Factors affecting students' experiences and satisfaction about teaching quality in Engineering

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ABSTRACT

Students’ experiences of their learning and the teaching in the subjects they are studying are one of the more ubiquitous sources of information about the quality of teaching for institutions and individual academics. The results are used in the design of new courses and degree programs, as evidence for promotions and awards, and for various policy decisions. The study described in this paper used 45,467 responses from engineering students to a standardized student feedback questionnaire over 7 years, to explore factors associated with variation in students’ learning experiences, including their experience of the quality of their teaching, and their overall satisfaction with their subjects. Of the factors considered, year of study, class size and coordinators’ professional development were significantly related with student satisfaction and learning experiences. Engineering sub-discipline, coordinators’ research activity, nature of employment and gender did not show any significant relations.
I. INTRODUCTION

Universities and governments are increasingly interested in using quality measures that provide evidence that can be used to improve the quality of student learning as well as for benchmarking and funding decisions. Standard scales for assessing the students’ experiences of their learning and of the teaching they receive during their studies are growing in popularity and use. At the level of the students’ whole program, instruments such as the National Survey of Student Engagement (NSSE) in North America [1], the National Student Survey (NSS) in England [2] and the Course Experience Questionnaire (CEQ) in Australia [3] are being used.

Questionnaires of this sort tap into a range of aspects of the student learning experience, and usually include an item on their overall satisfaction with their course. In the case of the Australian questionnaire, the areas selected to be monitored, such as effectiveness of teaching, have been found in research studies to correlate with the quality of student learning [3,4]. The questionnaire results are therefore more about students’ experience of their learning than about their satisfaction.

While these questionnaires provide information about specific areas of student experience which can be the focus of learning improvement interventions at the whole degree level, these changes are often hard to achieve. For this reason, questionnaires such as the Unit of Study Evaluation (USE) [5] have been developed as a means of collecting data from students on their experience of learning at the individual subject or unit of study level (these terms are interchangeable and are used as synonymously in this study). Some of the USE survey items correspond to the factor scales of the Course Experience Questionnaire [3]. Because of this correspondence, the USE can provide staff of the department, school or faculty with an indication of the relative contributions of different subjects, to faculty performance on the CEQ factor scales. The results of such studies are also used in the design of new courses and degree programs, as evidence for promotions and awards, and for various policy decisions.
This type of data from students is quite different to data collected about an individual teacher’s teaching performance, though most of the research on student feedback has been done on these student evaluations of teaching (SET) instruments focused on personnel evaluation [6,7]. The factors associated with SET results have been explored extensively. Some of the earlier studies [8] concluded that the SET depended more on the instructor than on the course itself. Other studies have shown relationships between the Faculty’s research activities and their undergraduate teaching [9].

In Engineering, Centra [10] and Dee [11] amongst others have compared SET of Engineering students with those in other disciplines. The views of students regarding what is a ‘quality Engineering Education’ has been also studied qualitatively [12]. What has not previously been explored are the relations between students learning experience and some of the factors that may be used to effect change to the quality of that experience.

The research described in this paper aims to address 5 questions:

1. How do USE scores change over time?
2. Are students’ learning experiences different between the years of study?
3. Are students’ experiences different between Engineering sub-disciplines?
4. Does class size correlate with USE scores?
5. What aspects of coordinators’ attributes are related to USE scores?

Section II reviews the literature on factors associated with variation in the quality of the student learning experience at the degree level. Section III describes the study method. Section IV reports the results, and Section V discusses the key findings and their implications.
II. BACKGROUND

A. Previous research on factors related to variation in student learning experience

**Course size.** The number of students enrolled in a university subject is known to relate to the way teachers approach their teaching [13]. When teachers perceive the class to be too large they adopt approaches to teaching that are more teacher-centered than student-focused. Relatively little is known about the ways that students in large classes experience learning.

**Changes over time.** Studies involving SET indicate that teachers do not become more effective with experience [6]. However, the research reporting changes over time on student experience questionnaires has not been reported. At the whole degree level, Course Experience Questionnaire scores over all disciplines and for Engineering show moderate increases each year [14].

**Year of study.** The experience of first year students has been widely studied, as it has a very high impact on the dropout rate of engineering students. The changes in environment, the adaptation to university life and the subject matter all affect junior engineering students. Senior students have work on specialization subjects, normally in smaller cohorts, so it is likely that the challenges they face are different.

