Students' in-class Thinking and Feelings during Mathematics Lectures

Ee Huei Wuan, Singapore Polytechnic
Wong Khoon Yoong, NIE/ Nanyang Technological University

Abstract

To ensure effective teaching at any level, the teacher needs to constantly monitor how the students are progressing during the lesson. This is easily said than done because teaching is a fast-paced and complex endeavour. One feasible approach, rarely attempted in normal lessons, is to stop the lesson at intervals and let students reflect on their learning at that moment in time.

This paper reports the findings of a study conducted at Singapore Polytechnic in August 2004 using this in-class reflection approach. The in-class thinking and feelings of 49 Year 2 Engineering Mathematics were gathered using a one-page checklist over a series of five lectures in a period of two weeks. During each reflection, the lecturer (first author) completed a similar checklist about her own lesson events. There were 13 reflections, implemented in approximately half hour intervals during the five lectures. Qualitative data were collected by interviewing 23 students about their perceptions and feelings of the lectures, conducted soon after the lectures. Differences and similarities in perceptions between the lecturer and her students were found, and the implications of the findings are discussed.

Introduction

It is the wish and intention of every teacher that he/she will deliver a good lesson and that each and every student understands the lesson. A plethora of teaching strategies, teaching aids, innovative technologies, coupled with relevant content, teaching plans and handouts are used by the teacher in order to achieve this goal. However, the results may vary on a continuum, from a satisfied audience to confused learners. As students are not mere vessels waiting to be filled, there are as many possible outcomes as there are personalities among the audience. Bess (2000) noted that,

> … teacher effects are mediated by the psychological processes or reactions of students and that teacher variables cannot be considered in isolation from student variables, such as prior knowledge, learning strategies, self-efficacy, and so forth. (p. 91)

Peterson (1988) suggested that studies should investigate teachers' and students' thinking in the classroom so as to find out what makes teachers effective, and how teachers facilitate students' learning and achievement. She claimed that thoughtful teachers who constantly engage in higher order learning will inspire and facilitate the same in their students. On the students' end, their thoughts and cognitions determine their achievement. Thus, it is important to determine the aspects of teacher cognitions and student cognitions that lead to effective teaching and learning in the classroom.

Peterson, Swing, Braverman and Buss (1982), in their study on students' aptitudes and cognitive processes, found that students who were aware of the overview provided by the teacher tended to achieve at higher levels than those who were unaware of the teacher's overview. Wong (1985) found that incongruence between students' perceived actual teaching activities and preferred teaching activities was negatively correlated with mathematics scores. Bell, Crust, Shannon, and Swan (1993) found that the mismatch between the teacher's and students' perceptions about purposes of mathematical activities became more pronounced as lessons became more open and less familiar to the students. Shimizu (2002) uncovered discrepancies in perceptions of classroom events between the teacher and the students: "They might share the beliefs about learning mathematics in the classroom and be constructing different meanings associated to the same events" (p. 12). These studies provide some justification to study students' perceptions of lesson events and purpose.

Peterson and Miller (2004) investigated the cognitive, emotional, motivational, achievement level and quality of classroom experience of pupils. Their study compared these student experiences during cooperative learning and large-group interaction. It provides an insight into using the experience sampling method (ESM), developed by Csikszentmihalyi and others, for classroom research. ESM is a research procedure for studying what people do, feel, and think during their daily lives. It involves asking individuals to provide systematic self-reports at random

occasions during the waking hours of a normal week. The study reported here also used an adaptation of ESM, to capture students' feelings and activities at specific moments of the lessons.

This brief review provides the rationale for a study of students' in-class thinking and feelings. The aim was for the lecturer to reflect on such information to better understand the learning experiences of her students so that subsequent lessons could be planned to enhance these experiences. Information on the cognitive, emotional, motivational, achievement level and quality of students' classroom experience of pupils was gathered.

Method

Participants

The participants were 49 Year 2 Engineering students of the Diploma in Electronics, Computer and Communication Engineering at SP. These students were a selected group of academically less inclined students, identified using students' O-level results and family background. They were taught by selected lecturers who had a history of good student feedback and who were known to be caring and student-centred in their approach. The objective of this arrangement is to increase the cohort's success rate by keeping the attrition rate as low as possible.

