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Student Learning Experiences: A Week at Singapore Polytechnic

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Abstract

Students are expected to engage in a variety of experiences when they learn mathematics. These include listening to teacher exposition, completing homework, reading assigned text, discussing with other students, and so on. This paper is based on data collected for a doctoral study on learning experiences engaged in by a group of Year 2 students when they studied an Engineering Mathematics module at Singapore Polytechnic in 2007. Data was collected online, an adaptation of the Experience Sampling Method developed by Csikszentmihalyi (1988). The descriptive statistics of students' feelings and perspectives of their learning experiences during lectures, tutorials, and self-study over one week only will be presented and discussed here. Although the students were in the same lessons, their perceptions of the learning activities and purposes varied widely. This methodology of data collection can provide rich data on student learning experiences.

Keywords: student learning, Experience Sampling Method, polytechnic students

Studies about Student Learning

Attending lectures and tutorials, followed by completing assignments at home, are activities many students at tertiary institutions will engage in. Students are expected to engage in a variety of experiences: listening to teacher exposition, completing homework, reading assigned text, discussing with other students, and so on. Although there have been some studies on student learning (e.g., Biggs, 1987; Entwistle, 1981; Marton, Hounsell, & Entwistle, 1984; Ramsden, 1988), more research can be done, as student learning experiences differ from country to country, from culture to culture, from subjects to subjects, and even from classroom to classroom taught by the same teacher.

Schiefele and Csikszentmihalyi (1995) conducted a study on 108 high school students to examine the relationships amongst interest, achievement motivation, mathematical ability, the quality of experience when doing mathematics, and mathematics achievement, using Experience Sampling Method (ESM) developed by Csikszentmihalyi (e.g., Csikszentmihalyi, 1988; Csikszentmihalyi & Larson, 1987). 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 upon receiving beeps on a beeper that each participant carries with him or her. Schiefele and Csikszentmihalyi (1995) argued that the quality of experience in class is an outcome variable in its own right, and suggested that positive affect should be a criterion in evaluating school instructions. They found that interest in the subject-matter was the strongest predictor of the quality of experience in mathematics classes, and that mathematical ability had no effect on the quality of experience at all. They also found that interest and mathematics achievement influenced each other, and that general motivational orientations like achievement motivation had no influence.

Since the quality of learning and mathematics achievement are affected by interest in the subject-matter, it is important to put in careful thoughts in designing a learning programme. Biggs (1996) outlined a framework, the constructive alignment, so as to support better quality in learning. Constructive alignment is based on the twin principles of constructivism in learning and alignment on teaching. Constructivism comprises a family of theories but all have in common the centrality of the learner's activities in creating meaning. Alignment on teaching emphasised alignment between the objectives of a course or unit and the targets for assessing student performance. Thus, a learning programme that is designed based on constructive alignment will have all its components (objectives, teaching and learning activities, assessments, etc.) aligned to the objectives. In Singapore Polytechnic (SP), lessons are taught in lecture-tutorial system, and students are assessed on components including online quizzes, class work, problem-based learning assignment, mid-semester test and end-of-semester examination. What are students' feelings and perspectives of these learning experiences?

In designing an effective learning programme, module coordinators and the lecturers need to understand the learners. Ramsden (1988) emphasised that to become a good teacher, the teacher must first understand students' experiences of learning. According to Ramsden, learning occurs when learners change their ways of seeing, experiencing and conceiving aspects of the real world around them, in the way that subject experts do. With good understanding about students' experiences of learning, the teacher will be able to plan better lessons and to improve practice so as to better bridge the gap between the learners' understanding of content and the goal of achieving the expert's understanding of the content.

In this study, data on student learning experiences – their feelings, perspectives of activities, purposes of these activities, and attitudes elicited by these activities – were collected over a period of 9 teaching weeks. Students submitted their responses online whilst in their respective learning activities, using an adaptation of ESM. Forgasz and Leder (2006) used ESM to gather rich data that provided a comprehensive picture of the daily lives, in and out of office hours, of 14 secondary mathematics teachers. The data for only one week of responses taken during lectures, tutorials, and self-study will be discussed here.

