Student Perspectives on Summer School versus Term-Time for Undergraduate Mathematics

George Papadopoulos[a], David Easdown[a]

[a]School of Mathematics and Statistics, The University of Sydney, Sydney NSW 2006, Australia

Keywords: tertiary mathematics education, summer school, term-time, learning, thematic analysis, grounded theory, phenomenography, surveys, mixed methods, presage-process-product (3P) model

Abstract

In earlier studies, firstly in 2009, and then more recently in 2019, researchers at the University of Sydney presented quantitative evidence supporting the claim that students undertaking particular first year mathematics units of study, in particular years, achieve superior learning outcomes by completing units at summer school rather than during term-time. In the present mixed-methods analysis, we expand the scope of these earlier investigations by surveying students taking any undergraduate mathematics units of study offered at the Sydney Summer School over the period 2009 to 2016. These surveys invite responses to thirty-six questions, probing a range of topics and issues relating to their learning, study methods and approaches to assessments, both at the Summer School and in term-time. Thirty of these questions require numerical Likert responses, and all questions provide opportunities for open-ended comments. The numerical data, derived from 181 survey respondents, is presented visually in the form of histograms, and suggests, for this cohort of students, that the learning environment is overwhelmingly in favour of the summer school mode compared with term-time. Nevertheless, there are features of both modes that appear to be successful, so a qualitative coding analysis is applied to over one thousand open-ended comments, to tease out or distil the most important factors that influence the quality and depth or learning and course satisfaction for this cohort in either mode. This leads to a table of categories with descriptors and key words. Relationships between the categories suggest an interactive flow-diagram, akin to Biggs' Presage-Process-Product (3P) model, with special emphasis on the importance of presage and temporality. It is hoped that the table and resulting flow diagram may become useful resources for educators, in helping to plan or design their courses and to elucidate the underlying dynamics of successful learning for their students.

Introduction

A preliminary study, from 2008 and 2009, examined evidence that students taking first year mathematics and statistics units at the University of Sydney had superior learning outcomes and overall course satisfaction by completing these units at Summer School rather than during the standard term-time (Easdown *et al.,* 2009). In particular, the academic histories of these students revealed significantly high median increases, over several core units, in the final mark for those that failed the corresponding unit in term-time and then attempted it again in Summer School. This phenomenon was observed and replicated in a follow up study with regard to further mathematics units in the period 2009-2014 (Easdown *el al.*, 2019). Both studies discussed possible underlying dynamics, as well as broader issues, with the intention of initiating scholarly enquiries that could investigate reasons and influences for improved performance and the success or otherwise of intensive courses in general. The second study also provided possible interpretations of its findings in the transition from superficial towards deep learning, in terms of phases in the SOLO taxonomy (Biggs & Collis, 1982), and also in terms of successful navigation through liminal space, in the theory of threshold concepts (Meyer & Land, 2005; Cousin, 2007).

Both of the above studies form part of the present authors' general response to the 'call to arms' for further research comparing intensive mode of delivery (IMD) with traditional semester or term-time modes (Daniel, 2000; Davies, 2006), and especially to address the apparent paucity of IMD research in an Australian context (Davies, 2006). Such enquiries should be encouraged: findings may have implications for giving students appropriate advice, particularly for those at risk, and for improving teaching practices and the quality of learning generally, especially in the context of accelerating demands for flexible learning and the creation of novel pathways for completion of degree programs (University of Sydney, 2016, see, in particular, Strategy 5: *Transform the learning experience*).

In the present study we expand the scope of the 2009 and 2019 investigations, by surveying students taking any undergraduate mathematics units of study offered at the Sydney Summer School over the period 2009 to 2016. These surveys invited responses to thirty-six questions (listed below in Table 1), probing a range of topics and issues relating to their learning, study methods and approaches to assessments, both at the Summer School and in term-time. Thirty of these questions required numerical Likert responses, to which we apply quantitative analysis below. All questions provided opportunities for open-ended comments. The numerical data, derived from 181 survey respondents, is presented visually in the form of histograms (Figures 3-32 below), and suggests, for this cohort of students, that the learning environment is overwhelmingly in favour of the summer school mode compared with term-time. Nevertheless, there are features of both modes that appear to be successful, so a qualitative coding analysis, using techniques from phenomenography (explained later in this introduction), is applied below to over one thousand open-ended comments, to tease out or distil the most important factors that influence the quality and depth or learning and course satisfaction for this cohort in either Summer School or term-time mode. This leads to a table of categories (Table 2 below) with descriptors and key words. Relationships between the categories suggest an interactive flow-diagram in the form of a Presage-Process-Product (3P) model (Figure 33 below), with special emphases on presage and temporality. The notion and dynamics of a 3P model are introduced and explained below.

Our 3P model is similar to the 'culturally modified' 3P model of Biggs (1996), in studying and attempting to understand the so-called 'paradox of the Chinese learner'. Watkins and Biggs (1996, 2001b) had compiled studies based on a variety of quantitative and qualitative methodologies, investigating an interesting and apparently wide-spread phenomenon, which becomes the 'paradox', in which students from countries with a Confucian Heritage Culture (CHC) were evidently learning more effectively than Western research might have predicted in large class environments that emphasised memorisation and strict or harsh socialisation practices. Our study similarly tries to understand the underlying dynamics of intensive learning environments, such as Summer School, that lead to unusually strong learning outcomes, alerted to in the 2009 and 2019 studies.

In the case of the Chinese paradox, possible and plausible solutions were suggested within the context of Confucian and related cultures and their effects on the personalities and cognitive abilities of the learners (Watkins & Biggs (1996, 2001a)). The research in a plethora of studies was based on a paradigm known as Student Approaches to Learning (SAL) (see Biggs, 1987, 1993b; Entwistle & Ramsden, 1983), focusing primarily on how students conceptualise learning. The analyses in these works used coding techniques from phenomenography, in the sense of Marton (1981) and Marton & Booth (1987), looking for qualitatively different categories, and connections between them, that underly the ways people experience or conceptualise a range of phenomena.

In our study, also, in the spirit of SAL, we focus on the student perspective. We also use coding techniques related to phenomenography, as explained in the next paragraph, to analyse the qualitative data. For general references about coding techniques, which allow factors or categories to emerge from qualitative data, including grounded theory and phenomenography, the reader is referred to Dewar *et al.* (2018), Ezzy (2002), Silverman (2014), Neumann (2011), Glaser & Strauss (1967), Bowden & Walsh (2000), Bowden & Green (2005) and Khan (2014).

The aim, in using phenomenography to code or process qualitative data, is to find similarities across perceptions of some given phenomenon (in our case, learning and teaching at Summer School and in term-time) expressed by some diverse group of individuals (in our case, students that took at least one unit of study at Summer School in the period 2009-2016). The focus of attention is on the collective characteristics of the perceptions rather than of the individuals, in order to elucidate some general, or even universal, principles (Barnacle, 2005). Phenomenography derives its strength by looking at collective human experience holistically, even though the phenomena under consideration may be perceived differently by different people and under different circumstances (Åkerlind, 2005). If the resulting analysis can then be used as a tool to constructively shape behaviour or policy of a group of educators or an institution (see, for example, Prosser, 2000; Khan 2014), then the phenomenography is referred to as *developmental* (see Bowden, 2000). The groupings that arise or emerge from the data are called *categories of description* (or simply *categories*). Interviews of subjects are probably the most common source of data in phenomenographic studies, but open-ended responses in surveys (such as in our study) are also common, and sometimes preferred for technical reasons and simplify the iterative process of developing the categories (see Åkerlind & McKenzie, 2003; Åkerlind, 2005). After the categories have been identified, the task of the researcher is to clarify any logical relationships between them (Åkerlind, 2005) and to display them, visually if possible, using some kind of table, hierarchical diagram, relations chart or network diagram (see Dewar *et al.*, 2018). In our case, we have used the dynamical systems approach of Biggs (1996b), to create a 3P diagram (explained below, culminating in Figure 33).

In our case, we followed the following procedure applied to the open-ended responses by students to our surveys:

1. Responses from students were 'cleaned' (spelling, grammar, structure, etc.) to improve legibility and neutrality, and placed into a large collective pool.
2. Responses were split into identifiable pieces or items of data, which we call *statements*.
3. Each statement was identified with a key word or theme.
4. The key words and themes were divided into a relatively large numbers of groupings.
5. The groupings were amalgamated into categories and sub-categories (leading to Table 3 below).
6. Relationships were sought between the categories and sub-categories, and a mapping made to the Presage, Process and Product phases of a 3P diagram (leading to Figure 33 below).

Most phenomenographic studies produce a relatively small number of categories. For example, Watkins and Biggs (2001b) identified six main features or categories that affect the quality of academic learning in the context of the culture of the Chinese learner. By contrast, Kember (1997) proposed five categories for studying conceptions of teaching in a Western university context. Lingbiao and Watkins (2001) develop a model of teaching conceptions by Chinese physics schoolteachers, using six categories or dimensions, overlapping with Kember's, but overlayed with a further five categories, that cut through 'orthogonally', producing a cascade of dynamic models, illustrated by flow charts, with a variety of directions of influence and feedback loops. Dahlin *et al.* (2001) undertook a phenomenographic study, based on semi-structured interviews of educators from Hong Kong and Sweden, exploring systemic relations between teachers and learners and the so-called 'backwash effect' (see Biggs, 1995, 1996a; Hargreaves, 1997; Cheng, 1998; Prosser & Trigwell, 1999; Trigwell *et al.*, 1999). Their analysis used the constant comparative method of Glaser and Strauss (1967), the originators of grounded theory, by reading and rereading the interview scripts until possible dimensions and categories of conceptions emerged (and see also Ng *et al.*, 2001, from a more linguistic point of view). They identified six dimensions in total, with a group of four dimensions 'orthogonal' to a group of two dimensions, culminating in a tentative dynamic relationship, which they represent diagrammatically. Tang (2001), also using a phenomenographic approach to investigate the Chinese paradox, conducted mixed-methods research, combining quantitative and qualitative data to investigate the relationships between conceptions of learning and teaching, producing six categories for each of learning and teaching, and then explored relationships between them. In our study, which is also mixed-methods research, after a large number of iterations in the procedure outlined above, we produced seven categories and several associated sub-categories (see Table 3 below).

Biggs (1993a) argues that the classroom is an ecosystem, in which all of the components have the capacity to influence each other. The classroom may be a component of a larger system, such as a school or institution, which, in turn, may be a component of even larger systems, such as the community and the broader culture. These systems produce complex multilayered equilibria, leading to 'pedagogical flows' that may be characteristics of a particular mode of teaching and learning. Many authors have investigated this as a cultural or geographical phenomenon (see Schmidt (1996); Stigler & Hiebert (1999); Mok *et al.* (2001); Biggs & Watkins, 2001), noticing relative uniformity within cultures, such as in Japan, the United States, Germany and CHC countries, compared with vast differences between cultures. Biggs and Watkins (2001), for example, observe that Japanese schools have a natural mechanism, known as *kounaikenshuu,* for enhancing the quality of learning, involving observation, analysis and refinement, and that similar reflective mechanisms also exist in Chinese schools. They argue that the Chinese paradox might be explained by noting that in the West, focus on presage factors tend to be in isolation rather than viewed as part of a holistic and integrated cultural system. Biggs and Watkins refer to three levels in teacher thinking: at the lowest, least effective, level, teaching is merely exposition and any differences in learning outcomes are dependent on the personal qualities, talents and attributes of the student. At the next, intermediate, level, teachers think about their own presentation skills, and the emphasis is on their own performance, disregarding whether this actually results in improved student learning. At the highest level, teachers encourage students to engage in appropriate learning activities, in which all aspects of the teaching/learning context interact, including design, delivery and assessment of learning. The focus at this third highest level is on creating an integrated and holistic system. We believe that there is a compelling case, in our study also, to claim that there are distinctive features of Summer School, sharing certain aspects with term-time, that lead to a vibrant and successful culture of learning, operating at this highest integrated level.

Biggs (1993a) formalises and abstracts relationships between the learning and teaching contexts, student learning processes and outcomes using his so-called Presage-Process-Product (3P) model, which is a refinement of models of teaching introduced by Dunkin and Biddle (1974), depicted in Figure 1 below (taken from Biggs, 1996b). The intention of the model is to capture useful relationships between characteristics or predispositions of the learner and the learning context (Presage), the activity of learning and interactions with the teaching (Process), and the outcomes of the learning (Product). As well as the appearance of a general flow from left to right, components may interact with each other dynamically. At the far left there are two interacting sets of Presage factors, for the student and teacher respectively. In the middle, there are Process factors relating to approaches to teaching and learning and how they might be adopted or facilitated. At the far right, the Product factors relate to learning outcomes, whose nature may be of varying quantity, quality and depth. However, the pathway for a student need not be simply linear, from left to right; rather, the students' experiences exist within an interactive dynamic system with feedback, possibly leading to some kind of equilibrium. Changing or modifying any one component of the system may propagate effects throughout the system, leading to different equilibria. Some systems may lead to equilibria that promote surface approaches to learning, with poorer outcomes, whilst others may promote deep approaches to learning, with higher quality outcomes.