Background information

A week before this study was carried out, students were informed of the nature of study. Individual student consent was obtained. A 2-page survey of student background was also collected. This student background was designed to obtain information on students' habit and support in studying mathematics, outside of curriculum hours: normal places of study, resources at home to aid the study of mathematics, hours spent a week in studying/doing mathematics, common time of study, past experiences of studying mathematics, language spoken at home, confidence in mathematics, encouragement from family members, help in mathematics homework and ways of studying mathematics. This data will not be presented here.

Instrument

The instrument, a one-page checklist, on reflection of the students is given in the Appendix. Question 1 was the same for both the students and the lecturer, asking them to indicate their feelings at specific pauses of each lecture. However, for questions 2 to 9, the lecturer (first author) indicated how the items might apply to her students. Some of the items were adapted from Peterson and Miller (2004).

The Lectures

The study involved a series of five lectures over a period of two weeks in Term 1 of the first semester of the academic year 2004/05 in August 2004, covering two chapters of the Year 2 Engineering Mathematics module. This series of lectures covered the solution of differential equations (DE) using the method of Laplace Transforms and the use of Heaviside unit step functions to model discontinuous functions. These were new topics to the students and built on Laplace and inverse Laplace functions, which were taught in the preceding four weeks. The lecture content was taught using PowerPoint slides. As the lectures were conducted in a lecture theatre, there was little seatwork for the students. Under the lecture-tutorial system, lectures are used for exposition of content, followed by tutorial exercises to be attempted by students at home and then discussed during tutorial lessons in the following week. However, at certain points during the lectures, when the material taught seemed a little too difficult, pauses were allowed so that students may seek clarifications from their peers or the lecturer. At appropriate junctures during the lectures, the lecturer may ask students to attempt repeat examples before explaining these examples. During such instances, the lecturer walked around the lecture hall to check on students' working, prompted students to do the next steps in their solutions, and answered questions and doubts, individually or in small groups. Students could use this time to review earlier example(s) or to seek clarification from peers or the lecturer. After the allocated time, the lecturer continued with the lecture and clarified doubts raised. Table 1 shows a summary of the lesson events for these lectures.

Lectures 1, 3 and 5 took place from 3 pm to 5 pm on Tuesday afternoons. Three in-class reflections were conducted for each of these lectures, approximately 30 minutes apart with a 10 minutes break immediately after the second interruption. Lectures 2 and 4 took place from 10 am to 11 am on Friday mornings, and only two in-class reflections could be conducted for each of these lectures. A total of 13 reflections were obtained. The attendances at these lectures were 48, 48, 39 (being the day after National Day celebration), 46 and 45

respectively. During each reflection, the lecturer completed a similar checklist about her perceptions of the lesson events.

Table 1
Lecture events for the 5 lectures

Lecture 1 Solving differential equation (DE) using Laplace	Lecture 2 Concept of Heaviside unit step function	Lecture 3 Laplace transform of functions involving Heaviside unit step function	Lecture 4 Express given functions in terms of Heaviside unit step function	Lecture 5 Find inverse Laplace transform of $e^{-cs}F(s)$
• Review: Laplace and Inverse Laplace functions • Introduction • Steps to solving DE using the method of Laplace transforms • Example 1 (Easy)	• Introduction: relate a story involving f(t) u(t – c) and another involving f(t – c)u(t – c) • Define Heaviside unit step function u(t – c) • Effect of Heaviside unit step function u(t – c).	• Definition and effect of Heaviside unit step function u(t – c). • Functions in terms of unit step functions • Extra example on sketching graph: Example 1a • Exercise 2	• Introduction: to express certain functions in terms of Heaviside unit step function • Define a rectangular pulse • Example 3.3 • Exercise 10 (a) • Exercise 10 (b)	• Definition of inverse Laplace Transform. • Theorems 3.1, 3.2 • Examples and exercises to strengthen and ensure students' ability to find inverse Laplace of various functions involving unit step functions. • Example 3.4 • Exercises 12 – 16
		Reflection 1		
•Example 2 (Intermediate)	• Graphs of f(t) u(t – c) and f(t – c) u(t – c) • Exercise 1 • The unit step function as an on/off switch.	• Laplace Transform of u(t – c) • Exercises 3 – 5 • Laplace Transform of • f(t – c)u(t – c), second shift theorem • Example 3.1 • Exercise 6	• Exercise 11	• Find Laplace and to sketch its graph. • Example 3.5 • Exercise 17
		Reflection 2		
Short Break	*End of lecture*	*Short Break*	*End of lecture*	*Short Break*
•Example 3 (Difficult)		• Recap Laplace of u(t – c), f(t – c)u(t – c) and introduce Laplace of f(t)u(t – c) • Example 3.2 • Exercises 7 – 9		• Impulse function • Derivation of impulse function from Heaviside unit step function
Reflection 3		*Reflection 3*		*Reflection 3*
End of lecture		*End of lecture*		*End of lecture*

