

Students' Opinions about Characteristics of Their Desired Mathematics Lessons

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As part of a larger project, we examined how students describe their ideal mathematics lesson. We found that the students' comments were similar to the characteristics that are often used by researchers to delineate the features of effective teaching. In particular the students liked clear explanations, they recalled lessons that used materials that allowed connections to their lives, felt the mode of grouping to be important, and many liked to be challenged. There was diversity in the types of lessons that they described indicating that variety is also important. Teachers are encouraged to pay attention to opinions of students on the pedagogies they value.

Although our overall project, *Task Types and Mathematics Learning*²⁹ (TTML) (see O'Shea & Peled, 2009 for a description of the project) focuses on tasks, this is a report of research into student opinions about features of their ideal mathematics lesson. Our interest in lessons arose from a realisation that effective learning is not solely dependent on the quality of the tasks, but also the way the teacher implements the task, and whether the students are able to take advantage of the opportunities that working on the task might offer them.

The project draws on the Stein, Grover, and Henningsen (1996) model of task use, in which they describe how the features of the mathematical task as set up in the classroom, and the cognitive demands it makes of students, are informed by the mathematical task as represented in curriculum materials, and influenced by the teacher's goals, subject-matter knowledge and knowledge of students. This in turn informs the mathematical task as experienced by students and creates the potential for students' learning. This report is seeking to elaborate the latter aspects of the Stein *et al.* model.

There are many lists of characteristics of effective teaching, which are generally compiled theoretically, or from surveys, or from descriptions of exemplary teachers (see Clarke & Clarke, 2004; Hattie & Timperley, 2007; Education Queensland, 2010). For example, the following is the advice that we give to teachers, extracted from various similar lists that are readily available. We have added a code in brackets to allow discussion of these later.

Identify big ideas that underpin the concepts you are seeking to teach, and communicate to students that these are the goals of the teaching (*clarity*).

Build on what the students know, both mathematically and experientially, including creating and connecting students with stories that contextualise and establish a rationale for the learning (*building on experience*).

Engage students by utilising a variety of rich and challenging tasks, that allow students opportunities to make decisions, and which use a variety of forms of representation (*variety and challenge*).

²⁹ TTML is an Australian Research Council funded research partnership between the Victorian Department of Education and Early Childhood Development, the Catholic Education Office (Melbourne), Monash University, and Australian Catholic University. Barbara Clarke is also a researcher on the project but otherwise exceeded the limit for submission for the conference.



Interact with students while they engage in the experiences, encourage students to interact with each other including asking and answering questions, and specifically planning to support students who need it, and challenge those who are ready (*interacting and adapting*).

Adopt pedagogies that foster communication and mutual responsibilities by encouraging students to work in small groups, and using reporting to the class by students as a learning opportunity (*grouping*).

It seems, though, that there have been few attempts to ask students what they think of such advice, or even what alternate advice they would offer. This is a report of our attempt to gather data on the latter.

Seeking Students' Views

There have been substantial efforts to seek students' views about aspects of mathematics learning. These include nuanced approaches to students' attitudes (Hannula, 2004; McLeod & Adams, 1989) addressing psychological considerations such as identity, autonomy and social connectedness, as well as liking, enjoying, and seeing the purpose and potential in mathematics. There has also been sustained study of students' beliefs about the nature of mathematics and the way it is learned (e.g., Leder, Pehkonen, & Törner, 2002; Pajares, 1992), the values they attribute to mathematics, the way it is learned, and its uses (e.g., Bishop, 2001), the ways in which students are motivated (e.g., Middleton, 1995), and the ways that students connect learning opportunities with the way they see themselves (such as whether they can get brighter through effort), and the subject (such as whether effort leads to success) (Dweck, 2000). Zan and di Martino (2010) extended this work, arguing that there have been no connections established between attitudes and achievement, and that the emphasis should move from measuring attitudes to describing them. They questioned the often cited causal link from beliefs to emotions to behaviours, and argued that negative attitudes are just as powerful in influencing behaviour as are positive attitudes. They argued for more narrative approaches to describing student attitudes, including with large samples, with the goal of understanding behaviour. We agree with this approach and sought to extend this to seeking students' views about lessons. The questions guiding this aspect of our work were:

What do students say, unprompted, about the characteristics of lessons that they value?

How do the themes identified in the students' responses about lessons match with the perspectives in the literature generally?

