced, and the type of support they needed to solve the problem. We also sought students' responses to a vignette about advice they might give to one of their peers who was a potentially high achiever who deliberately does not try.

The survey included items from three instruments adapted from Dweck (2000), asking students to rate their self confidence and achievement, their persistence, their perception of the value of schooling, and what constitutes successful learning. These data were supplemented by their teachers' rating of their achievement and effort in Mathematics and English. Only the results related to Mathematics are presented here.

RESULTS

During the interview, students were asked up to six questions requiring the calculation of area, stopping when the student responded incorrectly. The first question was a trivial task requiring students to count squares which all students

could do. The second task was also simple but required students to count half squares as well. All but one did this successfully. The third task asked students to draw a shape, in which the prompt suggested using half squares. Four more students were unable to do this.

The next task asked the students to calculate the area of the shape in Figure 1. Three more were unable to do this. While the task is slightly easier than the curriculum for these year 8 students would suggest, it is nevertheless a reasonable challenge, and that 38 out of the 46 students could do this suggests that their mathematics progress is at least satisfactory.

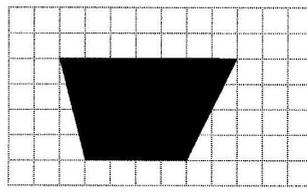


Figure 1: The 4th area question.

As an aside, the observers noted that many students tried to apply a rule for task 4 even though they had been successful on the previous tasks without using a rule.

The fifth task was slightly more demanding, as shown in figure 2, and this was at the level expected by curriculum for this level. That over one quarter of the students responded correctly suggests that these students, at least are progressing well at their mathematics. There was a sixth, much harder question that was completed by four students.

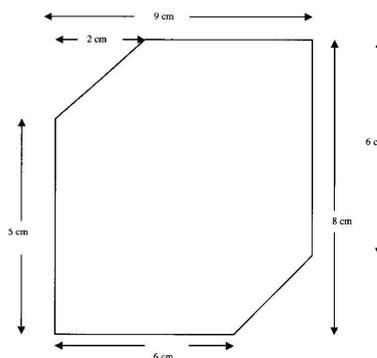


Figure 2: The 5th area question.

On the survey, the students were surprisingly confident in their own capacity to learn mathematics. Table 1 presents results from selected items from the survey, on which the students rated their responses on a six point scale, including strongly agree, agree, mostly agree, with similar options for disagreeing.

Table 1: Student self confidence (n = 46) (%)

	Strongly agree	Overall agree
I feel confident that I can learn most maths topics	38	94
I can learn anything in maths if I put my mind to it	41	94
If I find the work hard, I know that if I keep trying I can do it	37	91

About one third were very confident, most are confident, and they see a link between achievement and effort. Further responses related to effort are presented in Tables 2 and 3.

Table 2: Student self rating (%) of effort - positive (n = 46)

	Strongly agree	Overall agree
My friends say that I keep trying when maths gets hard	15	83

Table 3: Student self rating (%) of effort – negative (n = 46)

	Strongly disagree	Overall disagree
You are either good at maths or not. You cannot get better by trying	56	82
If I can't do the work in maths I give up	31	96

In both positive and negative forms, these students see themselves as persistent, and further confirm a link in their minds between effort and achievement. It is interesting to compare their self perceptions with those of their teachers who were asked to rate the students on their estimation of these students' effort and achievement. The ratings, choosing options from "poor" to "great" are presented in Table 4.

Table 4: Teachers' ratings (%) of student achievement and effort (n = 46)

	Great	Average or better
Achievement	29	82
Effort	46	90

In other words, the teachers also rate the students predominantly as achievers who try hard. Based on these student self ratings and the teacher ratings, it could be assumed that the students are progressing well and try hard.

It is interesting to compare the responses of the 12 students who demonstrated higher achievement by completing question 5 as presented in Figure 2. About half of these students strongly agreed with the propositions in Table 1, with the rest agreeing. Only 3 of these strongly agreed that their friends would say they keep trying when it gets hard. While 8 of this achieving group strongly disagreed with the proposition that you are either good at maths or not, and you cannot get better by trying, there were 2 who agreed. The teachers rated 8 out of these 12 students' achievement as great, and for 10 they rated their effort as great. In both items the rest were rated as good

achievement. Perhaps these achieving students' self ratings are below what might be expected.

There were 8 students who did not reach or complete question 4, and these could be considered as below the expected level. Only 1 student did not agree with the propositions in Table 1, and 2 students strongly agreed with them. Only one disagreed that their friends would say they keep trying when it gets hard, and none agreed with the proposition that you are either good at maths or not, and you cannot get better by trying. Only one agreed with the proposition "If I can't do the work in maths I give up". The teachers rated 3 of these students as good, and 5 of them as having good or great effort. Perhaps these students' self ratings are optimistic.

Overall, both the high achieving and low achieving students are confident in their ability, they feel they try hard, and they see achievement as connected to effort. We had not anticipated this result, and suspect that working in schools on either aspects is not likely to address whatever are the causes of the apparent threats to participation in the middle years.

To gain some insights into what the students overall considered success in mathematics, they were invited to give an open response to the prompt

I know when I am doing well in maths.

