SECONDARY STUDENT PERCEPTIONS OF WHAT TEACHING AND LEARNING APPROACHES ARE USEFUL FOR THEM IN LEARNING MATHEMATICS

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Students' perceptions of what teachers do and what students themselves do that helps them learn gives an insight into what might be effective in a mathematics classroom. This paper looks at student perceptions in general but also specifically in relation to the teaching and learning of mathematics. Data were collected from students at two South Australian schools via an online survey conducted each year for three years. The students were asked questions relating to what teachers did that helped them learn and what they did that helped them learn Mathematics. The results of the survey will be presented and will highlight areas that students think are most important in learning mathematics.

Introduction

The importance of teachers to student learning has been well established worldwide (Darling-Hammond, 2007) and in Australia, a government report *Teachers for the 21st Century: Making the Difference* (Department of Education Science and Training [DEST], 2000) highlighted that not only are teachers central to student learning, but that student needs are changing and therefore the skills teachers need to be effective are also changing. The related area of teacher effectiveness has in recent times been the subject of scrutiny in Australia (DEST, 2000, 2003) and overseas (Darling-Hammond, 2000, 2007; Wang, Haertel, & Walberg, 1993) and much has been written on the qualities of a good teacher (Center for Teaching Quality, 2006; Department of Education and Children's Services [DECS], 2005).

Darling-Hammond (2007) proposed a number of qualities for effective teachers,

- strong general intelligence and verbal ability that help teachers organize and explain ideas, as well as to observe and think diagnostically;
- strong content knowledge—up to a threshold level that relates to what is to be taught;
- knowledge of how to teach others in that area (content pedagogy), in particular how to use hands-on learning techniques (e.g., lab work in science and manipulatives in mathematics) and how to develop higher-order thinking skills;
- an understanding of learners and their learning and development—including how to assess and scaffold learning, how to support students who have learning differences or difficulties, and how to support the learning of language and content for those who are not already proficient in the language of instruction; and

- adaptive expertise that allow teachers to make judgments about what is likely to work in a given context in response to students' needs. (p. 3)

Wilson, Cooney and Stinson, (2005) looked specifically at mathematics teachers and highlighted four main areas that make for good teaching in mathematics; Prerequisite teacher knowledge, promoting mathematical understanding, engaging students, and effectively managing the classroom environment. They went on to examine these areas in more detail and highlighted some more specific practices such as *Connecting mathematics*, *Visualizing mathematics*, *Assessing students' understanding*, and *Refrain from telling*. Although they did indicate that while the "teachers were emphatic that good teaching was not telling, they believed that they should guide the students and even tell in instances where guiding was unsuccessful" (p. 97). Perry (2007) also highlighted that mathematics teachers needed to have "a passion and enthusiasm for both the subject and its teaching" and "to know their children well and to make sure that their lessons were fun and relevant, both for the children and for the teachers" (p. 282). The Australian Association of Mathematics Teachers [AAMT] (2006) has developed research-based *Standards for Excellence in Teaching Mathematics in Australian Schools*, which are organised around the three domains of *Professional knowledge*, *Professional attributes*, and *Professional practice*.

While much of the research into what makes a good teacher is based on data that has been collected from teachers (Perry, 2007; Wilson, Cooney, & Stinson, 2005), students' perceptions of what teachers do that helps them learn (Wang, Haertel, & Walberg, 1993) and what students do to help themselves learn (Hattie, Biggs, & Purdie, 1996, Lawson & Askell-Williams, 2002) has also been the subject of ongoing research. Wang et al. (1993) synthesised research into students perceptions of what helps them learn and identified 28 categories which were grouped into six broad types of influences. One type was *Classroom instruction and climate*, which included eight categories—*Classroom management*, *Student and teacher social interactions*, *Quality of instruction*, *Classroom climate*, *Student and teacher academic interactions*, *Classroom assessment*, *Classroom instruction*, and *Classroom implementation and support*. Kiewra (2002) looked into what teachers can do that develops the learning strategies of the students.

This paper adds to the research around teacher effectiveness from a student perspective and also what strategies they use when learning mathematics.

Method

The results presented here are a part of a larger 3-year study that examined "contemporary learning environments" (with a focus on the use of learning technologies) involving four South Australian schools. This paper reports on students' perceptions of what teachers do that helps them learn and what they, as students, do that helps them learn. The results are from two of the four schools involved in the larger study, one a large metropolitan high school with students from Years 8 to 12 and the other a small R–12 area school.