**Discipline.** Differences between the engineering sub-discipline or department on student experience of learning have been studied and found to be not significant. Using confirmatory factor analysis Ginns et al. [15] used inter-rater agreements on Student CEQ to show that discipline scores can be meaningfully aggregated up to the faculty level. However, a similar analysis has not been conducted at the subject or unit of study level. At this level differences between sub-disciplines may be stronger because of the differences in the pedagogical designs adopted within schools, which
make independent decisions about the structure and other pedagogical aspects of the curriculum (i.e., assessment), but typically coordinate their approaches within their own school.

**Staff development.** There is growing evidence of the positive impact of staff development on a range of aspects of university teaching, such as approaches to teaching [16] and conceptions of teaching [17]. Some studies, including in Engineering [18,19], have looked at how training affects academics and teaching assistants. However, this evidence is not consistent with the conclusions drawn from the studies of Student Evaluations of Teaching (SET), which show that there is no change over time in ratings, and therefore that development programs are having no effect. None of these studies have looked at the effects of development on the student learning experience, though the studies by Trigwell, et al. [20] show positive correlations between university teachers’ approaches to teaching and their students’ experience of learning.

Teaching development programs at the University of Sydney are conducted annually with 30-40 academic staff who are involved in a program involving sustained engagement with the practice and theory of university teaching in a course that runs part-time over a full academic year [21]. The effects on students’ learning experience of such a sustained program have not previously been explored at the subject level.

III. METHOD

A. **Instruments**

The Unit of Study Evaluation (USE) questionnaire has 12 questions, 8 of which are standardized University-wide and 4 that are selected by each Faculty. It is designed to provide information to those seeking a) to assess the learning effectiveness of a subject, for planning and implementing changes in the learning and teaching environments, and b) to assess the contributions
of units or subjects to students’ learning experience in their whole degree program, as monitored by the CEQ. The Engineering version of the USE contains 12 statements:

I1. The learning outcomes and expected standards of this unit of study were clear to me.
I2. The teaching in this unit of study helped me to learn effectively.
I3. This unit of study helped me develop valuable graduate attributes.
I4. The workload in this unit of study was too high.
I5. The assessment in this unit of study allowed me to demonstrate what I had understood.
I6. I can see the relevance of this unit of study to my degree.
I7. It was clear to me that the staff in this unit of study were responsive to student feedback.
I8. My prior learning adequately prepared me to do this unit of study.
I9. The learning and teaching interaction helped me to learn in this unit of study.
I10. My learning of this unit of study was supported by the faculty infrastructure.
I11. I could understand the teaching staff clearly when they explained.
I12. Overall I was satisfied with the quality of this unit of study.

Eleven items (I1-I11) measure students’ learning experience and one item (I12) measures student satisfaction. Students indicate the extent of their agreement with each statement based on a 5-point Likert scale: 1 - strongly disagree, 2 - disagree, 3 - neutral, 4 - agree and 5 - strongly agree. Below each statement there is a space requesting students to explain their response.

Typically subjects are evaluated every 2-3 years, but individual faculties and academics can request additional evaluations. Requests for an evaluation are normally done by the unit of study Coordinator. A central administrative unit, independent from the academic teaching areas, is responsible for managing the data collection and analysis of USEs.

For this study, additional information was collected about the coordinators, including gender, professional development, scholarship of teaching and employment status. From a unit of study
description database we also compiled information about the pedagogical design and assessment approach of each subject.

B. Sample and procedure

Sample. The student experience of the 1226 subjects taught by Engineering departments at the University of Sydney over a period of 11 semesters (2001-2007) has been collected. Where the same subject was taught more than once we count each instance as a different subject. The subjects were coordinated by 235 academics. According to enrolment numbers, a maximum of 84,780 responses was possible. The initial database contained 45,467 responses (54% average response rate). Initially the dataset was screened for technical inconsistencies and low response rates. During cleaning the following cases were removed: 1) records with system errors; 2) cases that contained more than 50% of missing responses; 3) subjects with response rate below 20%; 4) small population subjects (10 or less students) with response rate less than 50% and 5) 2003 semester 2 data, where records show that only 4 subjects were evaluated. In total 5.8% records (5.4% of subjects) were removed. The final dataset contained 42,853 student responses from 82,510 enrolments in 1159 subjects coordinated by 231 academics (response rate 51.94%). This dataset was used in the analysis.