Research Question

1. What are students' perceptions of the activities and their objectives during lectures and tutorials? What are students' corresponding activities and perceived objectives during out-of-class self-study?
2. What are students' cognitive and affective perceptions during lectures, tutorials, and out-of-class self-study?

The Study

The participants were 235 Year 2 Engineering students at SP. They were from four lecture groups taught by three lecturers and 12 tutorial groups taught by five tutors. SP is one of the five non-university tertiary institutions in Singapore, catering to the 30th to 70th percentile of the yearly cohort. The data for the whole study were collected online during May to September 2007, but the results to be reported below were from Week 7. The online data collection of this study tapped on the fact that all students in the module owned a laptop. They were the first batch of students that ownership of laptop was compulsory.

The instrument was a 12-question checklist that was administered, at specific pauses during lectures and tutorials. Question 1 consists of 8 bipolar semantic differential adjectives to assess students' feeling during the lectures, tutorials and self-study, on a 6-point scale. Reference was made to the feeling items found in Peterson and Miller (2004). Question 2 asked about the main activity engaged in by the students. Question 3 asked about student perceptions of the purpose of the activity. Students could choose up to three purposes. Ideas for the items on purposes of the activity were obtained from Bell, Curst, Shannon and Swan (1993). Questions 4 to 11 assessed students' perceptions of the importance of the activity, challenge from the activity, amount of learning from the activity, confidence gained from the activity, ability to concentrate during the activity, ability to cope with the activity, pace of learning, and if they wanted the activity to end soon. The 6-point scale was 1 (strongly disagree) to 6 (strongly agree). Question 12 was an open-ended question asking students to write down any comment or suggestion. Qualitative data were also collected using unstructured weekly interviews with volunteers amongst the students, at least one from each class. Their interviews were audio-taped and transcribed. The qualitative data will not be discussed here.

Every week there were a two-hour lecture and a two-hour tutorial for this Engineering Mathematics module. Students were required to complete a tutorial each week – during tutorial lesson and at home. Students were asked to submit three reflections for the lecture, tutorial, and self-study sessions. The submissions during lecture and tutorial were teacher-initiated but the submissions during self-study were student-initiated, upon completion of some work in Engineering Mathematics, at intervals of at least 30 minutes between any two submissions.

Results and Discussion

The Data

Complete data could not be obtained in Week 7 from all the 235 participants, for various reasons. The numbers of respondents are given in Table 1. Some students were absent from classes, some who did not bring laptop, and others were late for 8am classes. One lecture group had lectures timetabled over two days, and many students did not turn up for the first lesson (timetabled during lunchtime). Two tutorial classes were not conducted due to a public holiday. Three tutorial classes submitted only two reflections and another class submitted one. During self-study, some students forgot to submit their reflections, some did not do any self-study, and others reported not having internet access at home. Although not used in the analysis of data in this paper, maximum likelihood method and multiple imputations can be used to handle missing data (Peugh & Enders, 2004).

Table 1
Number of Respondents (n= 235)

	Reflection 1		Reflection 2		Reflection 3	
	Frequency	%	Frequency	%	Frequency	%
Lecture	149	63.4	168	71.5	172	73.2
Tutorial	125	53.2	102	43.4	28	11.9
Self-study	118	50.2	98	41.7	87	37.0

The Cronbach's alphas of the 8 bipolar semantic differential items in Question 1, and those of Questions 4 to 11 are tabulated in Table 2. These values range from 0.82 to 0.92, showing that students' responses were quite consistent during each reflection.

Table 2
Mean Cronbach's Alphas

	Lecture			Tutorial			Self-study		
	LR1	LR2	LR3	TR1	TR2	TR3	SR1	SR2	SR3
Q1: Feeling	0.82	0.83	0.88	0.85	0.88	0.90	0.84	0.84	0.86
Q4 to Q11	0.87	0.87	0.87	0.88	0.90	0.92	0.85	0.88	0.87