A three-stage process was used to gather the data for the research around student perceptions of what teachers do that helps them learn. In Stage 1, student focus groups were asked open ended questions. In Stage 2, the notes from the focus group responses were collated by the researchers and common themes extracted. These common themes were then turned into statements, where the words used by the students were

incorporated into the statements in order to make the student voice more evident. In Stage 3, the statements were added to an online survey and the students were asked to indicate what they thought were the five most important aspects and also to indicate how often they saw these actions on a five-point Likert scale.

The first time that the survey was run in 2008, an open response question **"**What advice would you give teachers to help them better support your learning?" was incorporated to allow students to add any other things that teachers did that helped them learn. This was done in order to capture anything not evident from the focus groups. The survey was then run in 2009 and 2010. The same statements were used in all three surveys, as the open response question had not yielded anything new.

The students were asked to nominate what they considered to be their best subject and then in relation to that subject to respond to a series of questions related to what they do that helps them learn. These questions were only part of the 2009 and 2010 surveys.

Each year, classes of students were taken to the computer room and given time to complete the questionnaire. A total of 918 students completed the online survey in 2008, 1105 in 2009, and 624 in 2010. The survey data was imported into SPSS for analysis and the open ended responses were examined by the researchers to identify any additional aspects of teaching that the students considered to be important.

Results and discussion

The student ranking of what they believe to be the most important practice or process that helps them learn was very consistent across the three years, particularly in the top five (see Table 1, next page). Teachers explaining things well was the most important for all three years, with almost half the students rating it either most or second most important in 2010. Given that the data were collected over a three year period, only the year 8, 9, and 10 students would have completed all three surveys. This meant that there were between 100 and 200 new students doing the survey each year. This level of consistency across two quite different schools across three years does strengthen this result.

The top five practices are quite consistent with aspects of the AAMT *Standards for Excellence in Teaching Mathematics in Australian Schools* (AAMT, 2006) as well as aspects identified by Wilson, Cooney and Stinson (2005) and Perry (2007). Interestingly, classroom management was rated quite low and not seen as being a significant issue in these two schools, and so it would be interesting to see if this was more highly rated in other more challenging schools. Being extended in class was also rated quite low by the students, as was looking at ways students learn. These are both about teachers' processes/practices that would be difficult for students to observe and would have long-term effects, as opposed to the more immediate effects from the more highly ranked processes/practices.

The students were also asked to rate how frequently they observed the teacher practice or process, on a Likert scale from 1–5 (Never, Some of the time, About half the time, Most of the time, and All the time). The mean of the ratings was calculated and used as a measure to compare across the three years.

Table 1. Student ranking of what they believed was the most important practice or process that a teacher used that helped them to learn.

No.	Aspect	Rank 2008	Rank 2009	Rank 2010
3	Teachers explained things well	1	1	1
1	In general teachers got me interested in the lesson material	2	2	2
17	My teachers were approachable	3	3	3
2	My teachers encouraged me to achieve	4	4	4
9	My teachers provided useful feedback	5	5	5
5	My teachers would check on our understanding of lesson material	6	8	7
15	My teachers were passionate and energetic about teaching	7	7	8
18	My teachers talked to me as an individual	8	9	9
7	My teachers' lessons were well organised	9	6	6
11	My teachers arranged for student to have some choice in class activity	10	13	10
16	My teachers used a variety of ways of explaining things	11	11	6
8	My teachers would generally try to provide for different student's learning needs	12	12	15
4	My teachers told me about ways to remember what we were learning	13	10	11
12	Generally classes were well managed	14	15	14
13	Generally the class environment encouraged me to achieve excellent results	15	14	13
14	Generally I was able to have input to the things I am learning	16	17	17
10	My teachers would extend me during classes	17	16	19
6	My teachers would closely look at the ways in which we were learning	18	18	16
19	My teachers implemented learning experiences with ICT that helped me learn	19	19	18
20	My teachers implemented learning experiences that used ICT to specifically cater for different needs of students	20	21	21
21	My teachers supported students to learn for themselves what ICT to use and when to use it	21	20	20

The top five most important practices, as rated by the students, were experienced by the students quite frequently, and in most cases there was an increase in the mean across the three years of the surveys which would indicate that the practice was becoming more frequently experienced by the students. It is interesting to note that there are some practices that are frequently experienced, such as "Generally classes were well managed" which was the second highest mean value, that were not considered to be important by the students, who rated it 14th or 15th. Teachers offering choice in a lesson was rated as the 10th most important but was one of the least frequently experienced practices.