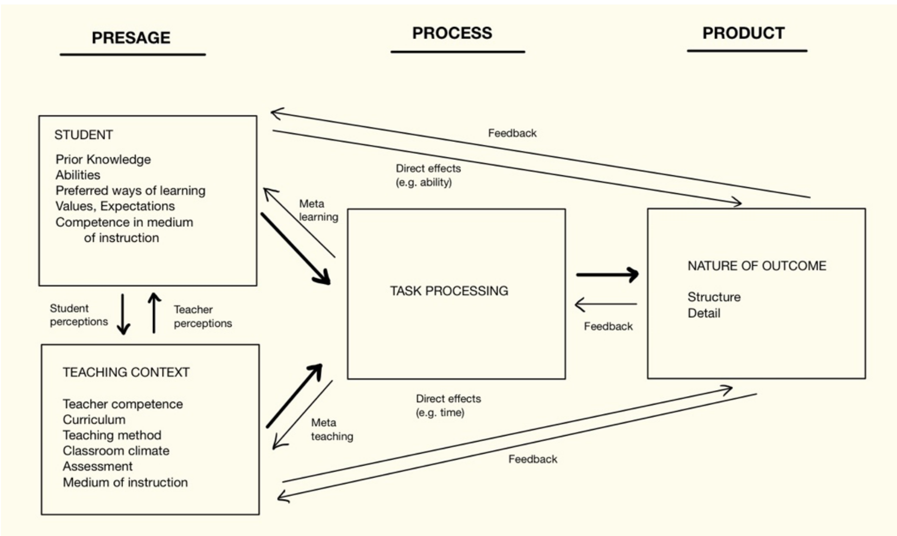


Figure 1. The Biggs 3P Model of Teaching and Learning.

Biggs (1996b), in trying to understand and explain the so-called Chinese paradox, develops a modified 3P model. In the case of students from CHC countries, such as China, Taiwan, Singapore, Hong Kong, Japan and Korea, Biggs believes that the cultural context is of fundamental importance, and he incorporates this in his so-called culturally modified 3P model (reproduced below as Figure 2). Salili (2001) also argues that culture and context of learning have a profound impact on students' motivation to learn and on the interactions and reciprocal effects, such as feedback loops, between students and their teachers (see also Pintrich & Schunk, 1996). Another variation of synthesis along these lines is given by

Cortazzi and Lixian (2001), who suggest a tentative model for influential features in interaction in large classes in China, based on the premise that learning is fundamentally cultural, and expectations, values, beliefs and behaviours may vary across cultural groups. Their model, however, is teacher focused and has a general flow, with the ideological background and culture as the starting point, and quality learning outcomes as the finishing point, with some scope for dynamic interaction.

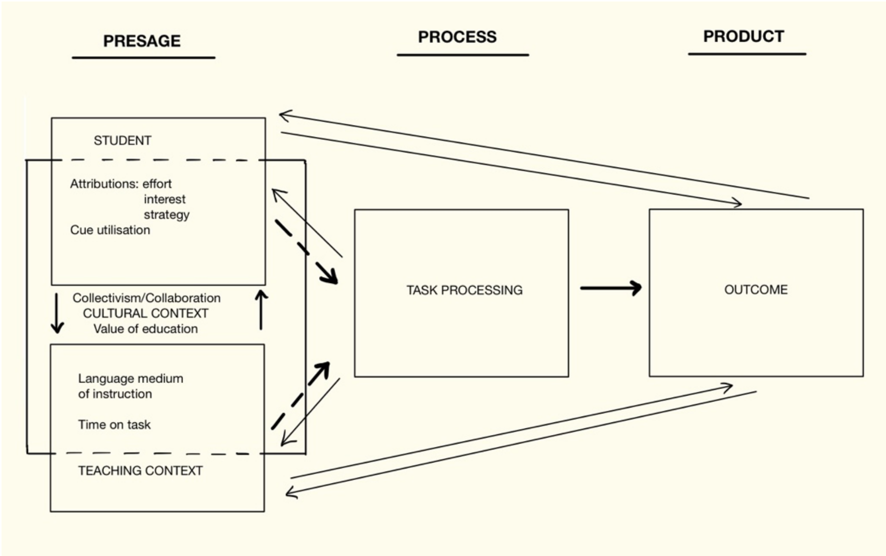


Figure 2. The Biggs 'culturally modified' 3P Model in the context of CHC learning.

The remainder of the paper is organised as follows: we

- set the scene by providing context and establishing terminology that is used throughout the paper.
- include a summary of related work of the authors and the scope of the present work.
- describe our methodology and surveys that underpin the data collection and provide a complete list of survey questions (Table 1).
- provide a quantitative analysis applied to 30 closed Likert questions, including histograms, means and medians (Figures 3-32).
- provide a qualitative analysis, using a phenomenographic coding technique, applied to open-ended responses to all 36 survey questions, including a table of categories (Table 3), which is then synthesised to produce a Presage-Process-Product 3P diagram (Figure 33).
- provide an extensive discussion with respect to the quantitative and qualitative data analyses respectively.
- finish with conclusions and suggest scope for further research.

Background and terminology

The intensive program, with 24 hours of lectures and 12 hours of tutorials spanning over six weeks in January and February, will be referred to as *Summer Schoo*l (advertised by The University of Sydney as "The Sydney Summer School"), and acts as a third or alternative 'semester', albeit highly contracted. The two other 'regular' semesters will be referred to collectively as *term-time*; they each have 26 hours of lectures and 12 or 13 hours of tutorials, spanning 13 weeks. Semester One, running from early March to June, and Semester Two, running from late July to November, are often referred to as the autumn and spring semesters respectively. Both term-time semesters contain two one-week study breaks: one mid-semester, and one at the end of the semester between the end of lectures and the beginning of the exam period. It is important to note that such relatively long breaks do not feature in Summer School due to time constraints.

Throughout 2009-2016, the period to which the research refers, there were nine term-time mathematics units of study offered at Summer School. As formally offered by the University of Sydney, these units were practically identical to their term-time counterparts, with at most minor changes and tweaks that may be incorporated by administrators and instructors, to facilitate and optimise teaching and scheduling of assessment tasks in the intensive delivery mode. The units offered at Summer School fall within the following levels:

- Year level – mathematics units of study are designed to be taken in succession in subsequent corresponding years of the student's candidature (though exceptions occur). In this study we only consider first- and second-year units of study.
- Stream level – there are two:
  - Fundamental – designed for students who do not intend to take mathematics beyond first year, featuring more applications in the biological and social sciences. The assumed knowledge for these units is HSC Mathematics (*without* Extension 1) in New South Wales, Australia (or equivalent).
  - Mainstream – designed for students who intend to take mathematics beyond first year (including engineering and mathematics majors), featuring many physical sciences applications as well as abstract or pure mathematics. The assumed knowledge for the first-year units in this stream is HSC Mathematics *with* Extension 1 in New South Wales, Australia (or equivalent).

With these in place, we can categorise the nine mathematics units of study offered at Summer School:

- two first year fundamental-level units,
- five first year mainstream-level units, and
- two second year mainstream-level units.

It should be noted that first and second year *advanced* units of study offered in term-time were not available at Summer School. Advanced units of study are typically taken by highly talented or gifted students, who might be contemplating pathways towards Honours or postgraduate research degrees in mathematics. Though there was nothing to prevent them from enrolling in Summer School, and sometimes they did, such high achieving students were not typically represented within the cohort of students targeted in this study.

Summary of previous work and scope of present work

The 2009 study (Easdown *et al.*, 2009) focused on four first year mainstream-level mathematics units of study, and analysis was both quantitative and qualitative. Quantitative analysis involved two parts: first, analysis of the differences in the students' final marks between subsequent attempts in Summer School following a failure in the identical unit in term-time, followed by Likert scores on closed-ended Unit of Study Evaluation (USE) survey questions. The qualitative aspect involved a brief categorisation and discussion of open-ended comments, especially regarding student attitudes. The 2019 study (Easdown *et al.*, 2019) focused on two first year fundamental-level mathematics units of study, extending the quantitative analysis performed in the 2009 study (namely, that of the differences in final marks).

The primary purpose of this present work is to extend upon the scopes of the 2009 and 2019 studies in three ways:

- The 2019 work focused solely on quantitative analysis of numerical marks in order to ascertain differences between Summer School and term-time education. This present work takes an approach similar to the analyses of the student surveys in the 2009 study; however, we add a comprehensive coding analysis, using techniques from phenomenography, to produce a table of categories (Table 2 below) and a 3P diagram (Figure 33 below). Quantitative data comes from Likert scores from closed-ended questions, and qualitative data from written responses left by the students in open-ended questions (or comment boxes within the closed-ended questions).
- Student cohorts from which data was collected in the previous studies were limited in various ways. The 2009 study focused on four first year mainstream-level units of study in a single year (2008), whilst the 2019 study focused on two first year fundamental-level units across several years (2007-2014). This present study analyses data from students who had undertaken *any* Summer School mathematics unit of study in the years 2009-2016.
- Finally, both previous studies focused only upon students that had failed in term-time and repeated an identical unit in either Summer School (2009 study) or either mode (2019 study). This present work extends the student sample to include all students that had undertaken Summer School mathematics units, regardless of whether or not they had failed a mathematics unit in term-time previously.

Methodology

Data collection

All data was collected using SurveyMonkey, an online electronic survey and analysis platform. Invitation emails were sent out to students who had participated in Summer School over the years spanning 2004 to 2016. However, response data was only[1] received from 2009 mathematics Summer School alumni onwards. Though the response rate was only 7.4%, we received 181 responses, of which 33 were partial or incomplete.

Survey design

The survey included thirty questions using a five-point Likert scale, with the opportunity to also provide open-ended responses or comments, and six further questions, which were purely open-ended. The Likert questions had options of two types:

- Type 1 (25 questions) – Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree. These were asked twice per question: once for each of Summer School and term-time.
- Type 2 (5 questions) – Term-time (by a large margin), Term-time (by a small margin), Indifferent, Summer School (by a small margin), Summer School (by a large margin).

Some of the Type 1 questions, which relied on unit of study context, had a N/A (Not Applicable) option. Below, in Table 1, we list these thirty-six questions and colour-code them as follows: Likert Type 1: Orange, Likert Type 2: Blue, and Open-ended: Green.

[1] There was, however, one response from a student who had initially participated in Summer School in 2007. This student had continued to enrol in mathematics Summer School units much later, in both 2014 and 2015. Thus, for simplicity, we classify this student as a 2014 alumnus.

Table 1 – the 36 research questions categorised according to their type and structure.

1.1. Overall I was satisfied with the quality of teaching by the teacher(s).
1.2. The work had been intellectually rewarding.
1.3. I developed relevant critical and analytical thinking skills.
1.4. I had good access to valuable learning resources.
1.5. The assessment tasks challenged me to learn.
1.6. I had been guided by helpful feedback on my learning.
1.7. Tutorials helped me to learn.
1.8. Staff were responsive to students.
1.9. Learning outcomes were clear to me.
1.10. The lecturers were effective in facilitating my learning.
1.11. The tutors were effective in facilitating my learning.
1.12. The unit of study materials were effective in facilitating my learning.
1.13. The exams were effective in testing my knowledge, understanding and aptitude.
1.14. The quizzes were effective in testing my knowledge, understanding and aptitude.
1.15. The assignments were effective in testing my knowledge, understanding and aptitude.
1.16. The homework was effective in testing my knowledge, understanding and aptitude.
1.17. The feedback in relation to assessment tasks was timely and of high quality.
1.18. I was personally motivated to pass or do well.
1.19. The pace was beneficial in facilitating my learning.
1.20. The timing was beneficial in facilitating my learning.
1.21. The lecture class sizes were appropriate for facilitating my learning.
1.22. The tutorial class sizes were appropriate for facilitating my learning.
1.23. I was able to focus on study without distraction.
1.24. Social context and interaction within/during scheduled classes were beneficial in facilitating my learning.
1.25. Social context and interaction outside/external to timetabled classes was beneficial in facilitating my learning.
2.1. Which mode of delivery did you find provided you with more enjoyment and satisfaction?
2.2. Which mode of delivery did you find provided you with better value for money, in terms of fees and your own resources?
2.3. Which mode of delivery did you find provided you with superior educational and learning outcomes?
2.4. Which mode of delivery did you find provided you with better compatibility with your own personal style of learning?
2.5. Which mode of delivery did you find provided you with units of study that were overall easier?
3.1. What were the reasons that you chose to enrol in mathematics units of study held during Summer School?
3.2. What were the best aspects of Summer School?
3.3. What were the best aspects of term-time?
3.4. What aspects of Summer School most need(ed) improvement?
3.5. What aspects of term-time most need(ed) improvement?
3.6. Do you have any additional comments that you would like to add to the Summer School versus term-time debate in general?