Lecture

For the similar 2-hour lecture delivered to four different groups, 54.8% of the respondents reported that they were mainly engaged in listening to the lecturer's explanation (Activity 1 in Table 3). Very few (10.5%) mentioned taking notes (Activity 3). Students were provided with lecture handouts, of which each new concept was reinforced with one worked example and a few similar exercises. After exposition of the new mathematical concept and the corresponding worked example by the lecturer, students were given 5 to 15 minutes (depending on students' abilities and readiness for any lecture activity, and the level of difficulty of the exercise) to attempt these exercises, followed by further explanation by the lecturer to reaffirm and to reinforce students' understanding. Students will then correct their working or copy the lecturer's solution. However, as evident from the fact that only a total of 10.6% of respondents reported either working on what the lecturer asked them to do (Activity 2) or solving mathematics problems on their own (Activity 6), it seems that lecturers spent a lot of time explaining. Since handouts were given, they did not need to take notes. Only 5% of respondents were involved in class discussions: took part in questions and answers (Activity 4), and discussing mathematics (Activity 5). A number of students (about 14% of the respondents) mentioned engaging in off-task activities such as talking to friends (Activity 8), day dreaming/looking around (Activity 13), gaming/browsing internet on laptop (Activity 10), planning activities after class (Activity 11), and reading and sending SMS (Activity 12). A handful reported waiting to clear their doubts (Activity 9), or reading or looking up information in the mathematics handout (Activity 7). The four responses to "others" (Activity 14) were: learning Heavy Sidestep [*sic*], finished inverse Laplace using second shift theorem, having lecture, and browsing – probably the internet.

It can be seen from Table 4 that the most frequently reported purposes during lecture was revising mathematical concepts taught (27% of responses), followed by learning new mathematical skills (21.2%), think or reason better in mathematics (14.3%), and to write better in mathematics (11.9%). During the same lesson, students were reporting that they were revising and learning new mathematical skills at the same time. By the nature of mathematics, mathematical concepts are linked. While students were learning new mathematical concepts, their knowledge of mathematical concepts previously learned was strengthened. During the lecture discussed in this paper, students learnt the concept of finding the inverse Laplace transform involving second shift theorem, and to sketch the resulting function, followed by the concept of the unit impulse function. Although they were learning new mathematical skills and the concept of a new function, they needed previous known knowledge to understand these skills and concept. Revising concepts and learning new skills will lead to mathematical thinking in students and to reason better in mathematics, and also to write better in mathematics. Students were also expected to relate different mathematical concepts but only 3.2% of respondents perceived so. The skills and concepts taught in this module were required for another engineering module, Circuit Analysis. However, only 5.2% of the students perceived that they were applying mathematics to other modules. Other important purposes of learning mathematics were also poorly perceived: only 7.9% of the students enjoyed learning mathematics, and only 5.6% of the students reported applying mathematics to daily life/workplace. On the other extreme, 1.7% reported learning how to use technologies in mathematics when there was no such attempt in this lecture. The responses to "others" (purpose 10) were: do example, confused (2 occurrences – by a same student), relax (2 occurrences – by a same student), do [*sic*] nothing, and ten submissions of nil, none, NA, or "-".

An important observation is that student perceptions of the activities that they were engaged in, and the purposes, varied widely (Biggs, 1987; Prosser and Trigwell, 1999; Ramsden, 1988).

Table 5 shows the mean scores of Question 1, and Questions 4 to 11, for lecture, tutorial and

Table 3
Lecture: Activities Reported by Students (choose one only)

Activity	Reflection 1		Reflection 2		Reflection 3		Overall	%
	Frequency	%	Frequency	%	Frequency	%		
1	79	54.5	95	57.9	88	52.1	262	54.8
3	18	12.4	16	9.8	16	9.5	50	10.5
2	14	9.7	9	5.5	14	8.3	37	7.7
8	5	3.4	10	6.1	9	5.3	24	5.0
13	5	3.4	8	4.9	9	5.3	22	4.6
6	7	4.8	5	3.0	2	1.2	14	2.9
4	6	4.1	4	2.4	3	1.8	13	2.7
10	2	1.4	3	1.8	7	4.1	12	2.5
5	3	2.1	3	1.8	5	3.0	11	2.3
9	3	2.1	4	2.4	4	2.4	11	2.3
11	1	0.7	2	1.2	7	4.1	10	2.1
7	1	0.7	1	0.6	2	1.2	4	0.8
12	0	0.0	2	1.2	2	1.2	4	0.8
14	1	0.7	2	1.2	1	0.6	4	0.8
	145	100	164	100	169	100	478	100

