UNDERSTANDING STUDENT LEARNING EXPERIENCES IN A LECTURE LEARNING ENVIRONMENT

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ABSTRACT

Students in tertiary institutions normally learn mathematics through the lecture-tutorial system. They are expected to be independent and to follow-up on the lectures with self-study, including seeking clarifications with their tutors during tutorial lessons. Much research has been conducted about this system and ideas on the effectiveness of large group lectures to engage and maximise student learning have been expounded by educational researchers. However, not much research has been conducted into student's day-to-day learning experiences. 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 were collected online, an adaptation of the Experience Sampling Method developed by Csikszentmihalyi (1997). The descriptive statistics of student feelings and perspectives of their learning experiences during lectures over a semester will be presented and discussed.

INTRODUCTION

There are many research studies on lecturing as a teaching format at post-secondary levels (e.g., Bergsten, 2007; Fritze & Nordkvelle, 2003; Saroyan & Snell, 1997). Bergsten (2007) investigated the quality of undergraduate mathematics lectures by using researcher's field notes and interview of the lecturer after the one and a half lecture. He found that critical quality aspects of a mathematics lecture can be framed using a triangular model consisting of mathematical exposition, teacher immediacy, and the general quality criteria of mathematics teaching. In another study, Fritze and Nordkvelle (2003) compared three different forms of lectures using the Systems Theory and its emphasis on communication. They concluded that live lecture superseded taped lectures and video-conferencing-lecturing, especially in the lecturer's ability to build personal trust as an educator and the provision for immediate response during live lectures. By analysing three divergent styles of one-hour lectures, Saroyan and Snell (1997) characterised the lectures into content-driven, context-driven and pedagogy-drive. They concluded that lectures can be effective if they are appropriately suited to the intended learning outcomes and are pedagogically planned and delivered. These studies looked into lecture details through lecturers' activities but not the students'.

Other studies research on lecture teaching and learning environment (e.g., Anthony, Hubbard, & Swedosh, 2000), from students' perspectives. Some studies also compared students' and lecturers' perspectives. Using exploratory open-ended questionnaires, Likert-type questionnaires and student interviews to compare students' and lecturers' perceptions, Anthony (1997) confirmed the importance of motivation (for example, the availability of lecturer's help, and easy access to worked examples) in influencing student success in first-year undergraduate mathematics courses. She suggested further research in the areas of active learning, student effort and student workload. Nisbert, Entwistle, and Robinson (2005) conducted interviews of staff and groups of students, and administered two questionnaires to study lecturers' and students' perceptions of the teaching and learning environment of a final-year module in analogue electronics. Their study highlighted the importance of coherence, continuity and connectedness in teaching and learning over the course of the degree. In this study, data on both students' and lecturer's perceptions were collected.

In research on participants' perspectives, data collection is usually done through interviews and once-only questionnaires. Csikszentmihalyi (1997) developed the Experience Sampling Method (ESM) for repeated data collection to study what people do, feel, and think during their daily lives. This technique 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. Using ESM, 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. They argued that the quality of experience in class is an outcome variable in its own right. 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. Forgasz and Leder (2006) used ESM to gather data of 14 secondary mathematics teachers in and out of working hours. The data provided a comprehensive picture of their daily lives, with extensive tasks that stretched well beyond formal school hours. Based on the idea of ESM, Wong and Ee (2006) used a one-page in-class reflection checklist to collect in-class reflections at primary, secondary and polytechnic levels. The data collected provided meaningful comparisons of similarities and differences in students' and teachers' responses to the same class events.

In this study, an adapted version of the one-page in-class reflection checklist (Wong & Ee, 2006) was used to collect data on polytechnic students' learning experience throughout a semester. Data collected from both students and lecturers during the lectures will be discussed in this paper.

THEORETICAL CONSIDERATION

Teaching and learning are activities that occur simultaneously. As much as the lecturer (or teacher) may try, the lecturer can never be certain of the exact learning that is taking place in the students. Students enter the learning environment with various prior learning experiences and conceptions. Students thus perceive the same learning environment differently (Prosser & Trigwell, 1999), which results in students achieving differing levels of understanding. According to the constructivist theory of learning, learning is subject to individual interpretation, for example, "knowledge is (derived from) experience, and actively constructed and re-constructed by subjects in interaction with their worlds" (Ackermann, 2007, p. 249).