Results and analysis

The data were exported from SurveyMonkey to a Microsoft Excel spreadsheet. Excel and Wolfram Mathematica were used to perform both quantitative and qualitative analyses.

Quantitative data analysis

The Likert responses were collated into five possibilities for each question for both Summer School and term-time. Numerical values were assigned in a standard way:

Table 2 – Numerical values assigned for the Likert categories.

Response		Score
Strongly Disagree	Term-Time (by a large margin)	-2
Disagree	Term-Time (by a small margin)	-1
Neutral	Indifferent	0
Agree	Summer School (by a small margin)	1
Strongly Agree	Summer School (by a large margin)	2

Histograms, means and medians were produced from the data, and statistical tests of significance (for Summer School versus term-time) were performed. The closed-ended questions (see Table 1) may be grouped as follows, corresponding to the eleven subsections below:

- Instruction (questions 1.1, 1.6, 1.8, 1.10, 1.11, 1.17)
- Learning (questions 1.3, 1.9, 1.23, 2.3, 2.4)
- Classes (questions 1.7, 1.21, 1.22)
- Motivation (question 1.18)
- Pace and Timing (questions 1.19, 1.20)
- Enjoyment (questions 1.2, 2.1)
- Resources (questions 1.4, 1.12)
- Assessment (questions 1.5, 1.13, 1.14, 1.15, 1.16)
- Easiness (question 2.5)
- Social (questions 1.24, 1.25)
- Value (question 2.2)

For each subsection, we present the quantitative data calculated from the Likert scores using the histograms, means, medians and *p*-values. We also include some examples of student comments from relevant open-ended sections that might provide some insight or help to inform the data. The histograms representing the Likert Type 1 data (questions 1.1-1.25 in Table 1) have bars measuring the frequencies of the categories in order from left to right. The legend is:

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

Furthermore, N/A responses were removed from four of the Likert Type 1 questions. The sign test was used to test the statistical significance of the median values, against the alternative hypothesis that the Summer School median is greater than the term-time median in the closed-ended questions. There is a slightly different test for questions 2.1-2.5: instead, we test against the alternative hypothesis that the median is greater than zero, in favour of Summer School over term-time.

Instruction

The p-values for all questions in this category are less than 10^{-15}.

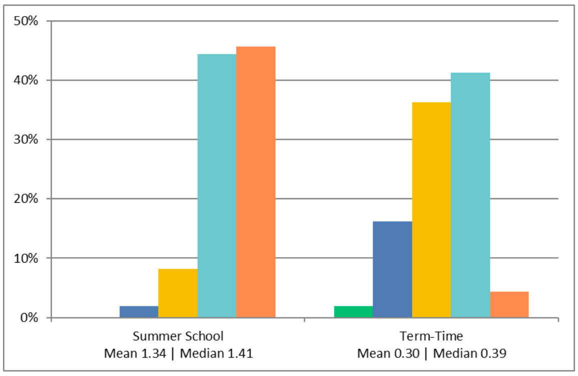


Figure 3 – Overall I was satisfied with the quality of teaching by the teacher(s).

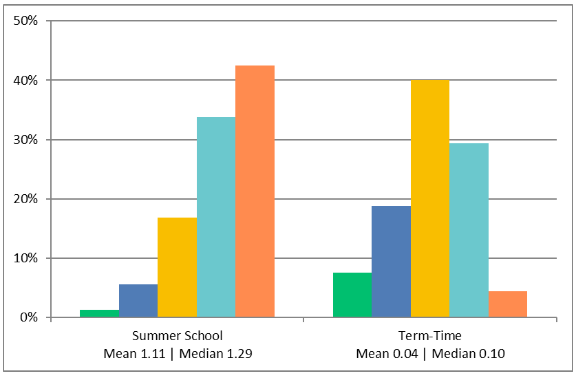


Figure 4 – I had been guided by helpful feedback on my learning.

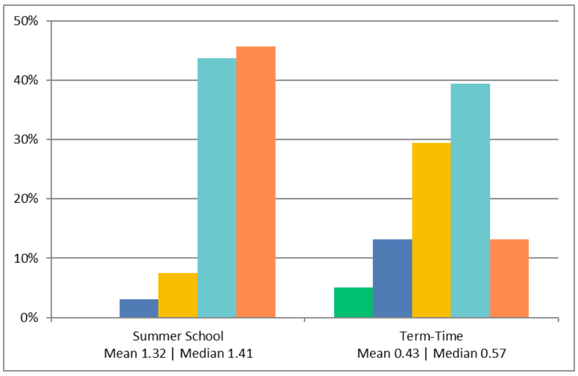


Figure 5 – Staff were responsive to students.

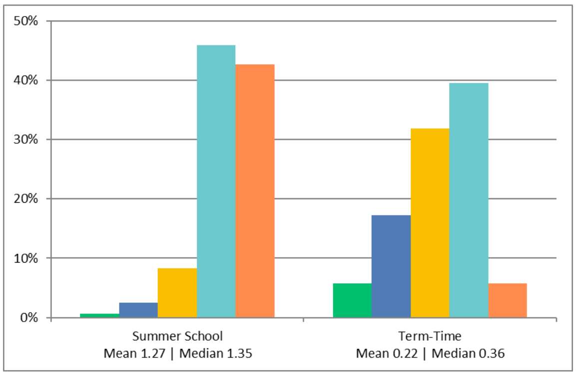


Figure 6 – The lecturers were effective in facilitating my learning.

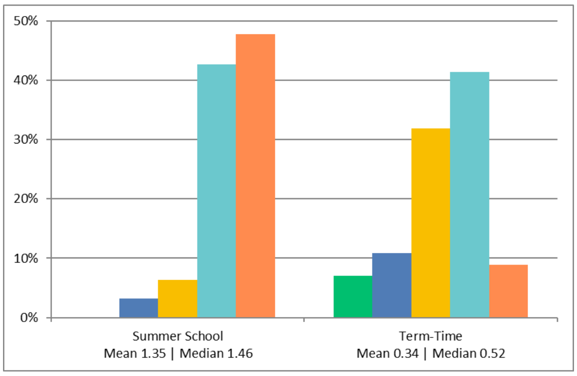


Figure 7 – The tutors were effective in facilitating my learning.

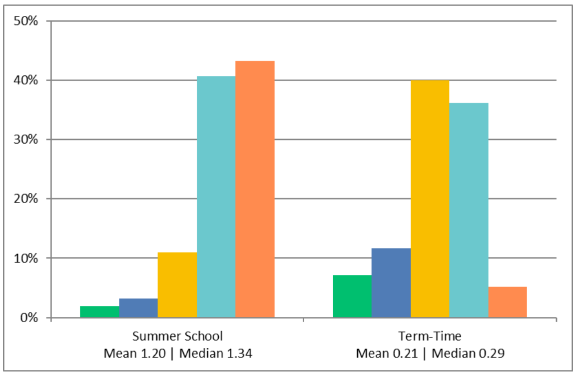


Figure 8 – The feedback in relation to assessment tasks was timely and of high quality.

"Teachers in [Summer School] were more likely to engage with us on an individual and personal basis, remembering the mistakes made in previous weeks, having a good idea of individual student level."

Learning

The p-values for all questions in this category are less than 10^{-12}.

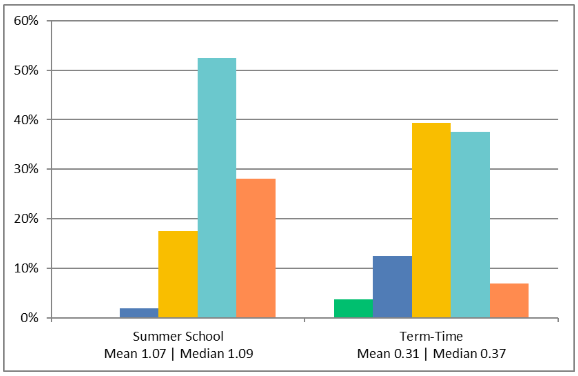


Figure 9 – I developed relevant critical and analytical thinking skills.

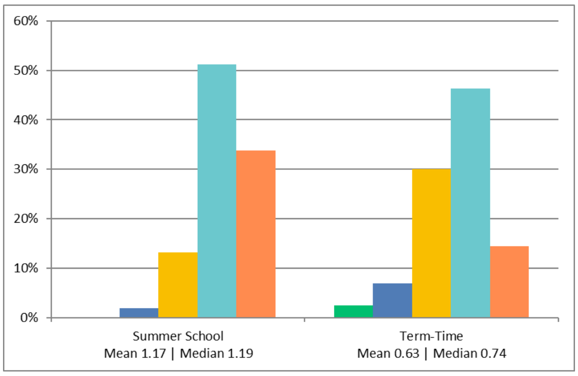


Figure 10 – Learning outcomes were clear to me.

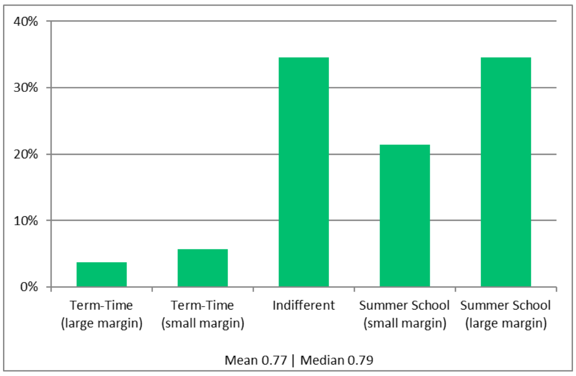


Figure 11 – Which mode of delivery did you find provided you with superior educational and learning outcomes?

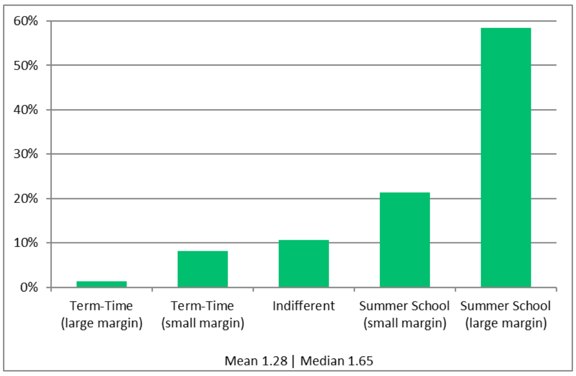


Figure 12 – Which mode of delivery did you find provided you with better compatibility with your own personal style of learning?

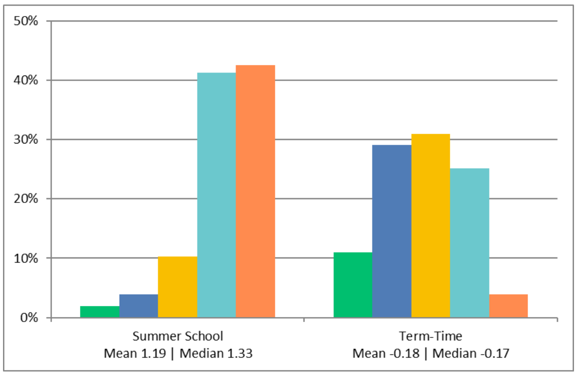


Figure 13 – I was able to focus on study without distraction.

"When you have more time (as it was during Summer School) you get to engage [with] content and learn and appreciate it more, and therefore I think I thought about assessments critically and analytically rather than being robotic about it like during term-time."

Classes

The *p*-values for all questions in this category are less than 10^{-18}.

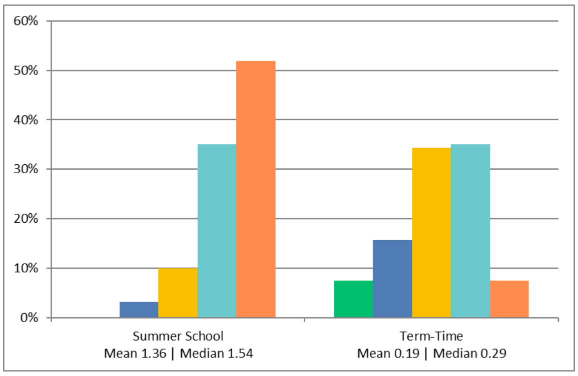


Figure 14 – Tutorials helped me to learn.