Soon after each lecture, several volunteers (8, 3, 6, 1 and 6 respectively) were interviewed and their interviews were audio-taped. There were more volunteers for interviews to Lectures 1, 3 and 5 as these interviews were conducted during lunchtime the day after the lectures,. There were only three volunteers and one volunteer, respectively, for interviews to Lectures 2 and 4 as these interviews were held immediately after the lecture, and before the next lesson one hour later. All volunteers were different, except who was interviewed_for both Lectures 1 and 3.

Results and Discussion

The data collected from the students and lecturer checklists were analysed using Excel and SPSS. A detailed discussion of the reflections in lecture 1 can be found in Ee & Wong (2004). The rest of this paper provides findings across the five lectures.

Question 1 – *How do you feel now?*

The eight semantic differential items in this question measure the students' feelings during the progress of the lecture. The negative items were reverse scored. The Cronbach alphas of the items are given in Table 2. These values show that the students' responses were quite consistent within each reflection, indicating that the student data were reliable.

Table 2
Cronbach alphas of the items in Question 1

Lecture 1			Lecture 2		Lecture 3			Lecture 4		Lecture 5		
Reflection			Reflection		Reflection			Reflection		Reflection		
1–1	1–2	1–3	2–1	2–2	3–1	3–2	3–3	4–1	4–2	5–1	5–2	5–3
0.87	0.77	0.84	0.77	0.77	0.71	0.77	0.86	0.81	0.72	0.84	0.83	0.79

Table 3 shows the mean scores for the students (top values) and lecturer (bottom values) for each item and the whole scale; similar items have been grouped together. There were clear differences in the feelings reported by the lecturer and the students as a class, although there were individual student differences. With the exception of item 1b (Difficult – Easy), the lecturer had higher values (5 to 7), hence more positive feelings, than the class means (3.46 to 5.14) on most of the items.

Table 3
Mean scores of students' responses to Question 1: Feelings (7-point scale)