The information about coordinators was obtained from the administration. However, this data was not complete and the percentage of missing data varied from 13% to 22% (details are reported later).

Data analysis. The resulting dataset was weighted and analysed on a subject level and student level. Subject weights were inversely proportional to the number of valid responses in the subject and, therefore, each subject had the total weight 1. Student weights were equal to the number enrolled divided by the number of responses. (In most cases results are reported at the subject level,
except those situations when relationships between class sizes and student experiences are examined, see step 5 below).

Analysis included the following steps:

1. Initially individual USE items were analyzed separately.
2. Relationships between the responses to individual items have been investigated using correlation analysis.
3. The USE scale was examined with factor and scale reliability analyses and from the outcome of that examination the subsequent analyses used three aspects from the USE: the average of students’ experience on 10 items (AV10), experience of workload (I4) and overall satisfaction (I12).
5. USE responses for subjects offered in year 1 to 4 and postgraduate (year 5 or later) were examined and compared and the impact of the class sizes was investigated.
6. Sub-disciplinary differences were examined by comparing the evaluations of units offered centrally by the faculty (ENGG, and listed as a school for the analysis) and by the five schools: Aerospace, Mechanical & Mechatronic (AMME); Chemical & Biomolecular (CHEM); Civil (CIVL); Electrical & Information (EIE) and Information Technologies (IT).
7. Information about coordinators was cross-tabulated with USE responses using following aspects: 1) professional development in HE teaching (measured as completion of Graduate Certificate in HE); 2) coordinator’s gender; 3) employment status (internal, external) and 4) scholarship (research active vs. not active).

T-tests were used for comparing two independent groups. ANOVA tests were used for the identification of significant differences with Games-Howell post-hoc tests for three or more independent groups (Welch F was reported, if Levine’s statistic for homogeneity of variance is
significant) [22]. Probability of p < .05 was used as a level of significance in all analysis the exact results of t tests and ANOVA are reported only when significant differences were found.

IV. RESULTS

A. Aspects of students' experiences

Table 1: Average scores for 12 USE items.

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1 ('outcomes')</td>
<td>1137</td>
<td>3.64</td>
<td>0.910</td>
</tr>
<tr>
<td>I2 ('effectiveness')</td>
<td>1140</td>
<td>3.57</td>
<td>0.984</td>
</tr>
<tr>
<td>I3 ('graduate attributes')</td>
<td>1139</td>
<td>3.57</td>
<td>0.908</td>
</tr>
<tr>
<td>I4 ('workload')</td>
<td>1136</td>
<td>3.04</td>
<td>0.932</td>
</tr>
<tr>
<td>I5 ('assessment')</td>
<td>1137</td>
<td>3.60</td>
<td>0.904</td>
</tr>
<tr>
<td>I6 ('relevance')</td>
<td>1144</td>
<td>4.08</td>
<td>0.845</td>
</tr>
<tr>
<td>I7 ('responsiveness')</td>
<td>1137</td>
<td>3.80</td>
<td>0.911</td>
</tr>
<tr>
<td>I8 ('prior learning')</td>
<td>1131</td>
<td>3.49</td>
<td>0.935</td>
</tr>
<tr>
<td>I9 ('interaction')</td>
<td>1116</td>
<td>3.59</td>
<td>0.989</td>
</tr>
<tr>
<td>I10 ('infrastructure')</td>
<td>1122</td>
<td>3.51</td>
<td>0.948</td>
</tr>
<tr>
<td>I11 ('understand')</td>
<td>1128</td>
<td>3.63</td>
<td>0.985</td>
</tr>
<tr>
<td>I12 ('overall')</td>
<td>1116</td>
<td>3.70</td>
<td>0.919</td>
</tr>
<tr>
<td>Av10</td>
<td>1159</td>
<td>3.65</td>
<td>0.380</td>
</tr>
</tbody>
</table>

