EFFECTIVE DIFFERENTIATION: WHERE A GROWTH MINDSET MEETS THE ZPD

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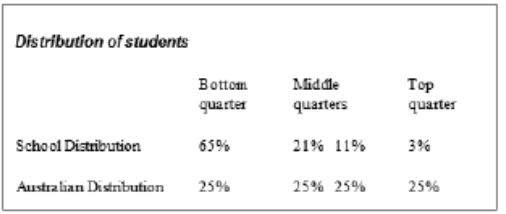
The challenge of practically providing each student in a class with the opportunity to work at their own Zone of Proximal Development (ZPD) (Vygotsky, 1978), is often insurmountable to many practitioners. Our model not only alleviates the practical aspects of this challenge, but in addition, creates an environment where students believe that they can improve and an environment where students are expected to identify and select the activity which is "just right" for their learning requirements.

Introduction

Sunshine College is a multi-campus Government secondary school located within the South Western Victorian Region. It is positioned across four sites and is made up of three junior campuses, including a deaf facility and one senior campus. It is a culturally diverse school with more than fifty language backgrounds. The population, in general, suffers a high degree of disadvantage and a low socio-economic position, with an average Student Family Occupation (SFO) index of 0.8, and a school ICSEA value of 909. Our distribution of students compared with the Australian average is shown in Figure 1.



Distribution of students	Bottom quarter	Middle quarters	Top quarter
School Distribution	65%	21% 11%	3%
Australian Distribution	25%	25% 25%	25%

Figure 1. Distribution of Students (http://www.myschool.edu.au/SchoolProfile).

In 2008 and after several years of little or no improvement in whole school data (AIM & VCE), and the placement of several numeracy coaches from the now-defu[illegible] Western Metropolitan Region, the authors of this paper began to construct a numeracy program which would support the conceptual understanding of all students. Prior to this the majority of mathematics classes at Sunshine College were teacher centred and followed a traditionally recognised structure. The teacher would complete worked examples on the whiteboard, students would copy the examples and then complete a number of almost identical questions from the prescribed textbook. Classes rarely, if ever, used concrete materials; students worked individually; assessment was summative and the opportunity for a tailored and individualised program was the prerogative of the classroom teacher, often resulting in lessons where weaker students were expected to complete fewer questions than the more competent students.

Context

At each junior campus of Sunshine College all students receive five 50-minute lessons of mathematics instruction per week. Each two-week cycle is divided into one of five elements, as illustrated in Table 1. Each element has been developed to specifically address a particular aspect of student learning and have been described in full detail in Siemon, Virgona, and Corneille (2006); Reilly, Parsons, and Bortolot (2009); Reilly, Parsons, and Bortolot (2010); Reilly and Parsons (2011), and in *The Common Denominator* (Jan, 2014). While each element of the Sunshine College Numer[illegible]rogram (SCNP) supports a different aspect of numeracy understanding, they all share a common philosophy, in that all students are encouraged to work within their ZPD in an environment which fosters the growth mindset.

Table 1. *Sunshine College Numeracy Program (SCNP)*

Week	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5
Odd	Differentiated curriculum	Reciprocal Teaching	Differentiated curriculum	Speedy maths	SNMY
Even	Differentiated curriculum	Reciprocal Teaching	Differentiated curriculum	ICT	SNMY

The Results

Prior to the implementation of the SCNP the college was regularly identified as a school where students on average tested two or more years behind the national average for literacy and numeracy. As is demonstrated in Table 2 and Figure 2 the introduction of the SCNP has led to on average a faster rate of growth for students at the college when compared to the average rate of growth demonstrated by the State in the NAPLAN standardised tests for students between grade 7 and grade 9.

Table 2. *The Rate Of Growth Between Years 7 And 9*

NAPLAN School Comparison Report Raw Scores			
Matched School Mean	2011	2012	2013
Ardeer Campus	56	47	45
North Campus	47	51	53
West Campus	45	64	54
School Mean	49.3	54	50.7
State Mean	42	38	39

In February 2014, Sunshine College was noted as a turnaround school by The Grattan Institute. It was heralded as one of four schools in Australia to have students improving at a rate faster than the state average in numeracy (Feb, 2014).