	Lecture 1			Lecture 2		Lecture 3			Lecture 4		Lecture 5			
	Reflection			Reflection		Reflection			Reflection		Reflection			
Feeling	1–1	1–2	1–3	2–1	2–2	3–1	3–2	3–3	4–1	4–2	5–1	5–2	5–3	Overall
1b:difficult	3.78	4.33	4.00	4.15	4.19	4.24	4.24	4.05	4.09	3.97	4.44	4.14	4.16	4.14
– easy	1	3	2	6	7	3	5	3	2	5	1	6	2	3.54
*1g:confused	4.16	4.57	4.87	4.87	4.81	4.76	5.05	4.85	4.77	4.55	5.11	4.56	4.73	4.50
– clear	7	6	7	7	7	6	7	7	7	6	7	6	7	6.77
*1a: sad	4.13	4.65	4.87	4.28	4.83	4.53	4.63	5.03	4.67	4.56	4.84	4.67	4.75	4.39
– happy	7	6	7	7	7	6	6	6	7	6	7	7	6	6.54
1h: bored	3.46	3.81	3.87	3.72	4.05	3.47	3.74	3.88	4.05	4.16	4.09	4.19	4.12	3.89
– excited	7	7	7	7	7	5	6	6	7	6	7	7	7	6.54
*1d:detached	4.50	4.65	4.64	4.30	4.59	4.53	4.45	4.72	4.74	4.55	4.58	4.33	4.39	4.26
– engaged	7	7	7	7	7	6	7	6	7	7	7	7	7	6.85
*1e: drowsy	3.85	4.64	4.57	4.55	4.49	4.56	4.82	4.74	5.14	4.86	4.91	4.70	4.67	4.49
– alert	7	7	7	7	7	7	7	5	7	7	7	7	7	6.85
*1f: passive	4.14	4.50	4.61	4.26	4.72	4.66	4.64	4.79	4.70	4.80	4.93	4.70	4.69	4.43
– active	7	7	7	7	7	6	7	6	7	6	7	7	7	6.77
1c: lonely	4.22	4.36	4.42	4.17	4.14	4.63	4.42	4.31	4.51	4.32	4.52	4.35	4.09	4.34
– sociable	7	7	7	7	7	5	6	6	7	7	7	7	7	6.69
Overall	3.92	4.42	4.48	4.26	4.50	4.46	4.53	4.55	4.56	4.53	4.72	4.49	4.48	
feeling	6.25	6.25	6.38	6.88	7.00	5.50	6.38	5.63	6.38	6.25	6.25	6.88	6.13	
Mean		4.27		4.38			4.51		4.55			4.56		
feeling		6.29		6.94			5.84		6.32			6.42		

* These items were reverse-scored. The positive polar adjectives are shown.

For the ease of the lectures (item 1b), the lecturer used ratings from 1 to 7, showing that different parts of the lectures presented materials of different difficulty levels. Her lower ratings at reflections 1–1, 1–3, 4–1, 5–1 and 5–3 showed that she found the task of teaching solving DE difficult. The technique of solving DE was first taught in Lecture 1, and then repeated using functions involving Heaviside unit step functions and impulse functions in Lecture 5. The most difficult task was explaining this new topic at the beginning of Lectures 1 and 5, as reflected in reflections 1–1 and 5–1. In particular, the lecturer rated Lecture 2 to be easy as in this 1-hour lecture, the concept of Heaviside unit step functions to illustrate the switching on and switching off of discontinuous functions was introduced. The lecturer related this mathematical concept to students' daily encounters. One example used was students' arrival at the lecture. This could be expressed as a function in terms of Heaviside unit step functions, followed by its illustration on a discontinuous graph, indicating a switching on effect.

Students, too, are observed to have rated Lecture 2 with more positive ratings, improving from a mean score of 4.26 for reflection 2–1 to a mean score of 4.50 for reflection 2–2. Students reported to be more at ease, happier, more excited, more engaged and more active, though more confused, drowsier and lonelier. There were two measures of feeling that consistently dropped as each lecture progressed: confused – clear (item 1g) and drowsy – alert (item 1e), indicating that the students felt less clear and less alert at the end of all the lectures. Except for Lecture 1, students reported to be less sociable towards the end of the lecture, probably as a result of being less clear and less alert. There are no obvious trends for other measures of feeling.

The mean feeling for Lectures 1, 2, 3, 4 and 5 had been progressively improving: 4.27, 4.38, 4.51, 4.55 and 4.56, respectively. As in Lecture 2, Lecture 3 showed positive ratings for four items: students being happier, more excited, more engaged and more active towards the end of the lecture. In Lecture 3, the lecturer taught the finding of Laplace and inverse Laplace of functions, here with functions involving Heaviside unit step functions, a form of revision to earlier topics on finding Laplace and inverse Laplace of functions. However, students also reported feeling more difficult, more confused, drowsier and lonelier.

Question 2 – *What was the* ***main*** *activity you were doing just before you were asked to do this reflection?*

This item asked the students to mention the main activity, but many responded with multiple activities. These were counted and summarized in Table 4. Hence, the total for each reflection adds up to more than 49. The notation (L) shows the lecturer's response. The percentage occurrence of each activity was calculated based on the total of 741 activities reported for the series of lectures.