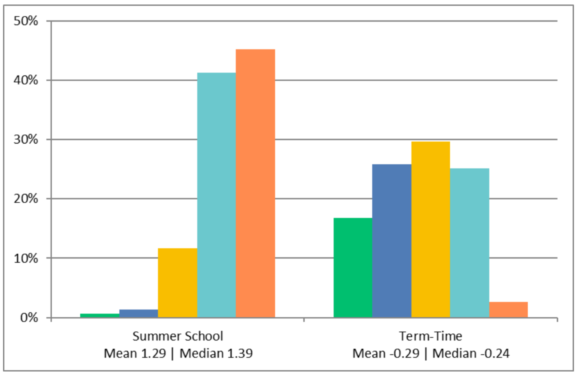


Figure 15 – The lecture class sizes were appropriate for facilitating my learning.

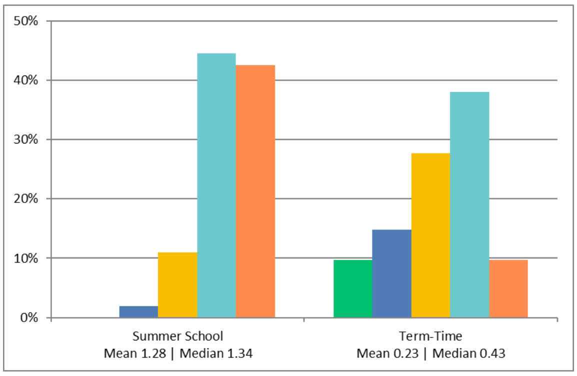


Figure 16 – The tutorial class sizes were appropriate for facilitating my learning.

"I preferred the tutorial class during Summer School as there it was a small number and I was able to learn more."

"Term-time classes were too large."

"The Summer School lectures felt a lot more like tutorials."

Motivation

The *p*-value for this question is less than 10^{-23}.

"The motivation is stronger for Summer School because you become much more involved in learning, so it becomes natural to be motivated."

"I just wanted to get my degree done as fast as possible, so I took two subjects at Summer School."

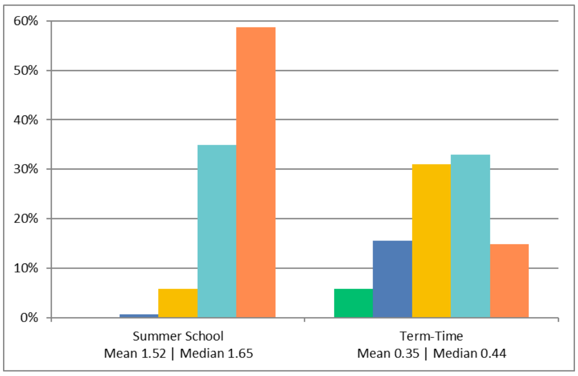


Figure 17 – I was personally motivated to pass or do well.

Pace and Timing

The *p*-values for both questions in this category are less than 10^{-11}.

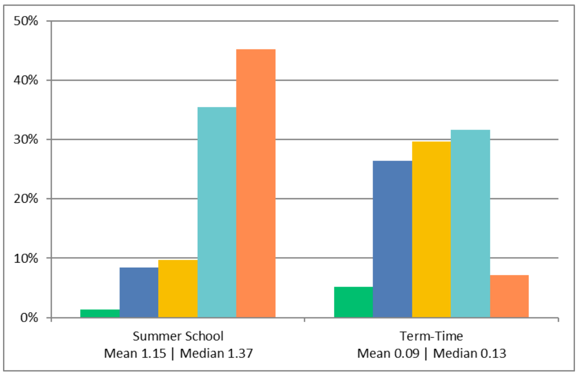


Figure 18 – The pace was beneficial in facilitating my learning.

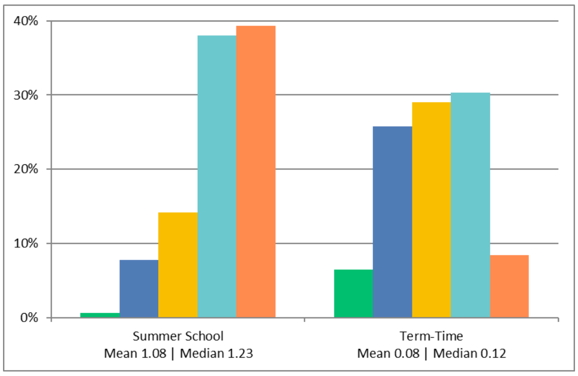


Figure 19 – The timing was beneficial in facilitating my learning.

Written opinions were mixed, showing preference for both term-time and Summer School.

"Term-time tutorials were okay, but lectures were too fast paced … Summer School was appropriate in both domains."

"The fast pacing of Summer School meant it was easier to recall and revise concepts from the beginning of the course when studying for exams. However, the fast pacing also made it difficult to keep on top of all the content and stay organised."

"It's hard to have timing effective in Summer School because many people are only attending one subject and may be travelling [from] far away. I personally found it overwhelming covering two weeks' worth in normal term[-time] in two days during Summer School …"

Enjoyment

The *p*-values for both questions in this category are less than 10^{-14}.

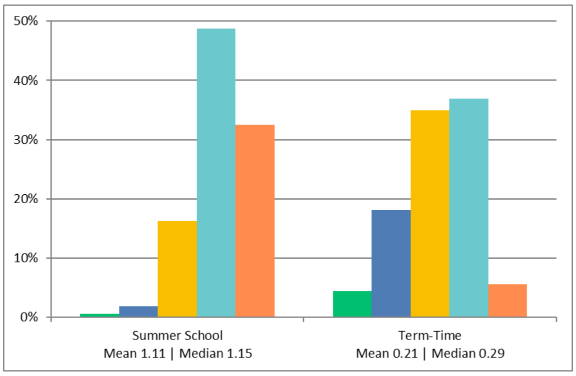


Figure 20 – The work had been intellectually rewarding.

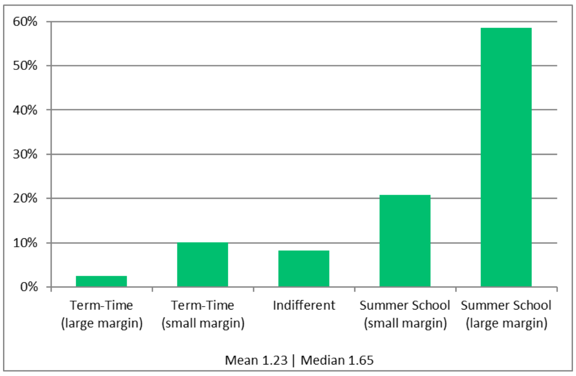


Figure 21 – Which mode of delivery did you find provided you with more enjoyment and satisfaction?

"The help of focusing on one unit in Summer School allowed me to both concentrate and find enjoyment in solving the problems, as opposed to term-time where you have less time to appreciate the work."

Resources

The *p*-values for both questions in this category are less than 10^{-6}.

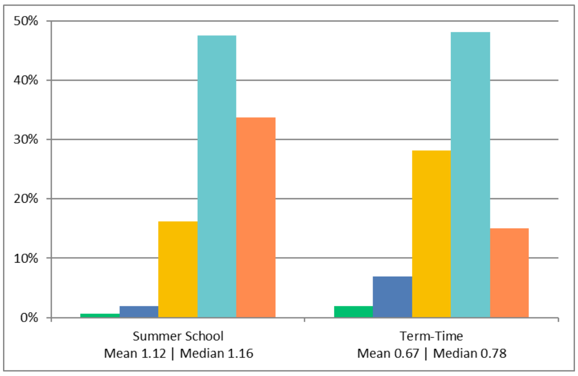


Figure 22 – I had good access to valuable learning resources.

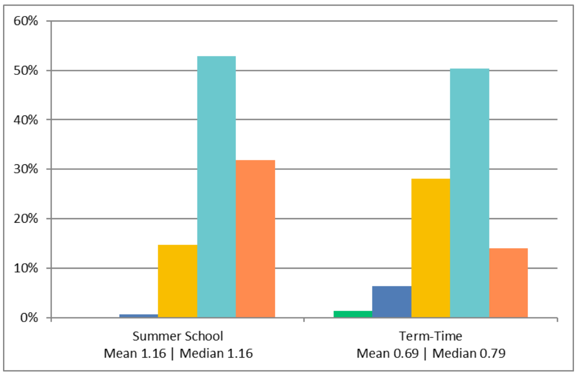


Figure 23 – The unit of study materials were effective in facilitating my learning.

Written comments were mixed:

"Summer School extra practice questions were the real differentiator."

"The Mathematics Learning Centre was a valuable resource during term-time. Would have been good to have access to during Summer School.

Assessment

The p-values for all questions in this category are less than 10^{-4}.

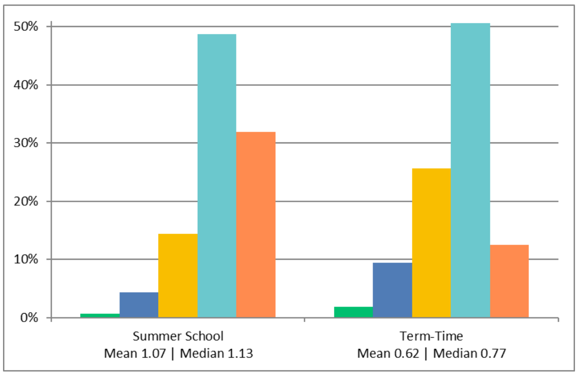


Figure 24 – The assessment tasks challenged me to learn.

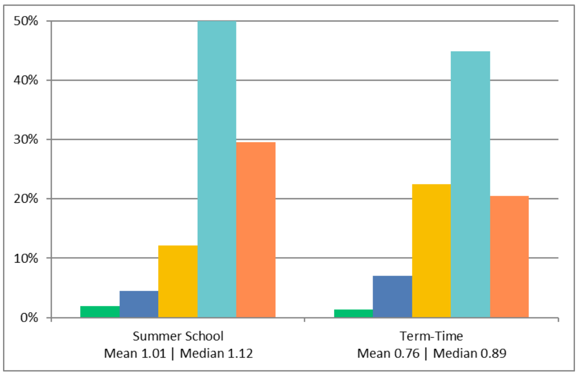


Figure 25 – The exams were effective in testing my knowledge, understanding and aptitude.

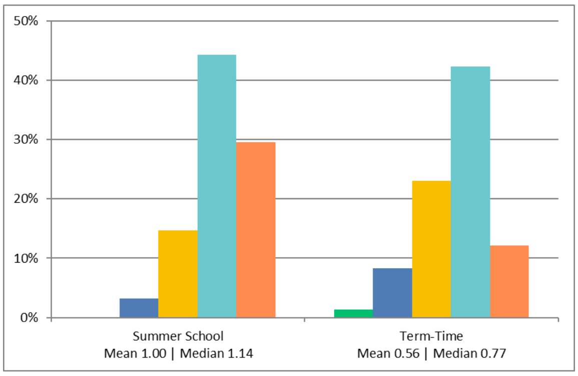


Figure 26 – The quizzes were effective in testing my knowledge, understanding and aptitude.

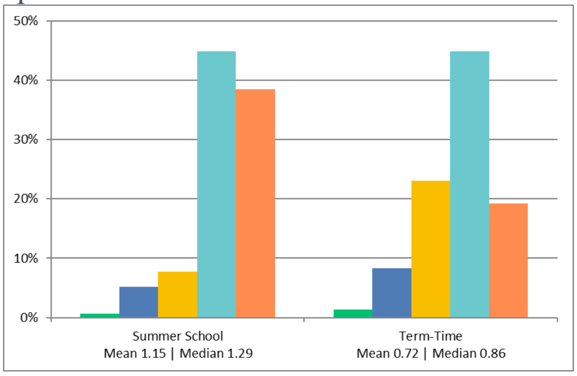


Figure 27 – The assignments were effective in testing my knowledge, understanding and aptitude.

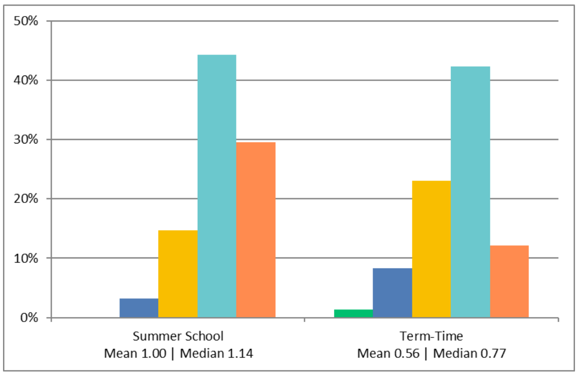


Figure 28 – The homework was effective in testing my knowledge, understanding and aptitude.