The average responses on individual aspects of students’ experience within the subjects were distributed between “Neutral” (3) and “Agree” (4) (Table 1). The relevance of the subject to student’s degrees (I6) was rated most highly (M = 4.08, SD = 0.845, n = 1144) followed by ratings of staff responsiveness to student feedback (I7, M = 3.8, SD = 0.911, n = 1137). The items rated lowest include: adequacy of prior preparation for learning the unit (I8, M = 3.49, SD = 0.935, n = 1131), the support of the faculty’s infrastructure for learning the unit (I10, M = 3.51, SD = 0.948, n = 1122); effectiveness teaching (I2, M = 3.57, SD = 0.984, n = 1140) and the contribution of the
subject to students’ graduate attributes (I3, $M = 3.57$, $SD = 0.908$, $n = 1139$). The average of the responses to the item about the workload (I4) was $M = 3.04$, $SD = 0.932$, $n = 1136$, indicating that students were neutral about this aspect of their learning experience in most of the subjects, i.e., neither agreeing nor disagreeing that “The workload in this unit of study was too high”.

Most of the responses to individual items correlated significantly, but there were large differences and Pearson correlation coefficients ranged from -.184 (I4 and I12) to .724 (I2 and I12). The correlations indicated that the relationships between the workload (reversed I4 score) and other items were negative and low (absolute values between .005 and .184) while correlations among all other items are positive and stronger (from .182 to .724).

**B. Changes over time**

The average evaluation scores (Av10) fluctuated over 2001 - 2007, but from 2003 to 2007 tended to increase (Fig. 1). These changes were relatively small and insignificant ($p > 0.05$). The fluctuations in students’ satisfaction (I12) followed similar pattern, with a minimum 3.62 ($SD = 1.04$, $n = 66$) in 2003 and gradually increasing to 3.76 ($SD = .893$, $n = 203$) in 2007.

Students’ feedback about the workload also fluctuated ranging on average from 2.92 ($SD = 0.920$, $n = 157$) in 2002 to 3.12 ($SD = 0.938$, $n = 207$) in 2006, however these variations were small and insignificant.
These results suggest that on average faculty’s interventions have not been particularly influential in changing the average scores of assessed subjects each semester. An exception was the professional development program (the latter result is discussed later).

C. Year of study and students' experiences

Figure 2 shows the average and 95% confidence intervals for subjects in each of the academic years. All Engineering degrees at the University of Sydney are 4 years long followed by one or more years of postgraduate studies (‘5+’ indicates those subjects that are offered for postgraduate coursework students). Year 5+ subjects are normally very specialized, and are normally electives for most students. The average evaluation scores tended to be the lowest in the units offered in the first two years of study and the highest in the fourth and postgraduate years (5+) of study. ANOVA and post hoc test showed that the second year subjects were on average evaluated significantly lower (M = 3.52, SD = 0.636, n = 185) than those in 4th year (M = 3.73, SD = .568, n = 249) and 5th or more years (M = 3.76, SD = .616, n = 242), F (4, 1153) = 5.741, p = .000, effect size $\omega =0.127$. Other differences were insignificant (Fig. 2).
Student satisfaction (I12) was the lowest in the first two years and the highest in the fourth and postgraduate years. ANOVA and post hoc test again showed that student satisfaction in the second year subjects, on average, was significantly lower (M = 3.51, SD = 0.982, n = 177) than those in the last year of studies: 4th year (M = 3.82, SD = .852, n = 240) and year 5+ electives (M = 3.82, SD = .842, n = 236). Evaluations of the workload (I4) did not vary significantly across the years of study.

These results suggest that students have a better learning experience in the last year, this is when students have the most freedom to choose subjects, and where they do their thesis projects on their chosen topic.

D. Class size

The correlation of the USE averages with the number of students enrolled in a subject was negative and significant (r = -.342, n = 1159, p < .001). Class sizes decrease for later years of study, but when the impact of the study year was controlled, the partial correlation between the USE average scores (Av10) and class size was still negative and significant (r = -.261, n = 1156, p < .001). These results indicate a potential direct relationship between class sizes and students’
experience of their learning environment, this relationship is likely to be stronger in the engineering subjects where laboratory activities are an important component. This is likely to be the reason that one of the lowest ratings was for how the faculty infrastructure supported their learning.

Similar relationships were found between the students’ overall satisfaction (I12), class size and study year. The correlation of the overall (I12) averages with the number of students enrolled was negative and significant ($r = -0.312$, $n = 1159$, $p < .001$), and remained negative and significant ($r = -0.243$, $n = 1156$, $p < .001$) when the year of study was controlled.