There are various experiences in everyday life. These experiences are subjective and are affected by interactions with others. In the theory of the social construction of reality (Berger & Luckmann, 1991), the various layers of everyday life experiences appeared to one as different spheres of reality. For example, a question and answer session during lecture, remembering the contribution made, and the feeling of self-satisfaction for the contribution, are three layers of experiences of an interaction. Amongst these different spheres of reality, there is one that is taken as reality. The reality of everyday life is “organised around the ‘here’ of my body and the ‘now’ of my present” (Berger & Luckmann, 1991, p. 36), these being the spatial and temporal components originating from the thoughts and actions through the various experiences. Sociologists take reality as the object of analysis. Although students may perceive learning differently, their perceptions form an important component of the reality of their learning. Thus, gathering data on student perceptions of their learning is an important consideration in research on student learning. Due to the temporal nature and subjectivity of learning experiences, data for this study was collected using student self-reports, repeatedly over a semester.

Although lecture may be seen as a learning system whereby students sit in rows facing the lecturer deliberating on the lecture content, there are many things that may be happening. Apart from expounding on the contents, the lecturer may use short questions and answers techniques to attract student attention, or conduct short learning activities. Due to different prior learning experiences, students may not perceive the learning activities as planned by the lecturer (e.g., Bell, Crust, Shannon & Swan, 1993; Shimizu, 2002). In a calculator investigation activity conducted by Bell, Crust, Shannon and Swan (1993), only two of the 104 pupils recognised the major intended purpose of the activity. Shimizu (2002) found that the structure of lessons around a “yamaba” (climax in lesson) by the Japanese teachers were perceived differently, or not perceived at all by the students. In this study, data on student learning experiences were captured on the activities that they were engaged in, their perceptions of the purposes of these activities, their feelings and motivation while engaged in the activity.

RESEARCH QUESTIONS

1. What type of engineering mathematics lecture events did polytechnic students pay attention to?
2. Was there a match between lecturer’s perceptions and students’ perceptions of the engineering mathematics lecture events?
3. What were students’ perceptions of the purpose of the lecture activities?
4. What were the effects of students’ experiences of lecture events on their feelings and motivation?

THE STUDY

The participants were 235 Year 2 Engineering students from two diploma courses at Singapore Polytechnic (SP). They were grouped into four lecture groups and taught by three lecturers, one of whom took two lecture groups. SP is one of the five non-university tertiary institutions in Singapore, catering to the 35th to 75th percentile of the yearly cohort of post-secondary schooling (Law, 2007).

The instrument was a 12-question checklist, administered at specific pauses during lectures and tutorials. Question 1 consisted of 8 bipolar 6-point semantic differential adjectives (Peterson and Miller, 2004) to assess students’ feelings during the lectures. Question 2 asked about the main activity engaged in by the students. Question 3 asked about students’ perceptions of the purpose of the activity, and students could choose up to three purposes. Ideas for the items on purposes of the activity were derived from Bell, Curst, Shannon and Swan (1993). Questions 4 to 10 assessed students’ perceptions of the motivation felt through the activity: its importance, challenge, the amount of learning, confidence gained, ability to concentrate, ability to cope, and pace of learning. 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, at least one from each class. Their interviews were audio-taped and transcribed. The qualitative data will not be discussed here.

Data were collected online, from May to September 2007, on all components involved in the learning of engineering mathematics – lecture, tutorial, self-study, e-learning, problem-based learning assignment and assessments (quizzes, test and examination). The online data collection of this study tapped on the fact that ownership of laptop was compulsory for all students in both courses. However, the response rate was not good, especially for tutorials, self-study and during preparation for the examination. Many students did not bring their laptops for tutorial lessons, and did not switch on their laptops while studying. Students also encountered difficulties with online connection, both in- and out-of campus. This paper focused on the lecture learning experiences.

RESULTS AND DISCUSSION

Types of Reported Lecture Activities

Table 1 shows the frequencies, and corresponding percentages (based on total responses submitted), of reported lecture activities, collected from the students and their lecturers over 9 weeks of lectures. There were 13 choices of lecture activities in the questionnaire, with an option for "others", of which respondents were to specify the activities. Students submitted three in-situ reflections within a 2-hour lecture, upon initiation by the lecturer, at least 30 minutes between any two reflections. The lecturers submitted their perceptions of the activity that they expected most of their students to have chosen. On-task activities were activities during lecturer-led didactic instructions. The total of 3881 reported activities from the 27 in-class reflections by the 235 participants consisted 64.3% of total expected responses.