Activities

1 – Listening to lecturer's explanation.	10 – Gaming/ browsing internet on laptop.
3 – Taking / copying notes.	5 – Discussing mathematics with my friends.
2 – Working on what the lecturer asked us to do.	9 – Waiting to clear my doubt with someone.
8 – Talking to my friends about other things.	11 – Planning activities after class.
13 – Day dreaming/ just looking around.	7 – Reading or looking up information in the mathematics handout.
6 – Solving mathematics problems on my own.	12 – Reading/sending SMS.
4 – Taking part in questions and answers.	14 – Others (please specify):

Note. The relatively higher responses are underlined.

Table 4
Lecture: Purpose of Activities (choose up to 3)

Purpose	Reflection 1		Reflection 2		Reflection 3		Overall	%
	Frequency	%	Frequency	%	Frequency	%		
1	70	29.9	74	26.9	68	24.7	212	27.0
6	46	19.7	54	19.6	66	24.0	166	21.2
2	28	12.0	43	15.6	41	14.9	112	14.3
3	32	13.7	28	10.2	33	12.0	93	11.9
4	12	5.1	19	6.9	10	3.6	41	5.2
7	18	7.7	22	8.0	22	8.0	62	7.9
8	14	6.0	14	5.1	16	5.8	44	5.6
9	6	2.6	8	2.9	11	4.0	25	3.2
10	3	1.3	6	2.2	7	2.5	16	2.0
5	5	2.1	7	2.5	1	0.4	13	1.7
	234	100	275	100	275	100	784	100

Purpose

1 – Revise mathematical concepts taught.	7 – Enjoy learning engineering mathematics.
6 – Learn new mathematical skills or concepts.	8 – Apply mathematics to daily life or workplace.
2 – Think or reason better in mathematics.	9 – Relate different mathematical concepts.
3 – Write better in mathematics.	10 – Others (please specify):
4 – Apply mathematics to other modules.	5 – Learn how to use technologies in mathematics e.g., mathematics software, calculator, applets.

Note. The relatively higher responses are underlined.

self-study. The lecture mean scores (in bold print in Table 5) for all items, except Question 11, differ only by a maximum value of 0.62 (i.e. difference between the lowest mean of 3.96 and the highest mean of 4.58). Amongst them, students' reported perceptions were highest for importance of the lecture activity (Q4), followed closely by challenge in thinking offered by the activity (Q5). Next in the list are amount of learning from the activity (Q6), ability to concentrate during activity (Q8), enough mathematics to cope with the activity (Q9), confidence gained from the activity (Q7), pace of the activity (Q10), and student feeling just before reflection (Q1). The respondents seemed to have reported least favourably for the item on whether they wished to continue with the lesson (Q11 – reversed scored).

Table 5
Mean Scores of Students' Responses to Q1, and Q4 to Q11 (6-point scale)

Q4 – Q11	Lecture				Tutorial				Self-study				Overall mean
	LR1	LR2	LR3	Mean	TR1	TR2	TR3	Mean	SR1	SR2	SR3	Mean	
Q4: Importance	4.61	4.65	4.49	**4.58**	4.34	4.24	4.33	**4.30**	4.55	4.51	4.52	**4.53**	4.47
Q5: Challenge	4.48	4.54	4.40	**4.47**	4.18	4.15	4.22	**4.18**	4.47	4.47	4.40	**4.45**	4.37
Q6: Learnt a lot	4.37	4.41	4.36	**4.38**	4.08	4.05	4.26	**4.13**	4.25	4.23	4.34	**4.27**	4.26
Q8: Concentration	4.33	4.33	4.30	**4.32**	4.04	3.89	4.07	**4.00**	4.13	4.15	4.26	**4.18**	4.17
Q9: Enough Maths	4.34	4.29	4.27	**4.30**	3.94	3.94	3.93	**3.94**	4.08	4.16	4.20	**4.15**	4.13
Q7: Confidence	4.24	4.30	4.28	**4.27**	4.05	3.96	4.07	**4.03**	4.26	4.24	4.11	**4.20**	4.17
Q10: Pace	4.23	4.21	4.19	**4.21**	4.01	3.98	4.07	**4.02**	4.16	4.17	4.16	**4.16**	4.13
Q1: Feeling	4.04	3.96	3.89	**3.96**	3.73	3.77	3.73	**3.74**	3.81	3.75	3.89	**3.82**	3.84
* Q11: Flow	3.24	3.00	2.98	**3.07**	3.38	3.43	3.30	**3.37**	3.71	3.82	3.86	**3.80**	3.41
Mean	4.23	4.22	4.16	**4.20**	4.00	3.96	4.03	**4.00**	4.20	4.22	4.23	**4.22**	4.14