Written comments were mixed:
"Summer School assessment tasks felt more challenging."
"Term-time assessment tasks weren't that different from Summer School."
"The Summer School exam was harder though."

Easiness

The *p*-value for this question is less than 10^{-13}.

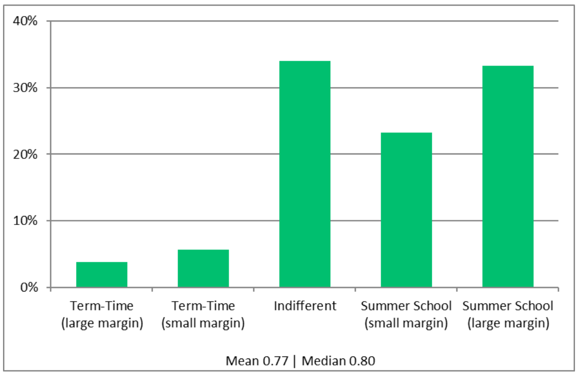


Figure 29 – Which mode of delivery did you find provided you with units of study that were overall easier?

Written opinions were mixed:

"... it was easier in Summer School with the smaller class, lecturer and tutor being the same person and them having a lot of time to help each student ..."

"They felt easier in term-time – again because all the content wasn't as rushed."

Social

The *p*-values for both questions in this category are less than 10^{-3}.

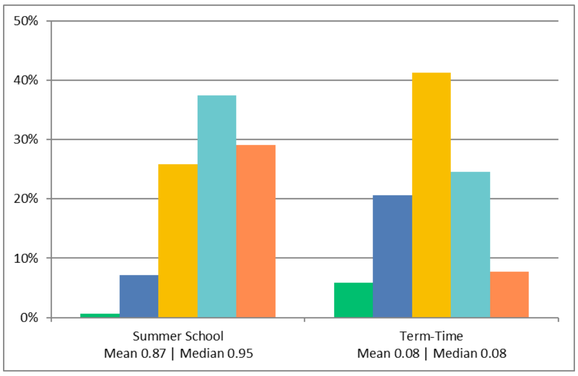


Figure 30 – Social context and interaction within/during scheduled classes was beneficial in facilitating my learning.

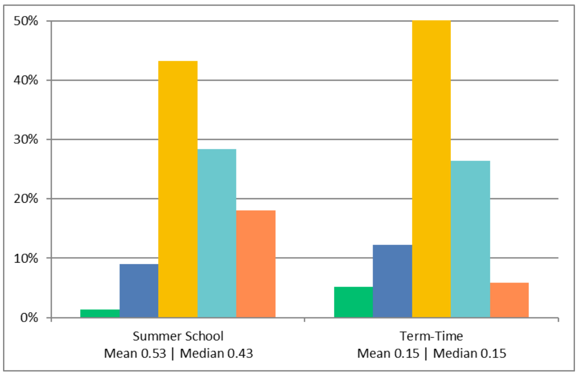


Figure 31– Social context and interaction outside/external to timetabled classes was beneficial in facilitating my learning.

Written comments were mixed:

"It's easier to learn from peers during term-time because people hang around more."

"During term-time I felt like the 'stupid' one in the class whereas in Summer School most of the people in the class were in a similar position to me, which meant I felt more comfortable asking questions and discussing the content with my peers."

Value

The *p*-value for this question is 0.9822.

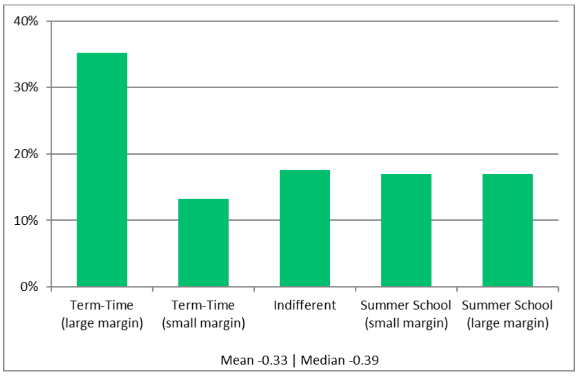


Figure 32 – Which mode of delivery did you find provided you with better value for money, in terms of fees and your own resources?

The higher cost of Summer School in those years was prominently voiced by the students:

"If Summer School cost the same as the regular courses in [term-time], I would say Summer School is better value …"

"Summer School is definitely way overpriced."

"… overall I don't believe the benefits outweigh the additional cost."

"Summer School having to be paid up front makes it almost impossible for most students."

"Summer School was very expensive. If I could I would undertake all my study that way but it is simply unaffordable."

Qualitative data analysis

Approximately 1200 open-ended responses or comments from students were extracted from the 36 survey questions listed in Table 1 and were 'cleaned' (spelling, grammar, structure, etc.) to improve legibility and neutrality. These were split, where appropriate, providing, in total, over 1900 items of data, which we refer to as *statements*. A thorough coding analysis was then performed on these statements, similar to that outlined in Khan (2014) or Dewer *et al.* (2018), and explained in more detail in the Introduction, producing seven broad categories, in order, roughly, of decreasing occurrence frequency, which appear below in Table 3:

> *Structure, Learning Outcomes, Community, Instructors, Focus, Affordability, Resources.*

It should be emphasised that this qualitative data arose directly from and only from the students' open-ended responses. Our aim is to give a clear voice to this cohort of students, who have provided us with such a rich source of data, the expression of which we would like to be as complete as possible, within reasonable bounds of space and concision. The seven categories above clearly overlap with the titles of the subsections used earlier to organise and describe the quantitative data. However, there are significant differences and the classification of the subsections above should not be confused with the separate process of coding the gratuitous comments, where students freely emphasise or draw attention to certain factors that they feel are important in the process of learning, or alert us to possible issues or influences about which we, the researchers, have no prior knowledge or expectation.

Structure – In their comments, students reflected upon the structure and design of the teaching and learning activities, assessment, materials and resources, and how conducive to these were with their own learning styles, preferences and capabilities. We find it useful to identity four distinct sub-categories:

Design, Pacing, Timing and *Fitment.*

Timing refers to the basic temporal features of delivery of a given unit of study, including the distribution of classes, such as lectures and tutorials, throughout the teaching period, deadlines for completing assessment tasks, and any associated teaching breaks or periods of study. Pacing refers to the rate at which material is delivered and absorbed within this framework. Fitment refers to the overall balance and effectiveness, by which the ingredients align and fit together, and how well the structure then serves the purpose of the unit of study, its aims and learning outcomes. Structure is listed below in its entirety as a Presage variable (with regard to the 3P model), though clearly the ingredients may be modified in the light of experience. The most obvious example of this would be the pacing of the material by the instructor, who, if sensitive to the needs and reactions of students, could be prepared to slow things down or speed things up, and even tailor the pace for individuals or certain groups (which reflects the fact that the 3P model is an interactive dynamical system with feedback).

Learning Outcomes – From the students' comments, we find it useful to identify two distinct sub-categories:

Quality and *Satisfaction*.

Their comments indicate that, from their perspective, learning and understanding of mathematics content and underlying concepts are often judged against a personal measure of 'enjoyability' and sense of 'value'. Just how students feel challenged or motivated by their studies is dependent upon the balance of difficulty and quality of the content and assessment, as well as the learning environment. This in turn drives their level of satisfaction and the application of some combination of surface and deep learning strategies. *Learning outcomes*, collectively, is listed below as a Product variable (with regard to the 3P model). In synthesising their comments, students appear to have a pragmatic point of view, even if this might jar slightly with ideals one might have as an educator that learning should become an ongoing process, hopefully life-long, that goes far beyond any particular course or unit of study.

Community – We find it useful to identify two distinct sub-categories from the perspective of the students:

Cohort Numbers and *Interactions*.

There is considerable discussion as to how and why the student numbers present in the teaching and learning activities influence their learning quality and experience. The overall sense of community then appears to be intricately shaped by their personal relationships and interactions with other students and staff. Cohort numbers are outside the control of any particular student and form a Presage variable, whilst interactions form a Process variable (with regard to the 3P model, developed below).

Instructors – The helpfulness and quality of the teaching staff (lecturers, tutors, coordinators, etc.) are referred to many times by students and are paramount in influencing student learning. Often students will either directly name or indirectly mention specific teaching staff, their styles and characteristics, which have some significant impact upon their learning experiences. *Instructors* is listed below as a Presage variable (with regard to the 3P model).

Focus – We find it useful to identity two distinct sub-categories from the perspective of the students:

Motivation and *Task Management*.

Student attitudes, in terms of their 'drive' or 'motivation' to study mathematics, are related to their ability to focus on their studies and varying levels of distraction. These depend upon personal circumstances, the management and balance of study, work and life tasks and goals. Motivation naturally forms a Presage variable, initially, whilst task management forms a Process variable (with regard to the 3P model, developed below), though clearly motivation may be influenced positively or negatively subsequently by Process (which again reflects the fact that the 3P model is an interactive dynamical system with feedback).

Affordability – Students express the desire to feel as if their learning outcomes are commensurate with the effort and financial costs involved. Thus 'value for money' becomes an important outcome of satisfaction for students. Affordability associated with undertaking particular mathematics units can often be a crucial factor in determining students' ability to enrol and participate in delivery modes that suit their personal study needs. Affordability is listed as a Presage variable below (with regard to the 3P model).

Resources – Students comment about the quality, availability and helpfulness of the teaching and learning resources (such as course notes, recordings, lecture slides, exercise sheets, learning management systems and support services), and how effective and influential they are towards supporting and developing their learning. Resources are listed as a Presage variable below (with regard to the 3P model), though of course they may be modified or augmented in the light of experience (again reflecting the fact that the 3P model is an interactive dynamical system with feedback).

The table of categories

In Table 3 below, we have included each of these categories and corresponding sub-categories and brief descriptions. In that table we have also included key words and themes that arose in the process of coding the students' comments. These key words and themes were used

- by students to describe their experiences, when providing open-ended responses, and
- by the authors to flag the statements for coding into relevant categories and sub-categories.

It is hoped that Table 3 could become a useful resource for educators, for browsing, for comparing and contrasting their own experiences or the experiences of their students, and for reflecting on a multitude of facets of learning and teaching.

The presage-process-product (3P) diagram

The final stage of the qualitative analysis is a synthesis, by which we try to understand how the categories, sub-categories and themes of Table 3 might be related and fit together within a useful conceptual framework. We have chosen to create a Presage-Process-Product (3P) model, Figure 33 below, which is similar in spirit to the 'culturally modified' 3P diagram of Biggs (1996b), which, as we explained in the Introduction, was used to gain insight into the phenomenon of the so-called 'paradox of the Chinese learner'. In our case, we aim to distil and conceptualise the most important features that lead to a successful culture of learning for the cohort of students who participated in Summer School over the period 2009-2016.

It should be noted that, despite the overall preference for the Summer School mode over term-time (see the quantitative analysis discussion below), the synthesis attempts to incorporate all of the factors, in the responses by these students, that influence learning outcomes, regardless of whether these stem from experiences at Summer School or in term-time.

Each of the previous categories and sub-categories becomes a feature of the 3P diagram in Figure 33, distributed across Presage, Process and Product:

- *Instructors*, *Resources* and *Affordability* become Presage variables,
- *Structure* splits into four Presage variables, corresponding to the sub-categories *Design*, *Fitment*, *Pacing* and *Timing*,
- *Focus* splits into two variables, the sub-category *Motivation* becoming a Presage variable and *Task Management* becoming a Process variable,
- *Community* splits into two variables, the sub-category *Cohort Numbers* becoming a Presage variable and *Interactions* becoming a Process variable,
- *Learning Outcomes* splits into two Product variables, corresponding to *Satisfaction* and *Quality*.