Table 1
Reported lecture activities by students and lecturers

Lecture activities	Students	%	Lecturers	%
On-task				
Listening to lecturer's explanation.	2167	55.8	58	58.6
Taking / copying notes.	357	9.2	15	15.2
Working on what the lecturer asked us to do.	337	8.7	5	5.1
Taking part in questions and answers.	108	2.8	2	2.0
		76.5		80.9
Other tasks				
Waiting to clear my doubt with someone.	126	3.2	0	0.0
Discussing mathematics with my friends.	79	2.0	1	1.0
Solving mathematics problems on my own.	79	2.0	1	1.0
Reading or looking up information in the mathematics handout.	27	0.7	0	0.0
Talking to my friends about other things.	216	5.6	6	6.1
Gaming/ browsing internet on laptop.	110	2.8	1	1.0
Day dreaming/ just looking around.	95	2.4	1	1.0
Planning activities after class.	73	1.9	0	0.0
Reading/sending SMS.	34	0.9	0	0.0
Others	73	1.9	9	9.1
		23.5		19.2
Total	3881	100	99	100

Amongst the students, the activity most frequently reported was listening to lecturer's explanation (55.8%, see Table 1). In commonly practised structure of lectures (Alsina, 2001; Bligh, 2000; Saroyan & Snell, 1997), students are expected to sit in rows, in a lecture theatre listening to the lecturer. If this was the case, 55.8% would then be too low a percentage because there was another 44.2% who did not report that they were listening to the lecturer's explanation. The next two frequently reported lecture activities, with significantly lower frequencies (see Table 1), were: taking or copying notes, and working on what the lecturer asked them to do. Although not a large percentage, some students reported taking part in questions and answers. With 55.8% of respondents reporting to be listening, 9.2% taking or copying notes, 8.7% working on what the lecturers asked them to do, and 2.8% taking part in questions and answers, these percentages made up to a majority of 76.5% of respondents who reported to be following the progress of didactic instructions in lectures; listening, taking or copying notes, working according to lecturer's instructions, and taking part in questions and answers. Thus, apart from just mere listening, there were some writing activities and whole class discussions in the lectures. The various off-task activities were quite minimal and were not disruptive to the lectures. The highest occurrence was talking to friends about other things and could have been controlled since it was similarly reported by the lecturers.

Comparing the percentages of students' and lecturers' responses, there were close matches on listening to lecturer's explanation (55.8% and 58.6%, respectively) and taking part in questions and answers (2.8% and 2.0%, respectively). Although there seemed to be mismatches between students' responses and lecturers' expectation for taking or copying notes (lecturer's expectation was 6.0% higher than reported by students), this activity might be construed by students as working on what the lecturer asked them to do. Combining the percentages to these two activities gave close matches between students' responses and lecturers' expectation (17.9% and 20.3%, respectively). This result supported Bell, Curst, Shannon and Swan (1993) who reported close match on students' perceptions and the teacher's perception on closed tasks. These on-task lecture activities – listening, taking or copying notes, working as told by the lecturer and taking part in whole class questions and answers – were closed tasks.

Although there are many criticisms, there are many who vouch for lectures as an effective and economical way to teach a large group (e.g., Bligh, 2000; Saroyan and Snell, 1997). It was reported earlier in this paper that Saroyan and Snell (1997) found that lectures can be effective when appropriately suited to the intended learning outcomes and were pedagogically planned and delivered. The Year 2 Engineering Mathematics students in this study reported being engaged in closed tasks: didactic instructions that met student expectations and format of learning that they were familiar with. Due to minimal disruptions from students, the lecturers were able to deliver the lessons as planned.

Purposes of Lecture Activities

Question 3 asked about students' perceptions of the purposes of the lecture activity. The lecturers submitted their perceptions of the purpose of the activity chosen by most of their students. Table 2 shows the frequencies, and corresponding percentages (based on total responses submitted) of the purposes reported by the students and lecturers. Since there might be more than a perceived purpose for each activity, respondents could choose up to three purposes, thus there was a total of 6154 reported purposes for the 3881 reported activities (Table 1) from students, and 217 reported purposes for the 99 reported activities from lecturers. The most commonly reported purposes amongst the students were revising mathematical concepts taught (28.3%), learn new mathematical skills or concepts (18%), think or reason better in mathematics (16.5%), and write better in mathematics (11.6%).