*This item was reversed-scored. The positive polar adjectives are shown.
Note. The highest and lowest mean score for each item are underlined.

Tutorial

There were 12 tutorial groups, taught by 5 different tutors. 33.5% of the respondents reported that they were mainly engaged in listening to the tutor's explanation (Table 6) and the main purpose was to revise mathematical concepts taught previously (Table 7). This perception is in line with the objective of a tutorial lesson i.e. to reinforce students' understanding from lecture and to clear any doubts. Collectively, 18.8% of respondents were working on what their lecturer asked them to do or doing mathematics problems on their own (activities 2 and 6) i.e. to work on tutorial problems. Another 14.2% reported other on-task activities such as taking or copying notes (Activity 3), discussing mathematics with friends (Activity 5), taking part in questions and answers (Activity 4), and reading or looking up information in the mathematics handout (Activity 7). 8.4% reported waiting to clear their doubts (Activity 9). A sizeable number of students (16.6% of the respondents) mentioned engaging in off-task activities such as day dreaming or looking around (Activity 13), reading or sending SMS (Activity 12), talking with friends about other things (Activity 8), planning activities after class (Activity 11) and doing homework of other modules (Activity 14). Thus, there were 25% of respondents not doing work during tutorial. The responses to "others" (Activity 16) were: doing math work [*sic*], Quiz on Bb[1], finally understand [*sic*] what I'm supposed to do, tutorial, and nil (2 occurrences).

From Table 7, the most frequently reported purposes during tutorial, revising mathematical concepts taught, was followed by clarifying doubts in the topic (11.0%). 10.8% found that they were thinking or reasoning better in mathematics and 7.8% reported writing better in mathematics. A surprising 6.7% reported learning new mathematical skills when new mathematical skills were taught during the lecture but not during tutorial. Just as in lecture, some important purposes of learning mathematics were poorly perceived: only 6.2% reported applying mathematics to daily life or workplace, 5.9% reported relating different mathematical concepts, and 4.3% reported applying mathematics to other modules. Also, 4.6% reported learning how to use technologies in mathematics when there was none. Although no student reported that they presented their work to the class in Question 2, 4.3% of respondents reported that they learned how to present ideas to the whole class and another

[1] Blackboard, a computer managed learning system used for online learning at SP

Table 6
Tutorial: Activities Reported by Students (choose one only)

Activity	Reflection 1		Reflection 2		Reflection 3		Overall	%
	Frequency	%	Frequency	%	Frequency	%		
1	38	32.5	26	27.4	16	59.3	80	33.5
2	17	14.5	12	12.6	0	0.0	29	12.1
9	10	8.5	9	9.5	1	3.7	20	8.4
6	8	6.8	5	5.3	3	11.1	16	6.7
3	8	6.8	5	5.3	2	7.4	15	6.3
10	5	4.3	7	7.4	2	7.4	14	5.9
13	7	6.0	6	6.3	0	0.0	13	5.4
5	3	2.6	7	7.4	0	0.0	10	4.2
4	4	3.4	3	3.2	1	3.7	8	3.3
12	2	1.7	6	6.3	0	0.0	8	3.3
8	5	4.3	2	2.1	0	0.0	7	2.9
11	4	3.4	2	2.1	0	0.0	6	2.5
14	2	1.7	2	2.1	2	7.4	6	2.5
16	3	2.6	3	3.2	0	0.0	6	2.5
7	1	0.9	0	0.0	0	0.0	1	0.4
15	0	0.0	0	0.0	0	0.0	0	0.0
	117	100	95	100	27	100	239	100