Table 4
Activities reported by students

	Lecture 1			Lecture 2		Lecture 3			Lecture 4		Lecture 5				
	Reflection			Reflection		Reflection			Reflection		Reflection				
Activity	1–1	1–2	1–3	2–1	2–2	3–1	3–2	3–3	4–1	4–2	5–1	5–2	5–3	Overall	%
1	2	14	13	4	6	1	11	7	11	8	12	3	4	96	13
2	12	5	7	6	4	6	3	2	5	4	2	2	4	62	8
3	15	17	16	8	11(L)	13	8	12(L)	14	14(L)	11	16	15	170	23
4	7	5	1	3	1	2	1	1			1	1	3	26	4
5	25(L)	17(L)	17	29(L)	26	8(L)	1	8	8(L)	11	10	12(L)	7	179	24
6	3	5	4			1				3	3	2		21	3
7				1			1			1				3	0.4
8	3	6	6	1	2	2	1	1	1	2	2	4	7	38	5
9		5	1				2	5	2	1	2	1	2	21	3
10	2	4	2	1	3	2	1	2	2	4	4	4	4	35	5
11	2	6	4	2	1		1		2		2			20	3
12	2		1	1	1		1	1		1				8	1
13	3	3	6(L)	1	2	1	1(L)	1	1	1	4(L)	1	2	27	4
14	4	4	5	7		1	1	1	1	3	3	2	3(L)	35	5
													Total	741	100

Activities

1 – Doing the problems on my own.	8 – Planning for activities after class.
2 – Day dreaming.	9 – Correcting my mathematics work.
3 – Taking / copying notes.	10 – Taking part in questions & answers.
4 – Talking to my friends about other things (not mathematics).	11 – Reading or looking up information in the handout.
5 – Paying attention to what the lecturer was saying.	12 – Waiting for lecturer to come around to help me.
6 – Discussing mathematics with my friends.	13 – Working on what the lecturer asked us to do.
7 – Doing my tutorial homework.	14 – Others (please explain):

The two most common activities reported by the students were paying attention (#5; 24%) and taking/copying notes (#3; 23%). This confirmed the standard lecture structure whereby it was a mainly teacher-directed lesson with the students listening most of the time. The next common activity reported was doing the problems on my own (#1; 13%). This was probably due to the lecturer's practice of providing pauses at certain junctures of the lectures for the students to practise on repeat examples before going through them. Next in line was day dreaming (#2; 8%) indicating some but not serious boredom and lack of interest in the lectures. The lecturer's expected activity of the students was paying attention for 6 of the 13 reflections, in agreement with 24% of the students. There was some agreement about taking/copying notes (#3; 23% from students). Finally, the lecturer ticked working on what she asked the students to do (#13) in three reflections, but most students did not choose this activity.

Question 3 – *The previous part of this lecture helped you to:*

This item was designed to find out how the part of the lecture just before the reflection had helped the students in their learning. These items relate to the objectives of the different parts of the lecture. Here, the students were allowed multiple responses. The responses are summarized in Table 5.

Table 5
Frequencies about purpose of lectures

	Lecture 1			Lecture 2		Lecture 3			Lecture 4		Lecture 5				
	Reflection			Reflection		Reflection			Reflection		Reflection				
Purpose	1–1	1–2	1–3	2–1	2–2	3–1	3–2	3–3	4–1	4–2	5–1	5–2	5–3	Overall	%
1	23	27	22	10	9	8	10	12	13	16	19	10	9	188	24
2	7	17	13	4	3	2	7	3	5	3	9	7	6	86	11
3	8	4	8	6	3	3	2	13	4	5	1	2	3	62	8
4	2	5	4	1	1		1	4	3	2	2	2	2	29	4
5	5	9	5	5	2	4	4	8	3	4	5	4	2	60	8
6	1	2	2			1	1		3	1	2			13	2
7	18 (L)	17 (L)	12	26 (L)	19	20 (L)	20 (L)	0 (L)	23 (L)	23 (L)	25 (L)	26	28 (L)	257	33
8	4	4	4	5	5 (L)	2		1	4	4	7	4	4	48	6
9		1	1			1	1	5						9	1
10	1	2	2 *(L)	3	2	2		2	2	1	2	3 **(L)	4	26	3
													Total	778	