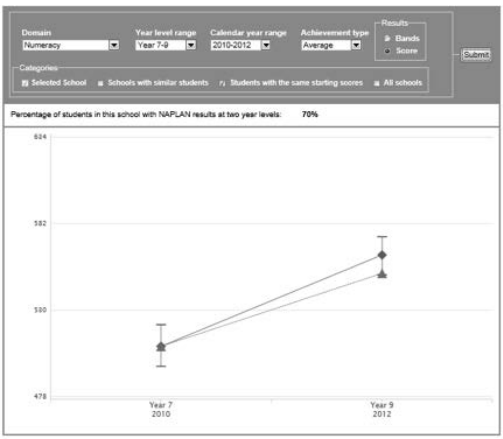


Figure 2. Sunshine College against 'Students at the same starting point', 2010–12 My School Website.

Anecdotal evidence also suggests students are now more confident in their mathematical ability and as a result more students are selecting General Mathematics (Advanced) in year 11 compared to previous years. When students are questioned as to why they are selecting mathematics they say it is because they like maths or that they are good at it.

It is the authors' belief that a number of factors working together have contributed to the success of the program, most notably a fully differentiated curriculum where students are offered mathematics at their ZPD and the fostering of a growth mind-set within each and every mathematics class.

A Fully Differentiated Curriculum

The mathematics curriculum for schools is governed by The Australian Curriculum Assessment and Reporting Authority. It describes the chronological expectation of student learning in each year of formal schooling. In mathematics this means students in year 8 are expected to develop an understanding of directed number while students in year 9 progress to developing an understanding of Pythagoras' Theorem and Trigonometry. This expectation notwithstanding, it is rare to find a classroom where all students are capable of learning a specific concept at the same time and in the same manner. In 2011, the authors described their model for differentiation which avoids the various negative connotations of streaming, grouping and withdrawal of students whilst demonstrating how the model is not just modifying or extending work (Reilly & Parsons, 2011). In addition to these

benefits the authors have noted an additional point of difference to their model where the teacher provides for different learning needs by what they refer to as the "Drop-out Model".

The Drop-Out Model

In this traditional model the teacher often constructs an activity, assessment task or topic test, where the initial questions are easier. However, as the task progresses the questions become increasingly more difficult. While all students work on the same material they drop-out when they have reached their capacity to understand. This model has two potential detrimental effects on student learning. Firstly, it provides the more able student with ample opportunity to demonstrate their knowledge and intelligence as they experience the metaphorical pat on the back as they successfully complete work that was well within their capability, or as with the initial activities, below their ZPD. These same students, who experience success often, when faced with small challenges, have a reduced capacity to cope and can on occasion, crumble. This Drop-Out model can mean that more capable students are not regularly presented with the opportunity to develop perseverance or resilience in their learning — thus supporting the development of a fixed mindset where individuals believe that understanding or intelligence cannot be improved upon (Dweck, 2006).

Secondly, the Drop-Out model indicates very clearly to students who are less able that there are many things which they cannot do. Even when the task is delivered by the most caring teacher saying things like "Don't worry, just do as many as you can". The student still hears "You are not as good as everyone else; my expectations of you are much lower than my expectation of the good mathematicians."

As previously described, (Reilly & Parsons, 2011) the development of an alternative model of differentiation which incorporates "just right" task not only provides learning opportunities for all students to work at their ZPD but also capitalises on the positive learning outcomes associated with a growth mindset.

The Development of a Growth Mindset in Mathematics

There are very few people in this country who would happily admit that they were illiterate, yet many highly educated and well respected individuals will publicly concede that they were "never any good at maths". There is a widely held perception that being a good mathematician is a particular talent that only a lucky few individuals exhibit and that your natural ability determines or limits your achievement in this area. The psychologist, Carol S. Dweck, PhD, describes this belief system as a fixed mindset, where your level of intelligence is seen as a fixed trait.