Activities

1 – Listening to lecturer's explanation.	4 – Taking part in questions and answers.
2 – Working on what the lecturer asked us to do.	12 – Reading/sending SMS or gaming.
9 – Waiting to clear my doubt with someone.	8 – Talking to my friends about other things.
6 – Solving mathematics problems on my own.	11 – Planning activities after class.
3 – Taking / copying notes.	14 – Doing homework of other module(s).
10 – Looking up information from the internet.	16 – Others (please specify):
13 – Day dreaming/ just looking around.	7 – Reading or looking up information in the mathematics handout.
5 – Discussing mathematics with my friends.	15 – Presenting my working to the class.

Note. The relatively higher responses are underlined.

Table 7
Tutorial: Purpose of Activities (choose up to 3)

Purpose	Reflection 1		Reflection 2		Reflection 3		Overall	%
	Frequency	%	Frequency	%	Frequency	%		
1	52	26.8	36	26.3	12	30.0	100	27.0
11	19	9.8	17	12.4	5	12.5	41	11.1
2	24	12.4	13	9.5	3	7.5	40	10.8
3	16	8.2	12	8.8	1	2.5	29	7.8
6	15	7.7	8	5.8	2	5.0	25	6.7
8	9	4.6	8	5.8	6	15.0	23	6.2
9	12	6.2	8	5.8	2	5.0	22	5.9
5	9	4.6	4	2.9	4	10.0	17	4.6
4	9	4.6	5	3.6	2	5.0	16	4.3
12	8	4.1	6	4.4	2	5.0	16	4.3
13	5	2.6	4	2.9	1	2.5	10	2.7
7	5	2.6	6	4.4	0	0.0	11	3.0
10	11	5.7	10	7.3	0	0.0	21	5.7
	194	100	137	100	40	100	371	100

Purpose

1 – Revise mathematical concepts taught.	5 – Learn how to use technologies in mathematics e.g., mathematics software, calculator, applets.
11 – Clarify my doubts in the topic.	
2 – Think or reason better in mathematics.	4 – Apply mathematics to other modules.
3 – Write better in mathematics.	12 – Learn how to present my ideas to the whole class.
6 – Learn new mathematical skills or concepts.	13 – Others (please specify):
8 – Apply mathematics to daily life or workplace.	7 – Enjoy learning engineering mathematics.
9 – Relate different mathematical concepts.	10 – Learn how to discuss mathematics with friends.

Note. The relatively higher responses are underlined.

5.6% reported discussing mathematics with friends. There seemed little interaction during the tutorial. A much smaller percentage than during lecture, 3.0%, reported that they enjoyed learning mathematics. The responses to "others" (purpose 13) were: all of the above (2 occurrences); nothing at all (2 occurrences); and nil, none or NA (6 occurrences).

From Table 5, the tutorial mean scores (in bold print) for all items differed slightly more than those of the lecture but still at a maximum difference of only 0.93 (i.e. difference between the lowest mean of 3.37 and the highest mean of 4.30). The order of perceptions for the following are in the same order as those for lecture, from high to low: importance of the tutorial activity (Q4), challenge in thinking offered by the activity (Q5), and the amount of learning from the activity (Q6). Although only by marginal differences, students reported the rest of the items in the following decreasing order: confidence gained from the activity (Q7), pace of the activity (Q10), ability to concentrate during activity (Q8), and enough mathematics to cope with the activity (Q9). They reported less positive feeling (Q1) in spite of being more positive to staying on with the tutorial lesson (Q11 – reversed scored).

Self-study

From Table 8, a total of 33% of respondents reported to be mostly doing homework, either in other modules(s) or in mathematics (activities 1 and 2). Another 29.4% were doing other mathematics learning activities such as solving other mathematics problems on their own (Activity 6), making notes on mathematics (Activity 3), reading or looking up information in the mathematics handout (Activity 7), discussing mathematics with friends (Activity 5), and looking up information on mathematics from the internet (Activity 4). A sizeable number of students (33.4%) reported off-task activities such as relaxing (Activity 13), talking to friends (Activity 8), gaming or browsing the internet (Activity 10), reading or sending SMS (Activity 12), waiting to clear their doubts (Activity 9) – maybe with friends, and planning other activities after class (Activity 11). The responses to "others" (Activity 14) were: just got back from school, watch TV (3 occurrences), went to Malaysia, got back from work, sleeping, do [*sic*] math Tutorial 4, shopping, apply maths to other modules, having dinner, and nothing (2 occurrences).