Responses of Students to Pre-determined Prompts about Lessons

The data below were taken from a larger survey designed to gather responses on aspects of lessons and tasks from a cross-section of students in Years 5 to 8. The items on general aspects of pedagogy were adapted from Clarke et al. (2002) and Sullivan et al. (2009), and the items on lessons were written for this purpose. The survey was piloted with some classes of students in schools similar to those in the project, and we interviewed students in those classes to seek clarification of confusing responses. After some revision, we administered the survey.

We asked each school to nominate one of the project teachers to co-ordinate the administration of the survey across all classes of students in the target years to ensure that the students completed the survey individually and seriously. The results were entered professionally, including double checking of the entries. There were 940 students in 96 classes across 17 schools who completed the survey.

Narrative Descriptions of Students' Perceptions of Desired Characteristics of Mathematics Lessons

We sought students' perceptions of the desired characteristics of mathematics lessons through their narrative responses. It was hoped in this way to gain insights into which lesson characteristics students valued most, rather than through their ratings of lesson characteristics described by us. We did this by seeking:

- open-ended responses to particular prompts on the overall survey; and
- free-format essays by students from two schools.

These approaches and the students' descriptions are described in the following sections.

Responses from the Overall Survey on Desired Lesson Characteristics

One of the prompts on the survey asked the students to write a free format response to the following:

Think about all the maths lessons you have EVER BEEN IN. Now think about the best maths lesson you have EVER BEEN IN. Describe what you did in that lesson.

The responses were generally informative but brief. The following are examples of medium-length responses.

We played the grand final of maths football. You have to answer questions and if you get them before you aponint (sic) the football goes closer to your goal. We won.

We did long jump outside and then we measured everyones and then put it in a chart.

All responses were read and preliminary categories for grouping the students' responses identified. The various responses were then coded by a second researcher, and adjustments made to the categories. To indicate the types of responses given by students, and the ways that we applied the codes, the following are some illustrative sentences and phrases allocated to particular categories. We coded as:

game that taught us maths general statements such as "we played maths games on the computer", and more specific statements such as "we coloured in some boxes on a fraction we roll 2 dice whatever fraction you get you colour in".

particular topic statements such as "we added fractions. We learnt how to add them with different dimoniaters (sic)", "algebra (sic) would be the best lesson because I was good at it", "I liked percentage. At the start of the term I couldn't understand but when my friend's and my teacher helped me it became easy as + and -", "when I was learning about decimals", "learnt how to add and subtract mixed numbers and turn them into improper fractions".

particular operation statements such as "I was starting to learn multiplication and I got it so easy and I loved it."

used or made a model general statements such as "when we did hands on activities" and more specific comments such as "smarties maths. We used smarties to work out fractions (colours). It was really fun!", "when we were making the maps of a town with 24 houses", and even (!) "when we drew Cardoids, Mystic Roses Hyperbola".

That last comment was of course delightful to read but it was clear that all of the 940 students were able to describe a lesson they liked. The number of comments coded in the various categories are summarised in Table 1. Note that one student might have comments coded in more than one category.

Table 1:

Number of Student Comments in Various Categories of the “Best” Mathematics Lesson (n = 930)

Category of response	Total mentions
Game that taught us maths	184
Competition or test on maths we know	83
Outside activity	59
Particular topic e.g. Measurement	395
Real-life problem e.g. Water in tank, maths to make food	49
Used or made a model e.g. Pita bread for fractions	258
Particular operation e.g. Multiplication	119
Learned mathematics I didn't know before	16

The most striking aspect is the diversity of lesson elements students chose to mention. We had perhaps anticipated that students would like games, real life problems, and use of models, but were surprised at the number of responses that focused on a particular topic. To explore this further, Table 2 presents some of the above categories combined.

Table 2:

Combined Categories of Responses to Characteristics of Best Lesson (n =930)

Category of response	Total mentions
Engaging pedagogies (Game, outside activity, real life, etc)	633
Topic, operation, or learned maths	530

In other words, close to half of the students in describing their “best” mathematics lesson referred to a specific topic, and just over half mentioned pedagogy. This surprised us. We had earlier asked students to rate their level of confidence that they can do mathematics using the prompt “*How good are you at mathematics?*” To explore whether a reference to a topic was a characteristic of a particular type of student, we compared the responses given by the lowest third of the students on their self rating of confidence, and those given by the highest third. Table 3 presents the number of responses in each of the categories in the previous table.