Blackwell, Trzeniewski, and Dweck (2007) studied a group of 7th graders in the United States, where after transition from elementary school, the students perceived the work to get harder and as a result the students begin to struggle. In this study, students were identified as having either a fixed mindset or a growth mindset. The authors found students who had been identified as having a growth mindset exhibited a dramatic increase in maths grades when compared to the fixed mindset group (Blackwell et al., 2007).

Dweck (2006) describes how, in order to develop a growth mindset in learners, it is necessary to change the belief that intelligence is a fixed trait, and that if an individual needs to work hard at something it means they are no good at it, as opposed to working hard to become very good at it. Those with a fixed mindset also believe mistakes demonstrate failure as opposed to providing opportunities for learning and understanding. Fixed mindset students have little or no recipe for recovering from failure and instead tend to either give up or blame the teacher. In contrast students who exhibit a growth mindset confront difficulties and seek solutions.

Our Model of Differentiation and a Growth Mindset

In conjunction with providing a differentiated curriculum, Sunshine College guides students towards developing a growth mindset. Students are encouraged to take control of their learning and to develop personal learning goals. In our classrooms the path travelled is as valued as the end result. We encourage students to determine their current level of understanding, help them to set realistic and achievable goals and then guide them to select tasks which best supports their learning, i.e., the task which is "just right" for them. A "just right" task refers to a learning activity which allows students to work in small groups on a mathematics problem at their ZPD. All students within the one classroom work on the same learning outcome, e.g., area of composite shapes, but at a level which maximises their opportunity to learn. It is this access to achievable tasks coupled with the perception that less able mathematician work alongside the better mathematicians on the same learning outcomes which we have observed to have the most substantial effect on student learning.

In order to support the development of a growth mindset while providing a fully differentiated curriculum the authors' believe the following key elements are essential.

- Each task is specifically planned and designed by a team of teachers to address the needs of students across a minimum three ability levels.
- Students work in concert with the classroom teacher (in the beginning) to select a task which is just right to their learning. "Just right" tasks focus on conceptual understanding of mathematics as opposed to procedural practice.

- Each task should be designed to teach more than one mathematical concept at a time, reinforcing the complex nature of mathematics.
- When the teacher introduces the tasks to the class, each level is described using the pre-requisite knowledge the students will need to complete the selected task successfully. The teachers avoid labelling the tasks as 'easy', 'medium', or 'hard' because if the task is 'just right' for the student it should feel hard.
- Students work with someone who has chosen the same task as they have and who thinks at the same speed as they do, encouraging equitable mathematic conversation.
- Tasks are created to support conceptual understanding and not just to provide opportunity to practice procedures.
- As students are working at different levels of understanding, teachers are no longer able to stand at the front of the room and explicitly teach to the class as a whole, instead explicit teaching is done at the point of need, with the teacher constructing small groups when necessary to increase efficiency.
- While using this model of differentiation teachers avoid telling the students anything, opting instead to guide them to discovery through effective questioning techniques. As stated by René Descartes in his book *La Géométrie* (1637), "I hope that posterity will judge me kindly, not only as to the things which I have explained, but also to those which I have intentionally omitted so as to leave others the pleasure of discovery." When teachers offer students the short-cut, it is often because the teacher is under pressure to cover the curriculum and believes that the student will understand quicker if given the algorithm or short-cut alongside multiple practice questions, often confusing students who cannot learn without first understanding.
- The use of assessment and feedback to support development of a growth mindset. Student data is shared with the individual student and student improvement data is shared with the class, the emphasis is on improvement above absolute score.

Conclusion

The Sunshine College Numeracy Program demonstrates that by providing students with various levels of tasks from which they can self-select the most appropriate for their learning within a culture that promotes students responsibility for their own learning, whilst fostering self-confidence and self-belief and where improvement is valued more highly than absolute scores, excellent learning outcomes can be achieved for every student.

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