The schools involved used the data from the first survey to look at their practices and identify areas that needed to be further developed. The schools used the data in different ways, with one school getting the student leadership team to report the data back to teachers during a staff meeting and talk about what they saw as being important. The other school had the student leadership work with the rest of the students to unpack what they meant by the top ranked practices and what they would like to see improved.

The student data provided a very useful stimulus for discussion and from the data in Table 2 there can be seen an overall trend of increased frequency of important practices experienced by the students.

Table 2. Mean rating of frequency of observation of teacher practice or process.

No.	Statement	2008	2009	2010
1	In general teachers got me interested in the lesson material.	2.95	2.99	3.18
2	My teachers encouraged me to achieve.	3.49	3.36	3.50
3	Teachers explained things well.	3.32	3.30	3.45
4	My teachers told me about ways to remember what we were learning.	2.76	2.76	2.87
5	My teachers would check on our understanding of lesson material.	3.08	2.99	3.07
6	My teachers would closely look at the ways in which we were learning.	2.84	2.76	2.81
7	My teachers' lessons were well organised.	3.66	3.55	3.58
8	My teachers would generally try to provide for different student's learning needs.	3.06	2.97	3.03
9	My teachers provided useful feedback.	3.22	3.15	3.36
10	My teachers would extend me during classes.	2.78	2.72	2.89
11	My teachers arranged for student to have some choice in class activity.	2.65	2.64	2.87
12	Generally classes were well managed.	3.54	3.45	3.61
13	Generally the class environment encouraged me to achieve excellent results.	3.05	3.10	3.30
14	Generally I was able to have input to the things I am learning.	3.10	2.97	3.26
15	My teachers were passionate and energetic about teaching.	3.13	3.09	3.31
16	My teachers used a variety of ways of explaining things.	3.16	3.06	3.22
17	My teachers were approachable.	3.60	3.50	3.75
18	My teachers talked to me as an individual.	3.10	3.09	3.38
19	My teachers implemented learning experiences with ICT that helped me learn.	2.82	2.86	3.21
20	My teachers implemented learning experiences that used ICT to specifically cater for different needs of students.	2.64	2.59	2.91
21	My teachers supported students to learn for themselves what ICT to use and when to use it.	2.85	2.77	3.18

The students nominated the subject that they did best at and were asked to rate a series of statements related to what they do that helps them learn that subject on a 5 point Likert scale (Strongly disagree, Disagree, Neutral, Agree, and Strongly Agree). The data from students who indicated that Mathematics was their best subject has been presented in Table 3 below, showing the means for each of the statements.

Mathematics was their best subject

In 2009, 16.9% of the students surveyed nominated Mathematics as their best subject, second only to English at 17%, this would seem to be a very positive and possibly a surprising result. However, the students who rated Mathematics as their best subject were, not surprisingly, very sure that they could succeed. The students also indicated

that they could do better if they made a greater effort and that they really wanted to understand what they were learning.

The data below, although presented in two sections, need to be read together. For example, the data in Table 3 indicate that the students are not very likely to use the World Wide Web for Mathematics, while Table 4 indicates they are less likely to use the web than for most other subjects.

Table 3. Student rating of agreement for statements relating to what they do that helps them learn Mathematics.

Statement	2009 Mean	2010 Mean
I am sure that I can do well in this subject.	4.40	4.42
I practise things over and over until I know them well in this subject.	3.68	3.97
I make a note of things that I don't understand very well in this subject, so that I can follow them up.	3.64	3.90
I make plans for how to do the activities in this subject.	3.22	3.43
I make up questions that I try to answer about this subject.	2.82	3.38
I try to put ideas into my own words when I'm learning something new in this subject.	3.51	3.78
I am deeply interested in this subject	3.64	3.72
I think about my thinking, to check if I understand the ideas in this subject.	3.59	3.78
I draw pictures or diagrams to help me understand this subject.	3.54	3.68
I can get better at this subject if I put in the effort.	4.17	4.22
When I have finished an activity in this subject I look back to see how well I did.	3.86	3.99
I want to really understand what I am learning in this subject.	4.17	4.26
I use the world wide web (e.g., Google, Wikipedia) to help me understand this subject.	2.80	3.08

It is notable that the students used practice as a way of learning mathematics, and the students also highlighted review as being very important—and that effort and understanding were valued.