There is an underlying *Cultural Context*, based primarily in the Presage part of the diagram, which splits into two interacting systems of variables:

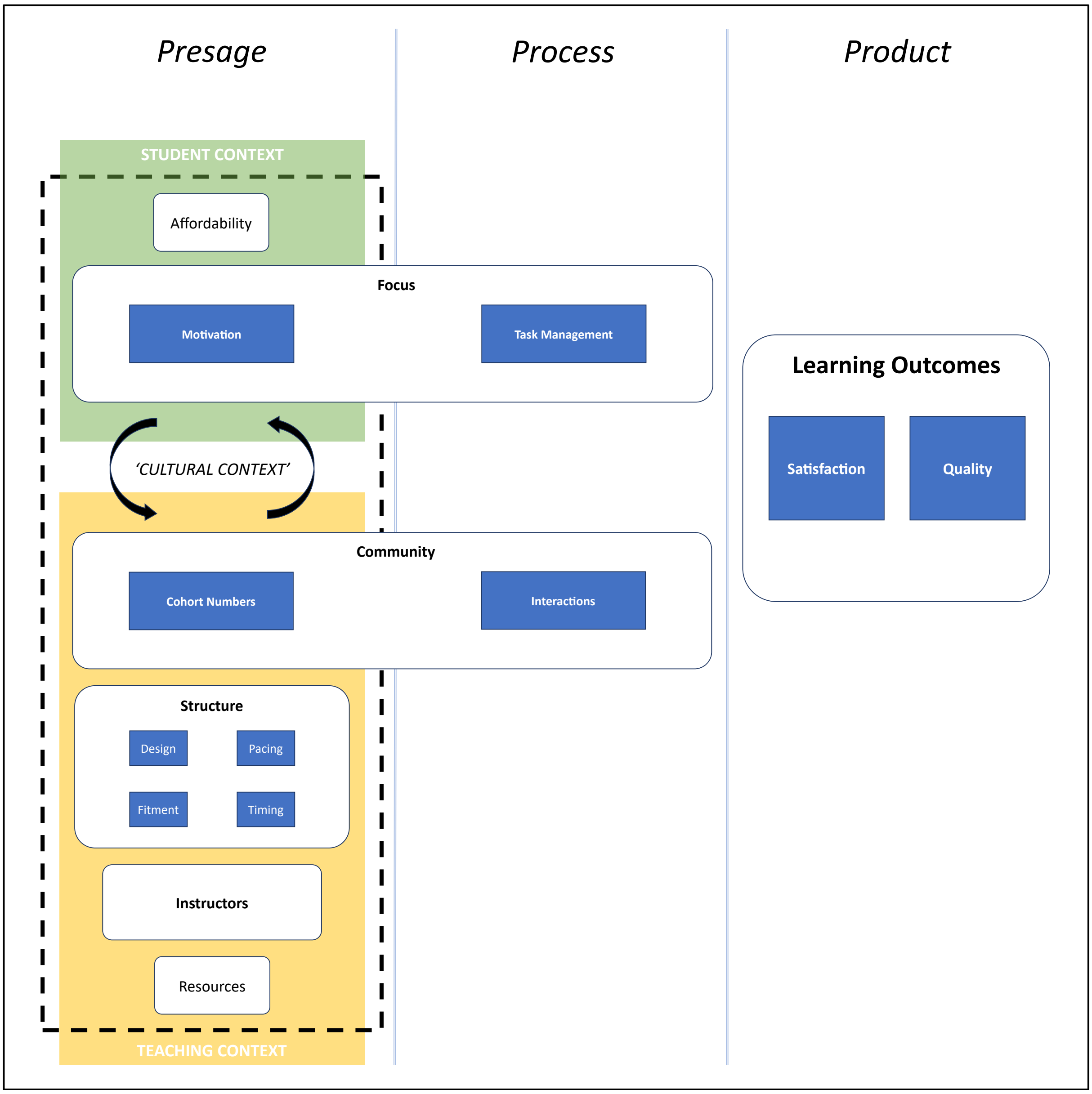
- the *Student Context*, encompassing the *Focus* and *Affordability* variables, and
- the *Teaching Context*, encompassing the *Structure*, *Instructors*, *Resources* and *Community* variables.

For the sake of simplicity and to avoid congestion, apart from arrows that emphasise the interplay between *Student Context* and *Teacher Context*, arrows between nodes are not drawn, due to the sheer number of possible connections present. The diagram is intended to represent a dynamical system with feedback, so that each of the variables can potentially influence any of the other variables, and examples of this are given in the Discussion section below. One expects, however, that there will be a general flow from left to right, progressing from Presage to Process to Product. The relative sizes of the boxes in the diagram give some indication of prevalence and importance of the categories and sub-categories in the students' responses, but these boxes are not drawn to scale.

Table 3 – The seven categories (and their subcategories where appropriate) formed from the student statements, along with corresponding descriptions, key words and themes.

Category	Sub-Categories	Description	Key Words and Themes
Structure	*Design* *Pacing* *Timing* *Fitment*	Students reflect upon the structure and design of the teaching and learning activities, assessment, materials and resources, and how conducive to and/or compatible these are with their own learning styles, preferences and capabilities. The pacing and timing of the delivery of the mathematics content, as well as the fitment (such as degree, course, or unit requirements) are influential factors in the students' learning.	Acceleration, adjacency, administration, alignment, arrangements, assessment, availability, block learning, breaks, clashes, completion, consolidation, constraints, continuation, convenience, coordination, cramming, credit points, delivery, demand, density, design, efficiency, enrolment, fitment, flexibility, flow, format, frequency, immediacy, integration, intensity, length, management, options, pacing, progression, repetition, requirements, revision, scheduling, spread, streams, structure, timing, variety, workload.
Learning Outcomes	*Quality* *Satisfaction*	The learning and understanding of mathematics content and underlying concepts are often evaluated against a personal measure of 'enjoyability' and sense of 'value'. Just how students feel challenged or motivated by their studies is dependent upon the balance of difficulty and quality of the content and assessment, as well as the learning environment. This in turn drives their level of satisfaction and the application of some combination of surface and deep learning strategies.	Alignment, appreciation, atmosphere, attendance, attention, authenticity, challenge, clarity, cohesion, comfort, commitment, communication, compatibility, completion, complexity, concentration, concepts, confidence, connection, consolidation, depth (of learning), development, difficulty, discussion, elaboration, encouragement, engagement, enjoyment, experience, exploration, familiarity, formality, formative vs. summative (assessment), independence, inspiration, intellect, intensity, interactivity, interest, knowledge, learning, motivation, outcomes, personal, practice, pressure, productivity, quality, reflection, relevance, retention, revelation, satisfaction, teaching, thinking, understanding, value.
Community	*Cohort Numbers* *Interactions*	There is considerable discussion as to how and why the number of students present in the teaching and learning activities influences their learning quality and experience. Regardless, it appears to be intricately shaped by their personal relationships and interactions with other students and staff, and an overall sense of 'community'.	Access (to resources), activity, camaraderie, campus, cohort, collaboration, commonality, communication, community, competition, cooperation, crowding, demand, discussion, disruption, encouragement, engagement, enrolment, environment, friendship, groups, inquiry, interactivity, intimacy, intimidation, liveliness, management, numbers (of students), opportunities, personal, rapport, socialising, support.
Instructors		The helpfulness and quality of the instruction by the teaching staff (lecturers, tutors, coordinators, etc.) is paramount in influencing student learning. Often students will either directly name or indirectly mention specific teaching staff, their methods, styles and characteristics, which have some significant impact upon their learning experiences.	Anecdotes, approachability, attentiveness, availability, charisma, clarity, effectiveness, effort, empathy, engagement, entertainment, enthusiasm, experience, explanations, feedback, formality, friendliness, guidance, helpfulness, influence, innovation, interactivity, interest, involvement, motivation, personality, position (of teacher), quality (of teaching), rapport, style, support, technology (use of), understandability.
Focus	*Motivation* *Task Management*	Student attitudes, in terms of their 'drive' or 'motivation' to study mathematics, are related to their ability to focus on their studies and varying levels of distraction. These depend upon personal circumstances, the management and balance of study, work and life tasks and goals.	Attendance, attention, attitude, balance, commitment, concentration, cramming, determination, discipline, distraction, focus, incentive, intensity, interest, isolation, laziness, motivation, multi-tasking, number (of tasks), pressure, quietness, responsibility, simplicity, simultaneity, stress, task management.
Affordability		'Value for money' is an important outcome of satisfaction for students; they express the desire to feel as if their learning outcomes are commensurate with the effort and financial costs involved. The affordability associated with undertaking particular mathematics units (of the students' choices) determine their ability to enrol and participate in delivery modes that suit their personal study needs.	Accessibility, affordability, choice, commitments, deferral, demand, deterrent, employment, expenses, fairness, fees, financing, free offer, funding, hinderance, hindsight, informedness, motivation, opportunity, outrage, payments, pressure, redo, responsibilities, satisfaction, subsidy, upfront, value-for-money.
Resources		The quality, availability and helpfulness of the teaching and learning resources (course notes, lecture slides, exercise sheets, etc.) are influential towards student learning.	Access, connection, consultation, demand, discussion board, exercises, external (resources), homework, infrastructure, legibility, LMS, MLC, notes, online, organisation, past papers, practice, quizzes, recordings, references, seating, slides, spaces, supplementary, technology, textbooks, venues, websites, worksheets.

Figure 33 – A culturally modified 3P diagram showing placements and relationships of the categories and subcategories.



Discussion

As per the title of this work, we focus on student perspectives when studying mathematics at Summer School versus term-time. Surveying alumni for the period 2009-2016 has provided us with a treasure trove of rich and varied data, both quantitative and qualitative. From the multitude of ways in which the data can be analysed, we aim to encourage discussion on some of the most prevalent issues that relate to student learning in this particular context. We will discuss the quantitative and qualitative analyses separately.

Insights from the quantitative data

As outlined previously, the closed-ended questions, in Likert form, once converted to numerical values, were used to produce means, medians, histograms and p-values after testing for statistical significance. This numerical data shows a clear trend for preference of Summer School over term-time, on all questions (see Figures 3-31) except for 'value for money' (see Figure 32). Though there is a mild (and not statistically significant) preference for term-time in terms of value for money, this should be seen in the context of the very high fees that were charged for Summer School over the period 2009-2016. Students in fact commented that if the fee structure of Summer School had been more closely aligned to that of term-time, then there would have been overwhelming support for Summer School in terms of perceived 'value'. It is gratifying therefore to observe that more recently, since after 2016, fees have been restructured at the University of Sydney, so that Summer School units of study are subject to the same HECS (Higher Education Contribution Scheme) rules as term-time.

The degree of preference for Summer School over term-time varies from question to question, and we highlight below what we see as the most striking or significant features.

Enjoyment – Overwhelmingly, students appeared to 'enjoy' learning mathematics at Summer School more than during term-time:

- about 80% of students preferred Summer School, with only about 12% preferring term-time, and about 8% indicating no preference (see Figure 21).

This corresponds closely to the fact that

- over 80% of students agreed or strongly agreed that Summer School learning is intellectually rewarding, compared with 40% for term-time (see Figure 20).

Instruction – Providing useful and timely feedback is always problematic in tertiary teaching, and it is striking that

- 75-80% of students at Summer School agreed or strongly agreed that feedback was timely, helpful and of high quality, compared with 35-40% for term-time (see Figures 4, 8).

Consistently, also,

- over 85% of students agreed or strongly agreed that instructors at Summer School were responsive to students and effective in facilitating their learning, compared with about 50% of students for term-time (see Figures 5, 6, 7).

There were similar percentages of for each mode indicating overall satisfaction with the quality of teaching (see Figure 3).

Learning – Two of the most striking features and points of contrast are that

- over 80% of students indicated that Summer School provided better compatibility with personal learning styles, compared with about 10% for term-time and about 10% who were indifferent (see Figure 12), and
- over 40% of students strongly agreed that they could focus without distraction at Summer School, compared with less than 5% for term-time (see Figure 13).

About 55% of students indicated that Summer School provided superior learning outcomes, with less than 10% for term-time, and about 35% of whom were indifferent (see Figure 10). Consistently, also, with respect to Summer School,

- over 80% of students agreed or strongly agreed that they developed critical skills, were able to focus without distraction and found that learning outcomes were clear (see Figures 9, 10, 13).

By contrast, for term-time, about 60% of students agreed or strongly agreed that learning outcomes were clear (see Figure 8), 45% that they developed critical skills (see Figure 9) and 30% that they could focus without distraction (see Figure 13).

Classes – The most striking feature about classes is that

- over 90% of students agreed or strongly agreed that class sizes (both lectures and tutorials) were appropriate at Summer School, compared with less than 30% for lectures and about 45% for tutorials in term-time (see Figures 15, 16).

It should be noted that lectures and tutorials blend or morph together very well at Summer School, so that their functions or roles become similar or even identical, depending on the style and approach of the instructor. That tutorials are successful in both modes is reflected in the fact that

- over 90% of students think tutorials help them to learn at Summer School, compared with about 40% in term-time, with over 30% being neutral or indifferent towards tutorials in term-time (see Figure 14).

Tutorial sizes at Summer School over the period 2009-2016 were capped at 10-15 students per tutorial, whereas in term-time up to 30-35 students could be scheduled for each tutorial, though attendance could be far less as the semester progresses. Clearly the smaller cap on tutorial sizes is likely to improve access to individual attention from instructors. It is unfortunate, in term-time, that crowded tutorials may initially lead to dissatisfaction and a weakening in the nexus between students and their instructor, followed then by dramatic drop-off in attendance in later weeks. By contrast, a strong relationship or bond between students and instructors appears to be robust and ongoing for the duration of Summer School.