Table 3:

Number of Students in Combined Categories broken down by Self Rating of Confidence

Category of response	Low (n= 337)	High (n = 292)
Engaging pedagogies (Game, outside, real life)	233	187
Topic, operation, or learned maths	174	177

There was a slight tendency for the students who rated themselves as confident to mention a topic. Nevertheless the interesting feature is that many students who rate themselves as lacking confidence at mathematics mention a topic, while many of those students who rate themselves as confident referred to an aspect of pedagogy.

These tables, taken together, indicate that the pathway to student engagement is not solely through creative pedagogies, and that many students recalled as a best lesson one in which the learning of a specific topic was the memorable feature. It is also notable that many students mentioned both a creative pedagogy and a topic: for example, going outside to do measurement. We infer that these students see lessons as about learning, and the topic they mentioned is connected to this learning. At the same time, many students refer

to particular engaging pedagogies, and so teachers need to consider this in their planning as well. We suspect that finding interesting ways to help students learn a particular topic is the ideal combination.

To explore the reasons behind the students' descriptions of their best lesson, we also invited them to answer, in free format:

Why did you choose that as the best maths lesson ever (that is, what made it best)?

Again categories were created, and progressively refined. The following were the categories that seemed to capture the major themes, along with an illustrative example of some students' statements:

Challenging: "It was one of the most challenging maths lessons, and the feeling of achieving the answer was great", "I like that maths lesson because you had to think"

Easy: "I chose that one because it wasn't too hard for me", "Because we didn't have to do any work"

Fun/interesting: "Because we had fun" "It was entertaining and fun because it was a race to win a game"

I learned something new: "Because I learnt how to times decimals"

I'm good at this: "Because I was the only person that knew it", "I chose that as the best maths lesson because I'm really good at"

Went outside: "We got outside, in the fresh air and did real life mathematics", "We got to run around and use our brains at the same time"

Worked in groups: "I really love working in groups and I think that working in groups makes me think better", "We got to do stuff with friends"

Made a model: "We did more 'hands on' than paper and pen", "I love creating things and we got to make a robot"

Table 4 presents the frequencies of statements coded in this way for this prompt:

Table 4:

Frequencies of Particular Responses Explaining their Choice of a Best Lesson (n = 930)

Category of response	Number of mentions
Challenging	89
Easy	65
Fun/interesting	502
I learned something new	179
I'm good at this	101
Went outside	47
Worked in groups	51
Made a model	80

Again the diversity of comments is noteworthy. The most frequently used code, with around 45% of responses overall, was the *fun/ interesting* category indicating that this is indeed an important aspect of planning mathematics learning experiences. There were 369 responses that referred to learning something new, to facility at the task, and to challenge, indicating that some students respond to these aspects as well. It seems that the advice to teachers is to devise "fun/ interesting" ways for students to learn something new while they are being challenged.

In summary, the main impression from these responses is their diversity, and there is clearly a range of ways in which students respond to lessons. There were two trends in

their lesson descriptions of, on one hand, students recalling effective teaching of a content topic, whereas there were others who remembered interesting aspects of the pedagogy. In explaining their choice of lesson, the main category of responses related to fun/ interesting, but learning something new was also frequently cited.

Students' Essays on their "Ideal Maths Class"

We also sought students' views on lessons and teaching through a particular prompt seeking narrative responses. We asked Years 5 and 6 students at two of the schools where teachers developed a lesson sequence using task types (a different aspect of our overall project) to write an essay, the particular prompt of which was:

Write a story about your ideal maths class. Write about the sorts of questions or problems you like to answer, what you like to be doing and what you like the teacher to be doing in your ideal maths class.

The intention was to gain insight into what the students recalled about their mathematics classes, and it can be assumed that these responses can be taken as indicative of the lesson features that the students liked. The following is an example of a typical student's essay, presented as it was written:

My favorite maths would start with a 10 min introduction were the teacher explains the game to all of us and still allowing time for questions. The games would be 2+ people for a competition and people will split into groups and will organize who plays who 5 min every one will be playing at all times unless there is an odd amount of people we will play for 25 min. at the end of the Lesson the groups will figure out who was the winner and people can share what they Learnt Liked and strategys they used. Sharing is for 10 min. for my second option I would do real life problems Like 250 grams of sugar for \$10.50 or 750 grams for \$33.15. I like real life problems because they could help me one day and its set out differently than math. for this the explanation is for 5 min this is because you don't need to explain the rules.