***** Understand the topic better
****** Understand the topic completely

Purpose

1 – Revise previous work.	6 – Learn to develop skills to work in groups.
2 – Become better at writing mathematics.	7 – Learn new mathematical skills or concepts.
3 – Apply mathematics to other modules.	8 – Enjoy learning mathematics.
4 – Learn how to discuss mathematics with friends.	9 – Learn how to use technologies that use mathematics, e.g., computer, calculator.
5 – Think or reason better in mathematics.	10 – Others (please explain):

The most common purpose reported by the students were learning new mathematical skills and concepts (#7; 33%) and the lecturer chose this 10 times out of 13 reflections, including the occasion when none of the students chose this purpose (3–3). This result shows some agreement between the lecturer and students about this purpose. The other commonly mentioned purposes were revising previous work (#1; 24%), becoming better at writing mathematics (#2; 11%), applying mathematics to other modules (#3; 8%) and thinking or reasoning better in mathematics (#5; 8%). This wide variety of responses indicates that the students interpreted the purposes of the parts of the lectures in different ways.

The majority of the students realised the fact that they were learning new mathematical skills for each lecture. However, each new skill in subsequent lectures had required mathematical skills taught in preceding lectures, thus some students perceived that they were revising previous work. This is more prominent in Lecture 1 as the lecture was on solving DE, a new mathematical skill, using the skills on finding Laplace and inverse Laplace that had been taught in the preceeding weeks. Another point to note is that this mathematics module was taught to support another engineering module, Circuit Analysis, hence some students had perceived that they were applying mathematics to another module. It also follows that as the series of lecture progressed, students having learnt more mathematics would perceive that they have improved in thinking and reasoning in mathematics. Hence, the various interpretation of the purposes of the lectures reported by the students.

Questions 4 to 8

These items were designed to find out the students' perception of the importance of the lecture, whether they could concentrate, if the lecture was challenging, if they have had skills to cope with the lecture and the amount of mathematics that they had learnt. The lecturer responded as how these statements might apply to her students. The mean score of their responses are summarized in Table 6.

Table 6
Mean scores of students' responses to Questions 4 to 8 (6-point scale)

	Lecture 1			Lecture 2		Lecture 3			Lecture 4		Lecture 5			
	Reflection			Reflection		Reflection			Reflection		Reflection			
Questions	1–1	1–2	1–3	2–1	2–2	3–1	3–2	3–3	4–1	4–2	5–1	5–2	5–3	Overall
Q4: Important	4.63	4.67	4.73	4.58	4.52	4.13	4.31	4.41	4.59	4.64	4.62	4.66	4.41	4.53
	6	6	6	6	6	6	6	6	6	6	6	6	6	6.00
Q8: Learn	3.78	4.19	4.25	3.81	4.02	3.84	4.00	3.85	3.80	3.73	4.31	4.14	3.89	3.97
much	6	6	6	6	6	6	6	6	6	6	6	6	6	6.00
Q7: Cope	3.38	3.64	3.71	3.75	3.72	3.64	3.74	3.72	3.74	3.38	4.11	3.66	3.77	3.69
	6	6	6	6	6	6	5	5	6	4	6	6	4	5.54
Q6:	3.81	3.54	4.02	3.56	3.77	3.46	3.62	3.85	3.63	4.11	3.13	3.82	3.68	3.69
Challenging	6	6	5	2	4	5	5	6	5	6	4	6	6	5.08
Q5:	3.13	2.88	3.35	3.33	3.21	3.15	3.15	3.46	3.04	3.42	2.89	3.09	3.43	3.20
Concentrate	2	2	5	1	1	2	3	3	1	2	1	3	2	2.15

The lecturer rated all the parts extremely important (using the highest rating), but the overall student mean was relatively lower, at 4.53. The students seemed to appreciate the importance of the work less than the lecturer. Indeed, responses to item 8 showed that on the whole, the students reported not learning much from the lectures, although the lecturer felt that they should have learned a lot. This discrepancy could be because students expected to have fully understood the topic during the lectures whereas the lecturer had given allowance that students will understand the topic better after attempting the corresponding tutorials at home.