Some respondents reported on enjoying learning mathematics (8%) as a purpose of the lecture activity. Less than 10% of respondents reported on application of mathematics as a purpose of the lecture activity: applying mathematics to daily life or workplace (5%) and applying mathematics to other modules (4.8%). The order of frequency of reported purposes by the lecturers matched that of the students for revising mathematical concepts, learn new mathematical skills, and think or reason better in mathematics.

Table 2

Purposes of lecture activities as perceived by students and lecturers

Purpose	Students	%	Lecturers	%
1 – Revise mathematical concepts taught.	1740	28.3	43	19.8
6 – Learn new mathematical skills or concepts.	1107	18.0	42	19.4
2 – Think or reason better in mathematics.	1013	16.5	33	15.2
3 – Write better in mathematics.	713	11.6	22	10.1
7 – Enjoy learning engineering mathematics.	495	8.0	28	12.9
8 – Apply mathematics to daily life or workplace.	308	5.0	23	10.6
4 – Apply mathematics to other modules.	295	4.8	2	0.9
9 – Relate different mathematical concepts.	221	3.6	12	5.5
5 – Learn how to use technologies in mathematics e.g., mathematics software, calculator, applets.	133	2.2	7	3.2
10 – Others (please specify):	129	2.1	5	2.3
Total	6154	100	217	100

Table 3

Students' perceived purposes of the respective lecture activities, in percentages

Purpose	Activity													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1–revise	35.8	25.9	22.2	17.4	16.2	15.8	26.8	13.9	6.9	14.2	8.4	7.3	12.0	15.2
2–reason	17.5	20.7	19.0	20.5	21.8	15.8	19.5	4.9	8.6	10.6	2.1	4.9	8.3	9.5
3–write	11.5	13.9	14.6	16.4	14.8	18.8	9.8	5.9	8.0	7.8	7.4	9.8	5.3	1.9
4–apply	3.6	3.8	6.3	12.3	12.7	16.5	12.2	3.8	5.1	4.3	5.3	2.4	5.3	2.9
5–IT	1.3	3.2	3.2	2.6	5.6	3.8	2.4	2.4	4.0	4.3	4.2	4.9	3.0	1.0
6–new	19.1	16.2	16.1	9.7	13.4	9.0	14.6	28.6	21.7	15.6	15.8	17.1	14.3	10.5
7–enjoy	5.9	7.7	9.1	6.7	3.5	9.0	9.8	14.3	21.7	17.7	22.1	17.1	11.3	10.5
8–daily	2.7	4.5	6.3	6.2	7.7	6.8	2.4	12.5	14.3	7.8	21.1	17.1	11.3	3.8
9–relate	1.9	2.8	2.6	8.2	3.5	4.5	2.4	7.7	8.6	9.9	12.6	12.2	11.3	10.5
10–others	0.7	1.3	0.5	0.0	0.7	0.0	0.0	5.9	1.1	7.8	1.1	7.3	18.0	34.3
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Activity

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

For the students, the extent to which the reported purposes were related to the types of lecture activity is summarised in Table 3, in percentages of the total number of purposes reported for each activity throughout the semester. The underlined numbers are the highest percentage of reported purpose for each activity, other than "others". For the first three lecture activities (three of four didactic lecture on-task activities), most students reported revising mathematical concepts as the purpose. However, more students reported that they were thinking and reasoning better as compared to revising mathematical concepts while they were taking part in questions and answers. Many mathematics researchers (e.g., Sfard, 2006) believe in thinking as a form of communication. Sfard (2006) used the term “participationist” versus “acquisitionist” (p.153), and illustrated how learners attempted to make sense of other people’s thoughts through participation in interpersonal communication. The lecturers could plan for more opportunities for students to take part in questions and answers.

Students who reported being on other tasks showed greater variations in reporting their perceptions of the purposes of these tasks. Nearly 20% of students who reported solving mathematics on their own reported that they were writing better in mathematics. Amongst students who reported to be talking to friends about other things, and students waiting to clear their doubts, many reported to be learning new mathematical skills as the purpose. There might be a possibility that these students were quicker students, and had either proceeded to solving mathematics on their own or were waiting to clear some thoughts and doubts that arose while learning new mathematical skills. These interpretations need to be ascertained after further data analysis of the interview transcripts.