E. Sub-disciplinary differences

On average there were no significant differences between students’ average experiences offered by different schools at the unit level. However there were significant differences between experiences when the analysis is done at the student level. In this case schools with smaller cohorts tend to do better. More details are described in Appendix A.

D. Coordinators’ profile

*Graduate certificate.* In 2007, there were 19 subject coordinators in the faculty who had completed a year-long Graduate Certificate in university teaching (Grad Cert) program. They coordinated 67 subjects before they began the program and 94 subjects after their graduation.

Before graduating their average USE (Av10) results ($M = 3.47$, $SD = 0.646$, $n = 67$) were significantly lower than the results after their graduation ($M = 3.68$, $SD = 0.627$, $n = 94$), $t = 2.041$, $df = 159$, $p = .043$, effect size $r = 0.16$. The average student satisfaction and agreement with the statement about the workload also increased, but insignificantly. These results are very encouraging, showing the positive impact of professional development programs.

The average USE (Av10) results for the 67 subjects coordinated by those who went on to complete the certificate were lower than for those who did not, but the differences were not
statistically significant. This points to the likelihood that some of those who went through the program did it as remedial intervention because they were asked to or for personal motivation.

The average USE (Av10) results for the 94 subjects coordinated by Graduate Certificate graduates were higher than for the whole set, but the differences were not statistically significant. Similarly insignificant differences were found for overall satisfaction (I12), and workload (I4).

**Coordinators’ personal attributes and USE.** Information about coordinators’ employment status, research output and gender was obtained for 78% - 89% of subjects evaluated using USE over 2001 - 2007 period (Table 2).

**Table 2: Coordinators’ personal attributes**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
<th>Valid %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External</td>
<td>179</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Internal</td>
<td>827</td>
<td>71</td>
<td>82</td>
</tr>
<tr>
<td>Missing</td>
<td>153</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Research active</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>127</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Yes</td>
<td>777</td>
<td>67</td>
<td>86</td>
</tr>
<tr>
<td>Missing</td>
<td>255</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>96</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Male</td>
<td>903</td>
<td>78</td>
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<tr>
<td>Missing</td>
<td>160</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1159</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

There were no significant differences between student average experiences (Av10), overall satisfaction (I12) and all individual aspects of experience (I1-I11), except for graduate attributes (I3). Students tended to reply more positively to the latter item about the graduate attributes if the
unit was coordinated by external lectures (M = 3.71, SD = 0.883, n = 176) rather than internal (M = 3.54, SD = 0.914, n = 813), t = 2.195, df = 986, p = .028, r = 0.07.

There were no significant differences between the average evaluations of the units (Av10), students’ experiences related to individual aspects (from I1 to I11) and overall satisfaction (I12) irrespectively if the unit was coordinated by female or male staff or by research active or not research active staff.

V. DISCUSSION AND CONCLUSIONS

Students’ perceptions about ten aspects of their learning experience correlate positively with their satisfaction with the quality of that subject. Engineering students are satisfied with the quality of their subjects when the learning outcomes and expected standards were clear to them, when the teaching helped them to learn, when they developed valuable graduate attributes, when the assessment allowed them to demonstrate what they have understood, when they could see the relevance of their subject to their degree, when staff were responsive to feedback, when their prior learning prepared them well, when they could understand their teacher, and when the faculty infrastructure was seen to be supportive. Regression analysis showed that almost all aspects of students experience uniquely contribute to students’ satisfaction with the subject quality. This provides evidence that students’ satisfaction could be better improved via holistic interventions rather than those that address only individual aspects. Nevertheless, process variables related directly to teaching, such as supportive teachers and their ability to explain clearly, were most influential factors that impacted students’ satisfaction the most, while workload and infrastructure had the smallest impact on students’ satisfaction. This indicates the critical role of staff development in higher education.
Of the factors considered, Engineering sub-discipline, coordinators’ research activity, nature of employment and gender did not show any significant relation with learning experience or satisfaction with the quality of the subject.

The year of study of a subject, smaller class size and coordinators’ professional development were all significantly correlated with higher student satisfaction and better learning experiences. These relationships suggest that reducing class size (or the effects on students of large class sizes) and providing more opportunities or incentives for professional development (teacher training) may improve students’ learning experience. These relations also suggest that when using the USE results for promotion and teaching awards, the possible effects of class size and the year of study of the subject need to be considered.