The lecturer reported a high rating for the skills that students had for coping with the lectures, in contrast to a much lower rating of 3.69 by the students. The lecturer's perception that enough skills had been taught is obviously in disagreement with the perception of the students. Likewise, this time in opposite contrast, is the rating of the lecturer and students for the challenge of the lectures. The lecturer indicated that the lectures were challenging to the students but the students indicated a relatively lower rating of mean value 3.69.

The only item that the lecturer and the students were in close agreement was for the level of concentration during the lectures. The lecturer rated a mean value of 3.20 for the concentration level as compared to a rating of 2.15 by the students. This might be because the lecturer allowed pauses at appropriate junctures during the lectures for students to seek clarifications with their peers or with the lecturer.

Question 9 – *Write down one thing you still do not understand.*

This was a free response item. Most of the responses (54%) were irrelevant comments such as "so far so good", "understand everything", "no question", "I think I understand everything" and "I am doing ok so far"; but not their problems in mathematics. Among the 28% entries related to mathematics, there were only 9 who expressed a specific problem, for example, "Step1, to rewrite the equation", "The graph, the moving of points", "the on-off part", "setting of timeline", "Laplace transform of f(t – c) u(t – c)" (five occurrences). The rest were general difficulties: "shifting theorem", "partial fractions", "inverse Laplace", "differential equation", "second shift theorem", "Math", "Heaviside" and "graph". A remaining 18% did not give any response.

Interviews

From the 24 interviews conducted, students had expressed that they were generally happy with the lectures as they had found them to be very clear, although it did not seem so from their response to Question 1. Students expressed their appreciation that they were allowed to discuss with their friends during the lecture. This had helped them to clear their doubts immediately so that instead of being lost and became disinterested in the lesson, they could proceed to the next part of the lecture. To them, this was an important element in the lecture as it had offered them a non-threatening learning environment. As there could clear their doubts immediately, they felt motivated to proceed on with the lecturer even though at times it was a little difficult to them. Nickson (2000) mentioned that pupils who gain in self-confidence through open discussion of mathematics may come to see mathematics itself in a less threatening light.

Students mentioned that there were a little tired of the 'survey' as they found that they were too many 'questionnaires' being administered in a period of three weeks. They did not see the value of answering the same questions thirteen times.

Four of them had suggested that the lecture could be improved if the lecture had been interjected with jokes. One student suggested that the lecturer revises the graphs of some common functions before teaching the sketching of graphs involving Heaviside unit step functions in Lecture 2.

The interviews provided an opportunity for the lecturer to see the underlying reasoning for students' rating of their feelings of the lectures. Students could also voice their suggestions for improvements. The lecturer could further understand some difficulties faced by her students as well as strong points of the lectures favoured by the students.

Conclusion

This study has supported previous research that there are discrepancies in the perceptions of the teacher and students about classroom events in terms of feelings, activities, and purposes. It is important that teachers and lecturers, being placed in a fast-paced and complex setting, to stop their lessons at some intervals so that the students may reflect on their learning and the lecturer can check the progress of the lesson. Having an awareness that students' perceptions of the lecture events may not be the same as the teachers' is a form of feedback that teachers could use to further improve their lessons. The lecturers would also be able to make tacit adjustment the moment they sense a discrepancy during a lesson so as to enhance the learning of students. More research could be done to probe further into students' in-class thinking and feelings during mathematics lessons.

In order to obtain more specific responses to the free response item, students need to be given more time so that they are able to write in more detail. In this study, they were given only 5 minutes to complete each reflection. Students also need to be given some training to be able to reflect in more specific details and precision.

References

Bell, A., Crust, R., Shannon, A., & Swan, M. (1993). *Awareness of learning, reflection and transfer in school mathematics. ESRC Project: R000-23-2329.* (Parts one, two, three). Nottingham: Shell Centre for Mathematical Education, University of Nottingham.

Bess, J.L. (2000) *Teaching alone teaching together*. San Francisco: Jossey-Bass.