Feeling and Motivation during Lecture Activities

Table 4 shows the feeling and motivation felt while students were on the various types of lecture activities. The grand means of the 8 bipolar semantic differential adjectives for feeling (question 1: sad-happy, lonely-sociable, drowsy-alert, passive-active, confused-clear, bored-interested, not enjoyable-enjoyable, not engaged-engaged) and motivation (questions 4 to 10: importance, challenge, amount of learning, confidence gained, ability to concentrate, ability to cope, and pace of learning) were obtained by taking the average of all responses from all respondents.

Table 4

Student mean feeling and motivation while engaged in the respective lecture activities

	Activity													
	4	1	2	3	6	7	5	14	9	8	10	11	12	13
Feeling	4.11	4.06	4.06	3.98	3.98	3.94	3.90	3.81	3.64	3.60	3.53	3.53	3.40	3.21
Motivation	4.56	4.52	4.46	4.38	4.54	4.20	4.30	4.00	4.02	3.96	3.79	3.79	3.45	3.51

Activity

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

The 6-point scale for the 8 bipolar semantic differential adjectives, for example sad–happy, was 1 (very), 2 (quite), 3 (somewhat), 4 (somewhat), 5 (quite), 6 (very) i.e., very sad, quite sad, somewhat sad, somewhat happy, quite happy, and very happy, respectively. Students scored most positively for their feelings while they were taking part in questions and answers. Students also scored positively while they were listening to lecturer’s explanation, and while working on what the lecturer asked them to do. Taking 3.5 as the mid-value between somewhat positive and somewhat negative, students were somewhat positive for other activities but not when they were gaming or browsing the internet (mean = 3.53, near mid-value), planning for activities after class (mean = 3.53), reading or sending SMS (mean = 3.40), and when they were day dreaming or just looking around (mean = 3.21). This might be an indication that students who resorted to off-task activities were not feeling positive about the lectures.

The 6-point scale for the motivation items was: 1 = Strongly disagree; 2 = Disagree; 3 = Slightly disagree; 4 = Slightly agree; 5 = Agree; 6 = Strongly agree. Taking 3.5 as the mid-value between slightly disagree and slightly agree, students agreed to the motivation items, for all the lecture activities except when they were reading or sending SMS, and when they were day dreaming or just looking around. They agreed that the lecture activities of their engineering mathematics lessons were important, challenged their thinking, helped them learn a lot, raised their confidence, helped them concentrate, had enough mathematic to cope, and that the pace of the lecture was suitable. Just as they were feeling less positive (mean ranging from 3.21 to 3.53) when they were on off-task activities, the mean score (ranging from 3.45 to 3.79) for the motivation items were on the lower range of slightly agree.

CONCLUDING REMARKS

This paper reported on students' and lecturers' perceptions of the various activities engaged by the students during lectures. Students and lecturers in this study matched to nearly 80% on their respective responses to the closed lecturer-led activities: listening, taking or copying notes, working according to lecturer's instruction, and taking part in questions and answers. The purposes, the feelings and the motivation felt by students during these various activities were also reported. Since lecture-tutorial system remains a widely used method in institutions of higher learning, optimising its effectiveness is important. The empirical data of this study shows that students who took part in questions and answers reported that they were thinking or reasoning better in mathematics, their feeling were most positive, and they agreed to the motivation items. One possible consideration arising from this result is to increase the frequency and duration of questions and answers opportunities for students during lecture. More research studies could be conducted to study the impacts of more opportunities for whole class discussions during lectures.

The in-class reflection technique, based on Csikszentmihalyi's (1997) idea of experience sampling, has shown to be a feasible data collection technique of students' and lecturers' perceptions of the same lesson events. These perceptions of the types of lecture activities, the purposes, feelings and motivation felt provided researchers with a picture of the "reality" in a lecture learning environment. As the data collected were massive, data analysis is still going on when writing this paper. Analysis of the data collected during tutorial lessons will provide a complete picture of the lecture-tutorial system. In addition, data collected while students were engaged in other components of this engineering mathematics module (self-study, e-learning, problem-based learning assignment and assessments) will provide a comprehensive picture of students' day-to-day learning experiences of engineering mathematics in a semester.

Wong and Ee (2006) suggested fine-tuning the in-class reflection technique. One particular area of concern was the loss of curriculum time taken up by data collection. In this research study, online submission was implemented in place of paper-and-pen data collection. There was no mention of loss of curriculum time by students and lecturers. However, there was "loss" of data from participants who did not bring their laptops and also from participants who encountered connection problem. An alternative could be the provision of the flexibility of paper-and-pen submission for these participants. Further research and development work is required to fine-tune this technique, either by conventional paper-and-pen or by electronic means.

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