From Table 9, the four most reported purposes of self-study sessions were to revise mathematical concepts taught (26.7%), to have better understanding of mathematical concepts taught (16.8%), think or reason better in mathematics (14.2%), and write better in mathematics (10.1%), which really were the purposes of self-study. This is an important element of repetitive learning (Biggs, 1994), that students develop interest in the subject as they became more familiar with the subject matter. Other reported purposes in decreasing order of frequencies are: enjoy learning engineering mathematics, apply mathematics to other modules, apply mathematics to daily life or workplace, relate different mathematical concepts, and learn how to use technologies in mathematics. The responses to "others" (purpose 10) were: relax (5 occurrences), de-stress (2 occurrences), revise what is taught in my last lecture, talking, know that I have not done my revision today, get new skirt, think better, and nothing, nil or "-" (8 occurrences) .

From Table 5, the self-study mean scores (in bold print in Table 5) for all items differ slightly more than those of the lecture but less than those of tutorial, by a maximum difference of only 0.73 (i.e. difference between the lowest mean of 3.80 and the highest mean of 4.53). The order of perceptions for the following are in the same order as those for lecture and tutorial, from high to low: importance of the tutorial activity (Q4), challenge in thinking offered by the activity (Q5), and the amount of learning from the activity (Q6). The rest, with slight difference in order, to the lecture and the tutorial are, in decreasing order of the mean scores: confidence gained from the activity (Q7), ability to concentrate during activity (Q8), the pace of the self-study activity (Q10), enough mathematics to cope with the activity (Q9), feeling (Q1), and to staying on with the self-study activity (Q11 – reversed scored).

Table 8

Self-study: Activities Reported by Students (choose one only)

Activity	Reflection 1		Reflection 2		Reflection 3		Overall	%
	Frequency	%	Frequency	%	Frequency	%		
1	21	17.8	14	14.3	15	17.2	50	16.5
2	22	18.6	14	14.3	14	16.1	50	16.5
6	8	6.8	17	17.3	18	20.7	43	14.2
13	12	10.2	14	14.3	11	12.6	37	12.2
3	8	6.8	10	10.2	8	9.2	26	8.6
8	15	12.7	4	4.1	4	4.6	23	7.6
10	8	6.8	6	6.1	6	6.9	20	6.6
12	7	5.9	4	4.1	2	2.3	13	4.3
14	5	4.2	6	6.1	2	2.3	13	4.3
7	6	5.1	1	1.0	2	2.3	9	3.0
5	3	2.5	2	2.0	2	2.3	7	2.3
9	1	0.8	1	1.0	3	3.4	5	1.7
4	1	0.8	3	3.1	0	0.0	4	1.3
11	1	0.8	2	2.0	0	0.0	3	1.0
	118	100	98	100	87	100	303	100

Activities

1 – Doing homework of other module(s).
2 – Doing homework assigned by my mathematics lecturer.
6 – Solving other mathematics problems on my own.
13 – Relaxing – not doing school work.
3 – Making notes on mathematics.
8 – Talking to my friends about other things.
10 – Gaming/ browsing internet on laptop.
12 – Reading/sending SMS.
14 – Others (please specify):
7 – Reading or looking up information in the mathematics handout.
5 – Discussing mathematics with my friends.
9 – Waiting to clear my doubt with someone.
4 – Looking up information on mathematics from the internet.
11 – Planning other activities after class.

Note. The relatively higher responses are underlined.