Assessment – The reaction of students to assessments in both modes are generally very favourable, with similar profiles and about 70-80% agreeing or strongly agreeing that assessment tasks are challenging and effective (see Figures 24, 25, 26, 27, 28). However, in all of these profiles,

- the stronger agreement at Summer School is much higher than for term-time, and sometimes more than twice as high.

The written comments from students vary considerably, which may reflect the variability of choices made by Summer School instructors, perhaps to use similar or identical assessment tasks from term-time, or to create their own, or introduce some form of innovation not used in term-time (such as videos or novel group assessment tasks). That strong agreement for Summer School is significantly higher suggests that there may be more effective alignment between learning activities and assessment, reflected perhaps in the fact, noted earlier, that feedback seems to be more effective in Summer School than in term-time (see Figures 4, 8).

Motivation – It is striking that

- nearly 95% of students agreed (nearly 60% strongly) that they were motivated or driven during Summer School, compared with under 50% (about 15% strongly) during term-time (see Figure 17).

Evidence of a heightened state of motivation during Summer School was prevalent also in written comments throughout the entire survey: students are able to focus, in a very concentrated timeframe, by studying just one or two subjects (instead of many in term-time), which allows them to catch up on a failed unit or accelerate through their degree programme. Enrolling in Summer School requires deliberate effort and making conscious choices, involving planning and organisation at a time when many people are having a break or on holidays, compared with relatively minimal decision-making when following conventional term-time academic pathways.

Social – It is striking that

- over 65% of students agree (nearly 30% strongly) that social context and interaction is important in facilitating learning *within/during classes* at Summer School, compared with less than 35% (under 10% strongly) in term-time (see Figure 30).

There is a real sense of community and social cohesion at Summer School, where students come together with a common purpose, meeting with the same cohort more regularly or frequently, in a concentrated timeframe, compared with term-time, where there can be more distractions and dispersion of the social environment. It is interesting that the importance of social context and interaction *outside/external to classes* is similar between Summer School and term-time, just mildly favouring Summer School (see Figure 31). This might be surprising, as one would expect that there should be many more opportunities during term-time for participation in extra-curricular activities or events organised by student groups, clubs and societies. There is some evidence that students at Summer School more readily form social bonds or connections with other participants that benefit their learning and persist beyond formal classroom activities.

Resources – The profiles of student opinion about availability and effectiveness of resources in Summer School and term-time are similar (see Figures 22, 23), though

- the strong agreement is markedly higher for Summer School than term-time.

With fewer numbers of students at Summer School, there come certain practical advantages, such as lecturer time and flexibility, perhaps leading to better direction towards or access to resources. In principle, all of the main teaching and learning materials supporting units of study, and Library access, for example, are identical or close to identical for both Summer School and term-time. One of the main deficiencies, noted in comments by students, is the lack of access to the Mathematics Learning Centre during Summer School, which was, in those years, during term-time, one of the main fully staffed centres of the University, whose purpose was to provide remediation, help and guidance for students at risk, with learning difficulties or with disabilities.

Pace and Timing – It is striking that

- 75-80% of students agree or strongly agree (with more than half of these in strong agreement) that the pace and timing is beneficial for their learning in Summer School, compared with less than 40% in term-time (with less than 10% in strong agreement) (see Figures 18, 19).

This is perhaps one of the most counter-intuitive results of the survey, as a commonly held view, which may be a misconception, is that intensive courses may be too condensed and that students need the extra time and space to learn over a full semester. Certainly, this point of view is reflected in some of the written comments of students preferring the pace and timing of term-time. However, there is an overwhelming sense, for this cohort, that the pace and timing of Summer School were well-matched for the demands of these units of study in mathematics and for producing learning outcomes of high quality, confirmed also by the fact that

- about 55% of students thought that units of study were easier to complete at Summer School than in term-time (and over a third by a large margin) (see Figure 29).

This preference, of course, is not universal and will vary from person to person, and there were some comments that the content was too rushed and congested in Summer School, making learning more difficult, compared with term-time.

Insights from the qualitative data

The qualitative analysis above produced two main documents:

- a table of seven categories (Table 3), with sub-categories, descriptions and key words and themes, the results of coding open-ended survey responses by students, using techniques in phenomenography, and
- a Presage-Process-Product (3P) diagram (Figure 33), in which all categories and sub-categories appear as variables, in relation to one another and to an overriding 'cultural context', made up of intertwining 'student' and 'teaching contexts'.

As mentioned in the Introduction, it is typical, when employing a phenomenographic coding technique, to produce a relatively small number of categories, the relationships between which can then be displayed in a table or simple flow-chart, such as a tree diagram. In our case, we felt that seven categories precipitated from the data, with some splitting up into further sub-categories. We took a dynamical systems approach to synthesise the data further, using a modified 3P diagram, akin to the 'culturally modified' 3P diagram of Biggs (1996b). Though there is a general flow from Presage to Process to Product, our 3P diagram anticipates a great deal of nuance and subtleties in relationships between the variables.

The most detailed and intricate part of our 3P diagram is the arrangement of Presage variables. Holistically, these form part of the 'cultural context', ideally providing a rich and vibrant platform for a given student to engage with the material, the instructors, and other students, to then move through the Process phase, leading hopefully to exemplary and satisfying learning outcomes in the Product phase. Successful features of such a 'culture' may vary from student to student and can occur in either Summer School or term-time. Students emphasise throughout the importance of *Structure*, *Instructors* and *Resources*. These are mostly stable variables, set by the institution, though facets of *Structure*, in particular, may be modified, adjusted or evolve in real time when there are strong communication channels and rapport. Formal or informal feedback between students and teachers, may lead to dynamic changes in the variables, so that, for example, *Satisfaction* and *Quality*, in the Product phase, or *Task Management* and *Interactions*, in the Process phase, may influence or alter *Pacing*, *Timing* and *Fitment*, in the Presage phase. Students make comments such as the following, which resonate with observations of Biggs (1996) about how, in CHC countries, teachers and students interact like fellow-travellers on a common journey, sharing learning-related beliefs and values:

"The lecturers and [tutors] are much more responsive to feedback; [they] really genuinely want you to learn and do well and understand the content."

"... the staff during Summer School were there to show us how to use resources provided as well as going outside what was provided ..."

"The tutor during Summer School was attentive and very helpful."

Students often refer to characteristics of their lecturers and tutors such as accessibility, approachability, empathy and helpfulness, all of which encourage and lubricate feedback loops, as well as strong personal qualities such as enthusiasm and friendliness.

One of the most striking features that emerges from this qualitative data analysis is the gratuitous praise and appreciation that students have for their teachers, even naming them directly or indirectly, or mentioning specific experiences or anecdotes that have a significant long-lasting impact upon their learning and personal development. Thus, *Instructors* becomes a key Presage variable.

Resources emerges as another important Presage variable, but not mentioned as much throughout the data as *Instructors*. It is notable that 'human resources', such as lecturers and tutors, appear to be more prominent in the minds of students than physical and other resources. This correlates also with the prominence of the *Community* category, where the personal relationships and interactions, both between students and teachers and between students and each other, appear to be vital factors in the process of successful and sustained learning. A student writes about the sense of travelling on a journey with others:

"In Summer School everyone was there just to do maths. It felt like a small group on a journey together. Term-time I felt more on my own despite much more people around me."

The *Community* category forms a bridge between Presage and Process in the 3P diagram, connecting the Presage variable *Cohort Numbers* with the Process variable *Interactions.* Students, in their responses, refer to the effect of class sizes. Of course, learning is personal, and some people prefer to study in private or in isolation, but more generally there appears to be a critical mass for developing characteristics of a vibrant and supportive community, including camaraderie, mutual respect, and a sense of belonging. Throughout the years of this study (2009-2016), the tutorial class sizes were capped at Summer School to 10-15, contrasted by class sizes in term-time, which could be two or three times larger. It is not the case that simply having a large number of people around necessarily leads to a sense of community. Loneliness in a crowd is a common phenomenon when individuals are surrounded by strangers, and can lead to learning disorders, anxiety and depression.

The *Learning Outcomes* category is placed in the Product phase of the 3P diagram, supported by the large number of student responses that refer to aspects of *Quality* and *Satisfaction*. Students in this study appear to be pragmatic, perhaps because they made conscious decisions, or had to organise their lives, to be able to study at Summer School. Favourable outcomes with respect to the Product variables *Satisfaction* and *Quality* may also feed backwards and influence the *Affordability* variable, in the Presage phase. For example, a student makes the following comment:

"Summer School is expensive, but it is worth the price because you will get good results and have a better understanding of the subject."

With regard to learning as a process, we have identified Process variables as *Task Management*, one of the sub-categories of *Focus*, and *Interactions*, one of the sub-categories of *Community*. The category *Focus* forms another bridge from Presage to Product. Students embark on their mathematics with certain attitudes and goals, aspects of *Motivation*. This drives them to focus and concentrate on their task at hand (for example, especially at Summer School, passing a failed mathematics unit of study, or accelerating their degree programme), utilising aspects of *Task Management.* Students may choose to study one unit at a time, which is a common occurrence at Summer School:

"This is tied to the fact that during Summer School the unit was my sole focus in study so I was more motivated to understand the content and succeed."

Students may have to balance many commitments simultaneously:

"Summer School was all on during a two-day block and in the evening. Term-time at Sydney University almost all maths subjects are spread across the entire week which is horrible for mature age students like myself that have to work."

The Presage variable *Motivation* has the capacity to evolve through Process (such as successful or appropriate *Task Management*) and within a favourable cultural context. Students, alluding to the holistic culture at Summer School, compared with term-time, write

"Term-time assessment tasks weren't that different from Summer School. I just had no motivation back then."

"During Summer School I felt motivated to finish everything. During term-time, with many other units at the same time, the assessments were more of a burden than a learning tool … in Summer School I found that I actually [had] the motivation to read them, because I was in a more relaxed state."

At least part of the success of the Summer School mode appears to be an ability to focus on a limited amount of material or units of study, delivered in a relatively short period of time, supported by a community of like-minded learners, interacting with empathic and enthusiastic teaching staff. With the right settings in the Presage phase, it seems, for many students, there appears to be a smooth pathway through Process towards Product, leading to successful learning outcomes. It is gratifying to see that intensive modes of teaching during term-time have been adopted in recent years at the University of Sydney. Many units of study now have the option of being taken in so-called intensive mode, where the delivery and assessments may be completed in half of a semester, instead of a full semester.

One might expect that individual characteristics of the student related to ability and mathematical background should appear as ingredients of Presage and be surprised that these are missing from our 3P diagram. In fact, personal characteristics relating to ability or levels of mathematical preparedness did not feature at all in the student comments (though, as mentioned earlier, there was a plethora of comments and commentary about the personal characteristics and qualities of the instructors), and therefore do not appear as part of any the categories that arise through coding the data. Certainly, there is some degree of homogeneity in the student population that attended Summer School in the period 2009-2016, as there was no opportunity, for example, to study advanced units of study. However, there was enough variation, for example between prerequisites for Fundamental and Mainstream units of study, that one would expect that levels of preparedness should be an important factor. In terms of student comments, there seems to be a 'blindness' about this issue: they appear to be determined to succeed, and do succeed, regardless of their background or ability. This resonates with the phenomenon noted in studies about the Confucian Heritage Culture (see Watkins and Biggs (1996, 2001b) that there is no impediment, in principle, to anyone succeeding in academic endeavours, given enough effort and a suitable teaching and learning environment. This also resonates with the findings in Easdown *et al.* (2009) and Easdown *et al.* (2019) of the tendency of students at Summer School to perform in the higher qualitative phases of learning (in the sense of the SOLO taxonomy), even when their background suggests an expectation of failure or at best superficial learning outcomes.

Conclusions

Previous research from 2009 and 2019 suggested that students undertaking certain undergraduate level mathematics units of study at the University of Sydney achieve better learning outcomes and overall satisfaction when choosing to take them during Summer School rather than regular term-time semesters. That research, however, relied on very specific numerical data of final marks as well as limited student comments via surveys and anecdotal experience. The research in this paper greatly expands the scope of the previous work, by considering students that took any fundamental or mainstream first- or second-year mathematics units of study offered at Summer School in the period 2009-2016.

It should be noted, however, that this cohort did not typically include highly talented or gifted students, who might be contemplating Honours or postgraduate research degrees in mathematics.

The quantitative data shows, overwhelmingly, for this wide cohort of students, a preference for the learning environment provided at Summer School, rather than during term-time. These students appeared to

- enjoy learning mathematics and find it intellectually rewarding more at Summer School than during term-time.
- find the quality of teaching, responsiveness of instructors and quality of feedback superior at Summer School than in term-time.
- believe that Summer School was more tailored to their particular personal learning styles than term-time, and that they had better opportunities to learn without distraction.
- have high regard for the clarity of learning outcomes and development of critical skills in the Summer School mode.
- appreciate the smaller or more appropriate class sizes at Summer School, especially where lectures tend to morph into tutorials, which appear to be a key factor contributing to a successful and vibrant learning culture.
- be able to focus, in a very concentrated timeframe at Summer School, by studying just one or two subjects, which allowed them to catch up on a failed unit or accelerate through their degree programme.