The means in all of the statements increased from 2009–2010, indicating that the students were more positive about the range of the strategies listed to help themselves learn. There had been a greater emphasis on contemporary learning within the schools and this may indicate that the students were more aware of their own learning strategies.

Differences between learning areas

The section on what students do that helps them learn was structured so that each student nominated one area and answered the questions in relation to that subject only; as such different students responded to each of the subjects and so care must be taken when looking at the results comparing subjects.

Table 4 highlights differences in column means for the different learning areas for the 2009 data. The comparison of column means is presented in Table 4, below, where a letter in a column indicates that there is a significant difference between the means of that subject and the column's subject for the question in that row. These results are based on two-sided tests assuming equal variances with significance level 0.1, and, for each significant pair, the letter of the subject with the smaller mean appears under the subject with larger mean. The letters in the table represent the subject that the students

nominated as their best subject: A—no subject nominated (Blank), B—Arts , C—Design and Technology (D&T), D—English, E—English as a Second Language (ESL), F—Languages other than English (LOTE), G—Mathematics, H—Physical Education (PE), I—Science, J—Studies of Society and the Environment (SOSE), and K—Vocational and Employment Training (VET). When reading the table, any letter in the Mathematics column represents a subject that has a mean less than Mathematics, while any subject column that has a G in it will have a mean greater than Mathematics for that question.

Table 4. Differences in column means.

	Subject										
	Blank	Arts	D&T	Engl.	ESL	LOTE	Math	PE	Sci.	SOSE	VET
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
H_1. I am sure that I can do well in this subject.		A	A				A	A	A		
H_2. I practise things over and over until I know them well in this subject.		D J						D			
H_3. I make a note of things that I don't understand very well in this subject, so that I can follow them up.							D		D H		
H_4. I make plans for how to do the activities in this subject.		G	F G								
H_5. I make up questions that I try to answer about this subject.									B		
H_6. I try to put ideas into my own words when I'm learning something new in this subject.				G					G		
H_7. I am deeply interested in this subject		A D E F G	A G					A G	A D E G F G		
H_8. I think about my thinking, to check if I understand the ideas in this subject.											
H_9. I draw pictures or diagrams to help me understand this subject.	D	D F H	D F H				D F H		D F H D		
H_10. I can get better at this subject if I put in the effort.		A							A D F		
H_11. When I have finished an activity in this subject I look back to see how well I did.		A F									
H_12. I want to really understand what I am learning in this subject.									A D F H		
H_13. I use the world wide web(eg. Google, Wikipedia) to help me understand this subject.	G	G	B F G H	G H	G	G			B F G H	B F G H	

Results are based on two-sided tests assuming equal variances with significance level 0.1. For each significant pair, the key of the smaller category appears in the column of the category with larger mean.

Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.

Table 4 provides some insight into the different approaches that students use to learn different subjects. Students indicated that they are more likely to use diagrams in Mathematics than in English, LOTE, and PE, while they are less likely to put ideas into their own words than in English and Science. Students also used notes to remind themselves of things that they did not understand more when learning Mathematics than English. Students planned more in the Arts and Design and Technology, which may be a reflection of the types of problems that are set in mathematics classrooms in general.

It would also seem that the students are not as deeply interested in mathematics than many of the other subjects, which may be cause for concern as these are the students who nominated Mathematics as their best subject. Has mathematics been presented as a tool to be used rather than as a discipline with its own knowledge that can be studied in depth?

Conclusion

The results of this study add to the body of knowledge around teacher effectiveness, and in particular it gives a student perspective on what teachers do that helps them learn. The consistency of the results across two schools and three years does indicate that the students are quite sure about what teachers' practices help them learn. While the statements provide some insight to what students value, by their nature they are open to interpretation and so more work is needed to unpack these statements. The student-generated statements support much of the previous work done in the area, and in particular the AAMT standards (AAMT, 2006) include many practices that students identified as being important.

The data on what the students do that helps them learn, while not as well developed as the teacher statements, do provide some useful insights to areas for further investigation. Why is it that students for whom mathematics is their best subject believe that they can do well and really want to understand what they are learning, but do not have the deep interest that other students have for their best subject?

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