Table 9

Self-study: Purpose of Activities (choose up to 3)

Purpose	Reflection 1		Reflection 2		Reflection 3		Overall	%
	Frequency	%	Frequency	%	Frequency	%		
1	52	26.1	43	25.7	42	28.6	137	26.7
6	37	18.6	26	15.6	23	15.6	86	16.8
2	26	13.1	26	15.6	21	14.3	73	14.2
3	20	10.1	17	10.2	15	10.2	52	10.1
7	18	9.1	15	9.0	10	6.8	43	8.4
4	12	6.0	12	7.2	12	8.16	36	7.0
8	8	4.0	9	5.4	6	4.08	23	4.5
9	10	5.0	6	3.6	6	4.08	22	4.3
10	7	5.0	9	5.4	4	4.08	20	4.9
5	6	3.0	4	2.4	6	4.08	16	3.1
	196	100	167	100	145	100	508	100

Purpose

1 – Revise mathematical concepts taught.
6 – Better understanding of mathematical concepts taught.
2 – Think or reason better in mathematics.
3 – Write better in mathematics.
7 – Enjoy learning engineering mathematics.
4 – Apply mathematics to other modules.
8 – Apply mathematics to daily life or workplace.
9 – Relate different mathematical concepts.
10 – Others (please specify):
5 – Learn how to use technologies in mathematics e.g., mathematics software, calculator, applets.

Note. The relatively higher responses are underlined.

Overall trend of lecture, tutorial and self-study.

Students had more positive feelings to lecture (overall mean score of 3.96), followed by self-study (overall mean score of 3.82) and tutorial (overall mean score of 3.74). Students agreed more positively to items Q4 to Q11 during self-study (overall mean score of 4.22) than in the lecture (overall mean score of 4.20), followed by the tutorial (overall mean score of 4.00). Moreover, the highest individual scores occurred, mostly in the middle of the lecture (underlined in Table 5). On the other extreme, the lowest scores occurred, mostly in the middle of the tutorial. This finding indicates that students were not as positive about the tutorial lesson. As noted earlier, 25% of the respondents reported that they were not doing work during tutorial.

Another observation is that the reported mean scores for Questions 4 to 11 were higher that those in Question 1. Students reported relatively lower mean scores for feelings and wished that the activities would end soon. As this paper discussed only data from one week, more conclusive observations can only be drawn after studying the whole set of data. This will be reported in another conference paper.

Concluding Remarks

This paper looks into a week of students' learning experiences during lectures, tutorials and out-of-class self-study at Singapore Polytechnic. Although in the same lessons (lectures and tutorials), students reported varied perceptions of each learning activity, the purposes, the feelings involved and the attitudes elicited by the activities. This is in resonance with findings of Shimizu (2002) (students perceived the planned "yamaba" (climax of a lesson) at different junctures of the same lesson, or not at all in some instances) and Wong (2000) (workshop participants had different ideas from the same exposition).

SP students reported positive feelings for lectures, self-study and tutorials, although least so for tutorials. Module coordinator and the tutors need to probe deeper into the root of this finding so as to provide better learning experiences for students. There could be more presentations by students and more opportunities for students to speak mathematics. Studies have shown that tutorial dialogues, rather than monologues, that allow high interactivity can enhance learning gains in students (e.g., VanLehn, Graesser, Jackson, Jordan, Olney & Rose, 2007).

The findings underscore the importance for teachers to find out and to understand students' learning experiences. Having planned and designed structured lessons for students is the first step. The next step is for teachers to look into students' perceptions while in the midst of their learning activities and to study the impact of these lessons on students. With deeper understanding of students' experiences and the impact of the planned lessons, teachers can improve on the design and the pedagogies employed in the teaching of these lessons.

This paper confirms that data collected using the adaptation of ESM developed by Csikszentmihalyi (1988) could help researchers and practitioners gain deeper insight into student learning experiences. The advantage of ESM is to collect data on student experiences, repeatedly over a period of time, while they are in the progress of thinking, while still in the midst of the activity. Other studies using ESM in learning settings include Peterson and Miller (2004) (overall quality of learning experience was greater during cooperative learning), and Schiefele and Csikszentmihalyi (1995) (quality of experience when doing mathematics was mainly related to interest). Both studies used different adaptations of ESM. Variants of other adaptations can be explored. In cases with serious missing data, as in this study, the use of maximum likelihood method and multiple imputations in handling missing data can be employed.

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