Ee, H. W. & Wong, K. Y. (2004) *Student experiences of mathematics lectures at Singapore Polytechnic*. Paper presented at the 2004 conference of the Educational Research Association of Singapore, 24 – 26 Nov.

Nickson, M. (2000) *Teaching and Learning Mathematics 2nd Edition*. London: Continuum.

Peterson, P.L. (1988). Teachers' and students' cognitional knowledge for classroom teaching and learning. *Educational Researcher, 17*(5), 5–14.

Peterson, P. L., Swing, S. R., Braverman, M. T., & Buss, R. (1982). Students' aptitudes and their reports of cognitive processes during direct instruction. *Journal of Educational Psychology, 74*(4), 535–547.

Peterson, S. E., & Miller, J. A. (2004). Comparing the quality of students' experiences during cooperative learning and large-group instruction. *The Journal of Educational Research, 97*(3), 123-133.

Shimizu, Y. (2002). *Discrepancies in perceptions of lesson structure between the teacher and the students in the mathematics classroom*. Paper presented at the interactive symposium 'International Perspectives on Mathematics Classrooms' at the Annual Meeting of the American Educational Research Association, New Orleans, April 1-5, 2002. Available from http://extranet.edfac.unimelb.edu.au/DSME/lps/subpubs.shtml

Wong, K. Y. (1985). *Mathematical understanding: An exploration of theory and practice.* Unpublished PhD thesis, University of Queensland.

Appendix

Student Experiences of Mathematics Lectures (SEML): Singapore Polytechnic

Name: _____ **Date:** _____ **Time:** _____

Aim: This is **not** a test, and your responses will **not** be graded. There are **no** right or wrong answers. Please answer the questions as honestly as you can. If you have difficulties with the lecture, please mention here so that we can help you learn mathematics better. **Thank you.**

1. How do you feel now? For each pair of adjectives, tick the circle that is closest to your feeling.

	Very	Quite	Somewhat	Neither	Somewhat	Quite	Very	
Happy	○	○	○	○	○	○	○	**Sad**
Difficult	○	○	○	○	○	○	○	**Easy**
Lonely	○	○	○	○	○	○	○	**Sociable**
Engaged	○	○	○	○	○	○	○	**Detached**
Alert	○	○	○	○	○	○	○	**Drowsy**
Active	○	○	○	○	○	○	○	**Passive**
Clear	○	○	○	○	○	○	○	**Confused**
Bored	○	○	○	○	○	○	○	**Excited**

2. What was the **main** activity you were doing just before you were asked to do this survey? Tick **one** only.

❑	Doing the problems on my own.	❑	Planning for activities after class.
❑	Day dreaming.	❑	Correcting my mathematics work.
❑	Taking / copying notes.	❑	Taking part in questions & answers.
❑	Talking to my friends about other things (not mathematics).	❑	Reading or looking up information in the handout.
❑	Paying attention to what the lecturer was saying.	❑	Waiting for lecturer to come around to help me.
❑	Discussing mathematics with my friends.	❑	Working on what the lecturer asked us to do.
❑	Doing my tutorial homework.	❑	Others (please explain):

3. The previous part of this lecture helped you to: (may tick more than one)

❑	Revise previous work.	❑	Learn to develop skills to work in groups.
❑	Become better at writing mathematics.	❑	Learn new mathematical skills or concepts.
❑	Apply mathematics to other modules.	❑	Enjoy learning mathematics.
❑	Learn how to discuss mathematics with friends.	❑	Learn how to use technologies that use mathematics, e.g., computer, calculator.
❑	Think or reason better in mathematics.	❑	Others (please explain):

1 = Not at all (Not much); **2 – 3**: Somewhat; **4 – 5**: Quite; **6**: Very (a lot)

4.	Was this part of the lecture **important**?	1	2	3	4	5	6
5.	Was it hard to **concentrate** during this part of the lecture?	1	2	3	4	5	6
6.	Was this part of the lecture **challenging** to you?	1	2	3	4	5	6
7.	Do you have the **skills** to cope with this part of the lecture?	1	2	3	4	5	6
8.	How **much** mathematics were you learning at this part of the lecture?	1	2	3	4	5	6

9. Write down one thing you still do not understand. (Use page overleaf.)