This response is illustrative of the detailed way that students responded to the prompt. In fact all of the students gave a thoughtful and detailed response. In this response there were three key elements: the use of a game; the use of real life problems; and the mention of the grouping of students.

Each of the responses was read, and a preliminary set of codes established. A second reader then used the first set of codes and added others as appropriate. Where a sentence or phrase could be categorised in two places, this was done.

The first characteristic of the responses overall was the diversity of aspects on which individual students commented, again suggesting that there is no commonly agreed ideal lesson, and there are many ways that students experience engaging lessons. The following indicates trends or themes in the responses. Since it seemed that there were aspects of the responses idiosyncratic to the particular schools, the responses from the two schools are discussed separately.

In the outer suburban school, there was a total of 39 students in two classes, one Year 5 ($n=21$), the other Year 6 ($n=18$). Unless otherwise stated the responses were from both classes. In this school, the Year 6 class mainly responded in point form, and so multiple aspects were mentioned by many students.

Thirty students included a desire for materials in their ideal lessons, and some mentioned specific examples such as teddy bears, robots, alarm clocks, class market, and mapping. These are not the structured materials that teachers would expect to see in such responses. There were also 25 specific references to working outside (12 Year 5, 13 Year 6). Given that one suspects that this happens quite rarely, this is a surprising result. It is worthy of note that some students in the survey also mentioned going outside as their best

lesson. Fourteen students mentioned a connection to practical aspects such as food, money, and newspapers.

There were 25 specific mentions of working in groups as part of their ideal class, and a further 15 mentions of working in pairs. Note that there were also 9 students who wrote that they preferred to work alone. The ways of working in class are clearly important for students, and however the teacher intends that the student work, the reason for this needs to be clarified for the students.

There were 22 students who wrote that they liked to be challenged, and 15 students wrote that they liked open-ended tasks or those that had more than one answer, although all 15 were from the Year 5 class. Twenty-three students liked to be helped by the teacher, although most of these were also from Year 5. A further 14 students, again mainly from the Year 5 class, wanted their teacher involved by circulating, listening or sitting down with the students. Interestingly many of these students indicated that they preferred to work uninterrupted by the teacher or their peers.

Nineteen students wrote that they liked clarity in both the lesson goals and in teacher explanations, using phrases such as “makes sure we understand”, “gives examples” and “explains focus of lesson”.

In the inner suburban school, there were three mixed Years 5 and 6 classes involving 65 students. There were similarities in the responses of the students across the classes. Fifty students wrote that the ideal lesson included working in groups, in pairs, or with friends, but 10 wished to work alone. Twenty-two students mentioned explanations and 7 referred to the teacher’s interactions with students. Twenty-six students claimed to like a challenge. Nineteen specifically mentioned fun or enjoyment, 22 mentioned games, 17 mentioned specific hands-on activities, 13 mentioned specific measurement activities, and 15 gave examples that connected learning to their lives. As with the other school, 18 students saw their ideal lesson as being outside!

Both schools were technology rich, and it was therefore interesting that very few students mentioned working with computers or other technology. Perhaps they saw the availability of technology as a given, but the scarcity of such mentions may require some further investigation.

In summary, it seems that the responses to this prompt about an ideal lesson seemed dependent on the teacher. In synthesising the responses, students like lessons that used materials (although these were not structured materials), were connected to their lives, were practical with some emphasis on measurement, in which they worked outside, with the method of grouping being important, and over half of the students claim to like to be challenged. Some implications of these issues are discussed below.

Summary and Conclusion

All students we asked had clear views on the nature of mathematics lessons, and were prepared to articulate those views. In terms of the hypothetical descriptions of effective teaching given above, we argue that:

- *clarity* was important given the prominence of mentions of specific topics, and the importance to students of clear explanations;
- *building on experience* was important in terms of the mentions of use of materials (although these were not structured materials), and connections to their lives;
- *variety* was perhaps the key theme in both aspects of the data and this variety is needed because different students like different approaches;

- *challenge* is important since it was mentioned unprompted by many students; and
- *grouping* seemed important to students as a way of learning.

The advice above termed *interacting and adapting* was also prominent in the responses, although in this case perhaps in the direction opposite to that indicated by the advice. Some students emphasised that they only wanted to be helped when needed, while others wanted to work uninterrupted by either classmates or teachers.

In general, the results seem a very strong endorsement of the earlier list of recommendations to teachers, noting that the endorsement comes from the very people who most need interesting and engaging lessons: the students.

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