- find social interaction in facilitating learning within/during classes occurs more prominently at Summer School than in term-time, providing a sense of community and social cohesion,
- find that there can be more distractions and dispersion of the social environment in term-time.
- find that, with fewer numbers of students at Summer School, there come certain practical advantages, such as lecturer time and flexibility, leading to better direction towards or access to resources.
- with some exceptions, find the pace and timing more beneficial for students' learning in Summer School, compared with term-time.

In spite of a clear overall preference for Summer School, open-ended comments indicate that there are features of both Summer School and term-time modes that are important in influencing the quality and satisfaction of learning outcomes. This led the authors to code the qualitative data, using a phenomenographic technique, producing a table with seven categories, some of which split naturally into sub-categories. The table includes brief descriptions and lists of key words and themes, which hopefully should become a useful resource for educators.

A dynamical systems approach was used to synthesise the relationships between the categories and sub-categories, leading to a Presage-Process-Product (3P) diagram. This was motivated by the 'culturally modified' 3P diagram of Biggs (1996b), in his attempt to understand the so-called 'paradox of the Chinese learner' associated with learners in CHC countries.

The 3P diagram of this paper emphasises the importance of presage and temporality, within the context of a culture associated with a vibrant and dynamic community of learners. The most detailed and intricate part of this diagram is the holistic arrangement of Presage variables, which form part of the 'cultural context', providing a platform for students to engage with the material, the instructors, and other students. They then move through the Process phase, leading to hopefully exemplary and satisfying learning outcomes in the Product phase. Successful features of this 'culture' may vary from student to student and can occur in either Summer School or term-time mode.

Students often refer to their lecturers and tutors in terms of friendliness, enthusiasm, accessibility, approachability, helpfulness and empathy. Such characteristics enrich the experience and should enhance and lubricate feedback loops in the 3P diagram. It is striking that 'human resources', such as lecturers and tutors, appear to be more prominent in the minds of students than physical and other resources. This resonates also with the prominence given to personal relationships and interactions, both between students and teachers and between students and each other, which appear to be vital factors in the process of successful and sustained learning.

At least part of the success of the Summer School mode appears to be an ability to focus on a limited amount of material or units of study, delivered in a relatively short period of time, supported by a community of like-minded learners, interacting with empathic and enthusiastic teaching staff. With the right settings in the Presage phase, it seems, for many students, there appears to be a smooth pathway through Process towards Product, leading to successful learning outcomes.

It is interesting that personal characteristics relating to ability or levels of mathematical preparedness of the students themselves did not feature in their comments and therefore do not appear in the categories that arise through coding the data. This cohort of students appears to be determined to succeed, regardless of their background or ability.

Scope for further work

Follow-up face-to-face interviews with this cohort of students could prove useful in garnering further insight, perhaps by shining light on other nuances that did not surface in the surveys.

The present work focuses on the student perspective. A complementary avenue of research could be to survey or interview Summer School teaching staff. This could mirror the series of studies initiated by Watkins and Biggs (1996, 2001b), in investigating the paradox of the Chinese learner, both from the students' and teachers' points of view.

Daniel (2000) and Davies (2006) lament the paucity of rigorous studies relating to the effectiveness of IMD. The present work focuses on mathematics units of study only. It should be possible to use similar methods to investigate IMD in other disciplines, both at the University of Sydney, especially since intensive modes are now an option in term-time for a range of disciplines, and more widely in Australia and abroad.

Acknowledgements

This study is part of a research project (Reference Number 07-2009/11959) approved by the Human Research Ethics Committee of The University of Sydney. The authors would particularly like to thank Jackie Nicholas, former Head, Mathematics Learning Centre, and staff and students of the School of Mathematics and Statistics, University of Sydney, for their assistance in completing this study.

References

Åkerlind, G. (2005). Learning about phenomenography: Interviewing, data analysis and the qualitative research program. In J. Bowden, & P. Green, *Doing Developmental Phenomenography* (pp. 63-73). Melbourne: RMIT University Press.

Åkerlind, G. & McKenzie, J. (2003). An Introduction to Phenomenographic Research. Invited workshop presentation at the 2003 Improving Student Learning Conference, Leicestershire, England.

Barnacle, R. (2005). Interpreting interpretation: A phenomenological perspective on phenomenology. In J. Bowden, & P. Green, *Doing Developmental Phenomenography* (pp. 47-55). Melbourne: RMIT University Press.

Biggs, J. (1987). *Student Approaches to Learning and Studying.* Melbourne: Australian Council for Educational Research.

Biggs, J. (1993a). From theory to practice: A cognitive systems approach. *Higher Education and Research and Development,* 12, 73-86.

Biggs, J. (1993b). What do inventories of students' learning processes really measure? A theoretical review and clarification. *British Journal of Educational Psychology,* 63, 3-19.

Biggs, J. (1995). Assessing for learning: some dimensions underlying new approaches to educational assessment. *The Alberta Journal of Educational Research,* 41(1), 1-17.

Biggs, J. (1996a). Assessing learning quality: reconciling institutional, staff and education demands. *Assessment and Evaluation in Higher Education,* 21(1), 5-15.
Biggs, J. (1996b). Western Misconceptions of the Confucian-Heritage Learning Culture. In D. Watkins, & J. Biggs, *The Chinese Learner: Cultural, Psychological and Contextual Influences* (pp. 45-67), 1996. Hong Kong | Melbourne: CERC | ACER.
Biggs, J. (2003). *Teaching for Quality Learning at University* (2nd ed.). Berkshire: Open University Press.
Biggs, J. & Collis, K. (1982). *Evaluating the quality of learning: the SOLO taxonomy.* New York: Academic Press.
Biggs, J. & Watkins, D. (2001). Insights into teaching the Chinese learner. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 277-298). Hong Kong | Melbourne: CERC | ACER.
Bowden, J. (2000). The nature of phenomenographic research. In J. Bowden, & E. Walsh, *Phenomenography* (pp. 1-18). Melbourne: RMIT University Press.
Bowden, J. & Green, P. (2005). *Doing Developmental Phenomenography*. Melbourne: RMIT University Press.
Bowden, J., Green, P., Barnacle, R., Cherry, N., & Usher, R. (2005). Academics' ways of understanding success in research activities. In J. Bowden, & P. Green, *Doing Developmental Phenomenography* (pp. 128-144). Melbourne: RMIT University Press.
Bowden, J. & Walsh, E. (2000). *Phenomenography*. Melbourne: RMIT University Press.
Cousin, G. (2006). An introduction to threshold concepts. *Planet,* 4-5.
Cheng, L. (1998). Impact of a public English examination change on students' perceptions and attitudes toward their English learning. *Assessment and Evaluation in Higher Educational Evaluation,* 24, 279-301.
Cortazzi, M. & Lixian, J. (2001). Large classes in China: 'good' teachers and interaction. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 115-134). Hong Kong | Melbourne: CERC | ACER.
Dahlin, B., Watkins, D. A., & Ekholm, M. (2001). The role of assessment in student learning: the views of Hong Kong and Swedish lecturers. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 47-74). Hong Kong | Melbourne: CERC | ACER.
Daniel, E. L. (2000). A review of time-shortened courses across disciplines. *College Student Journal*, 34(2).
Davies, W. M. (2006). Intensive teaching formats: A review. *Issues in Educational Research*, 16(1), 1-20.
Dewer, J.M., Bennett, C.D., & Fisher, M.A. (2018). *The Scholarship of Teaching and Learning, a Guide for Scientists, Engineers, and Mathematicians*. Oxford University Press.
Dunkin, M.J. & Biddle, B.J. (1974). *The Study of Teaching*. New York: Holt, Reinhart, & Winston.
Easdown, D., Ougrinovskaia, A., Saunders, N., Warren, D., Ancev, T., Bishop, T., & Mansfield, S. (2009). Learning and teaching in summer: is it better and why? *Motivating Science Undergraduates: Ideas and Interventions* (pp. 24-29). Sydney: UniServe Science.
Easdown, D., Papadopoulos, G., & Zheng, C. (2019). Summer school versus term-time for fundamental mathematics at the tertiary level. *International Journal of Innovation in Science and Mathematics Education.* 27(5), 13-26.
Entwistle, N. J. & Ramsden, P. (1983). *Understanding Student Learning.* London: Croom Helm.
Ezzy, D. (2002). *Qualitative Analysis*. London: Routledge.

Glaser, B. G. & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research.* Chicago: Aldine Publishing Company.

Hargreaves, M. (Ed.) (1997). The Role of Assessment in Learning. *ASDU Issues.* Brisbane: Queensland University of Technology.

Ho, A. S. P. (2001). A conceptual change approach to university staff development. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 239-254). Hong Kong | Melbourne: CERC | ACER.

Kember, D. (1997). A reconceptualization of the research into university academics' conceptions of teaching. *Learning and instruction,* 7(3), 255-275.

Khan, S. H. (2014). Phenomenography: a qualitative research methodology in Bangladesh. *International Journal on New Trends in Education and Their Implications*, 34-43.

Lingbiao, G. & Watkins, D. (2001). Towards a model of teaching conceptions of Chinese secondary school teachers of physics. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 27-45). Hong Kong | Melbourne: CERC | ACER.

Mok, I., Chik, P., Ko, P., Kwan, T., Lo, M., Marton, F., Ng, D., Pang, M., Runesson, U., & Szeto, L. (2001). Solving the paradox of the Chinese learner. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 161-179). Hong Kong | Melbourne: CERC | ACER.

Marton, F. (1981). Phenomenography – describing conceptions of the world around us. *Instructional Science,* 10, 177-200.

Marton, F. & Booth, S. (1997). *Learning and Awareness.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Meyer, J. H. F. & Land, R. (2005). Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. *Higher Education* 49(3), 373-388.

Neuman, W. L. (2011). *Social Research Methods: Qualitative and Quantitative Approaches*. Boston: Pearson.

Ng, D., Tsui, A., & Marton, F. (2001). Two faces of the Reed relay: exploring the effects of the medium of instruction. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 135-159). Hong Kong | Melbourne: CERC | ACER.

Pintrich, P. R. & Schunk, D. H. (1996). *Motivation in Education: Theory, Research and Applications.* Englewood Cliffs, New Jersey: Prentice Hall.

Prosser, J. (2000). Using phenomenographic research methodology in the context of research in teaching and learning. In J. Bowden, & E. Walsh, *Phenomenography* (pp. 34-46). Melbourne: RMIT University Press.

Prosser, M. & Trigwell, K. (1999). *Understanding Learning and Teaching: The Experience in Higher Education.* Buckingham, UK: Society for Research into Higher Education.

Prosser, M., Trigwell, K., & Taylor. (1994). A phenomenographic study of academics' conceptions of science learning and teaching. *Learning and Instruction,* 4, 217-231.

Salili, F. (2001). Teacher-student interaction: attributional implications and effectiveness of teachers' evaluative feedback. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 77-98). Hong Kong | Melbourne: CERC | ACER.

Schmidt, D. (1996). *A Summary of Characterizing Pedagogical Flow: An Investigation of Mathematics and Science Teaching in Six Countries*. London: Kluwer.

Silverman, B.J. (2014). *Interpreting Qualitative Data*. Singapore: Sage Publications.

Stigler, J. & Hiebert, J. (1999). *The Teaching Gap.* New York: The Free Press.

Tang, T. (2001). The influence of teacher education on conceptions of teaching and learning. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 221-238). Hong Kong | Melbourne: CERC | ACER.

Trigwell, K., Prosser, M., & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education,* 37, 57-70.

University of Sydney (2016). 2016-2020 Strategic Plan. [Online: https://www.sydney.edu.au/dam/intranet/documents/strategy-and-planning/strategic-plan-2016-20.pdf].

Watkins, D. & Biggs, J. (Eds.) (1996). *The Chinese Learner: Cultural, Psychological and Contextual Influences.* Hong Kong/Melbourne: Comparative Education Research Centre, The University of Hong Kong/Australian Council for Educational Research.

Watkins, D. & Biggs, J. (2001a). The paradox of the Chinese learner and beyond. In D. Watkins, & J. Biggs, *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives* (pp. 3-23). Hong Kong | Melbourne: CERC | ACER.

Watkins, D. & Biggs, J. (Eds.) (2001b). *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives.* Hong Kong/Melbourne: Comparative Education Research Centre, The University of Hong Kong/Australian Council for Educational Research.