While there were many responses, 24 of the responses were categorized as "Getting correct answers and completing the work"; 23 as "Seeking teacher praise and good marks"; and 11 as "Emphasising learning and understanding". Some students had responses scored in more than one category. We would rate only the 11 students giving the third category of response as clearly mastery oriented. We rate the 23 students giving the second category of responses as clearly performance oriented, and we infer that responses in the first category are indicative of a performance orientation. Interestingly all of the 12 higher achieving students gave performance oriented responses, although focusing on what the good students would do. Only one of the low achieving students mentioned understanding. In other words, all but one of the students we rate as mastery were neither in the high or low achieving group.

To gain some sense of the importance the students attribute to mathematics, they were invited to give an open response to the prompt:

What are the advantages of being good at maths.

About half of the responses were related to getting a better job or assisting them in their life generally. We take these responses to indicate an acceptance of the value of mathematics, and the worth in learning it. The other half of the responses were school and mark (grade) oriented. This may be evidence that substantial numbers of students have limited perception of the value of mathematics, and see it only as a school oriented task. Such perceptions would be vulnerable to external threat. Interestingly 11 out of the 12 higher achieving students gave job or life oriented responses whereas only 3 of the 8 low achieving students did so. Twenty-two students indicated that

they persevered when the task got difficult and nearly all of these responses were related to getting the right answer.

The students were posed with a scenario of a friend who was good at maths but does not try. When asked to explain why this might be, in open response format, nearly half of the responses were either that their friend was trying to be popular or that they were scared of being bullied. Interestingly this finding was even more marked for the corresponding English prompt. This is perhaps the key finding in this study and has significant implications for the culture of schools, and the value for learning communicated by our society.

DISCUSSION AND CONCLUSION

In interpreting these results it should be noted that the process of seeking ethics agreements across grades and schools meant that only students who returned the forms were included. This may have had a biasing effect. Nevertheless there was a spread of achievement evident and so the results are informative at face value.

Overall, these students were surprisingly confident in their own ability, they perceived themselves as trying hard, they saw these as linked, and they achieved up to expectations on the mathematics tasks. The teachers' ratings generally confirmed the student self ratings, although it was noted that the weaker students seemed rule oriented in a counterproductive way. The students seemed very aware of the importance of effort. It seems that the schooling of the students in this study has developed an awareness of the importance of effort, and of metacognitive awareness of their approaches to problems. The students overall seemed aware that some students underachieved through lack of effort.

We suspected that students would give up when posed difficult tasks and this would provide the prompt for our discussions. However, in both the English and Mathematics tasks all students persevered for the whole time. It should be noted that the situation was artificial in that an adult observer was with the students individually for all the time, and this does not reflect a classroom situation. Nevertheless it does show that all of these students were willing to persevere under these conditions. Perhaps teachers could seek to simulate such conditions with difficult students at times.

Inferences from some responses suggested that generally the students have a performance orientation, not only to mathematics but also to effort. It confirms the Dweck conjecture that orientation to mastery or performance is not connected to confidence or achievement. Teachers will not address the students' participation in schooling solely by improving confidence, achievement or even awareness of the connection between effort and achievement (although these are obviously desirable).

Many of the responses, that we interpreted as evidence of a performance orientation, may be related to short term goals. In other words, the students saw pleasing the teacher, getting questions correct, getting the work completed, and scoring well on

tests as the desirable goals. Students may benefit if teachers direct attention explicitly to the longer term goals of deep understanding, linking new knowledge to previous knowledge, linking new knowledge to its usefulness and application, and generally focusing on the mastery of the content rather than performance to please the teacher or parents, or even their own self esteem through any competitive advantage.

About half of the students connected success at mathematics to life opportunities. Interestingly nearly all the better students saw this connection, and few of the weaker students did. Teachers could well find ways to make connections between the content and its long term value. This is also connected to the purpose of schooling.

In an open item, nearly half of responses to a prompt seeking explanations for under participation suggested that either students deliberately do not try in order to comply with a particular classroom culture or avoid the perception of trying due to threats of sanctions by peers. Perhaps this is a key finding. The students seem to have the necessary self confidence and appreciation of the contribution of effort and persistence, but may under contribute due to characteristics of the classroom culture. Teachers and schools could well address this issue as a priority and seek strategies for addressing it.

References

- Australian Curriculum Studies Association (1996). *From alienation to engagement: Opportunities for reform in the middle years of schooling*. (Vol 1, 2 & 3) Canberra: Australian Curriculum Studies Association.
- Brophy, J. E. (1983). Research on the self-fulfilling prophecy and teacher expectations. *Journal of Educational Psychology*, 75(5), 631-661.
- Dweck, C.S. (2000). *Self theories: Their role in motivation, personality, and development*. Philadelphia: Psychology Press.
- Hill, P., Holmes-Smith, P., & Rowe, K. (1993). School and teacher effectiveness in Victoria: Key findings from Phase 1 of the Victorian Quality Schools Project. Melbourne: Centre for Applied Educational Research.
- Hill, P., Mackay, A., Russell, V., & Zbar, V. (2001). The middle years. In P. Cuttance (Ed.) *School innovation: Pathway to the knowledge society* (pp.101-141) Canberra: Dept of Education, Training and Youth Affairs.
- King, A. (1999). *The costs to Australia of early school leaving*. Sydney: National Centre for Social and Economic Modelling and Dusseldorp Skills Forum.
- Lokan, J., Greenwood, L. & Cresswell, J. (2001). *15-up and counting, reading, writing, reasoning. How literate are Australia's students?* Melbourne: Australian Council for Educational Research.
- Middleton, J. A. (1995). A study of intrinsic motivation in the mathematics classroom: A personal construct approach. *Journal for Research in Mathematics Education*, 26 (3), 254-279.