VI. ACKNOWLEDGEMENTS

The authors would like to thank Yun Cai for her help collecting and analyzing data for this project, and the participants of a faculty workshop participants were many of the ideas discussed here were matured. This project was partially funded by a University of Sydney Teaching Improvement Fund.

VII. APPENDIX

A. Sub-disciplinary differences

Subjects were offered by the six different schools listed earlier. Schools varied in terms of the number of the subjects they offered that were assessed using the USE, from 42 units (ENGG) to 294 units (IT) over the period of seven years. They also varied in terms of the number of students who took these units from 5,712 to 23,526 and average numbers of students enrolled in the evaluated units ranged from 40 to 152 (Table 3).
Table 3. Numbers of subjects evaluated using USE in different years of study and an average number of students in a subject in each school

<table>
<thead>
<tr>
<th>Year School</th>
<th>Years of study</th>
<th>Total of subjects</th>
<th>Average class size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>AMME</td>
<td>36</td>
<td>51</td>
<td>86</td>
</tr>
<tr>
<td>CHEM</td>
<td>12</td>
<td>36</td>
<td>53</td>
</tr>
<tr>
<td>CIVIL</td>
<td>7</td>
<td>29</td>
<td>58</td>
</tr>
<tr>
<td>EIE</td>
<td>11</td>
<td>30</td>
<td>93</td>
</tr>
<tr>
<td>ENGG</td>
<td>25</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>IT</td>
<td>26</td>
<td>34</td>
<td>71</td>
</tr>
<tr>
<td>Total</td>
<td>117</td>
<td>185</td>
<td>366</td>
</tr>
</tbody>
</table>

Note: n – total number of units evaluated, M – an average number of students in the evaluated units, offered by a school, SD – standard deviation.

On average there were no significant differences between students’ average experiences offered by different schools at the unit level. However there were significant differences between the experiences at individual student level, Welch F (5, 26933) = 211.75, p = .000, ω = 0.106. The highest USE averages at student level were for CHEM units (M = 3.69, SD = 0.551, n = 5712) and the lowest for EIE (M = 3.47, SD = 0.674, n = 23526) and ENGG (M = 3.41, SD = 0.6110, n = 6374), while differences between other three schools were small.

Overall, even the differences were insignificant on a subject level, the USE averages for schools were inversely proportional to the average number of students enrolled in the subjects (Fig. 3). The results for students’ satisfaction (I12) were similar to the average experience (Av10). Students’ answers about the workload varied between the schools, indicating that on average
students enrolled in the units offered by three schools (AMME, EIE and IT) tended to agree with the statement that the workload was too high, while the students enrolled in the units offered by ENGG school agreed with this statement least often, $F(5, 1130) = 1.969, p = .045, \omega = .075$. However, the post hoc test did not confirm that any of these differences were significant, $p > .05$.

**Figure 3**: Relationship between the average unit size and average students’ responses to 10 USE questions.

**B. Hierarchical Multiple Regression analysis**

The relationship between students’ overall satisfaction (I12) and various aspects of their experience where investigated further using hierarchical multiple regression and enter method. Overall satisfaction (I12) was used as a dependent variable in the regression analysis.

The 3P model [23] includes a Presage (i.e. what the student knows and the context around him), a Process (i.e. the learning focused activities) and a Product (i.e. the learning outcomes).

Using this model, 11 experience variables were grouped into three parcels: 1) presage (prior experience) (I8), process experience (I1, I2, I4R, I5, I7, I9, I10, I11), product experience (outcome)
(I3, I6). These variables selected as independent variables for the hierarchical regression analysis. One presage variable was entered into regression analysis in the first step, all 8 process variables were entered together in the second step and two product variables were entered together in the last. Table 4 and 5 show the summary of the results.

Overall, all 11 experience variables explained 68.8% of variance in students’ overall satisfaction. At the first step obtained regression explained 14.1% of variance in the students' overall satisfaction. Process variables, entered at the second step explained further 53.4% of variance, while product variables entered in the last step explained only 1.2% of additional variance. All three increments were statistically significant. In the final model, however, all standardized regression coefficients, but for I8 were statistically significant indicating that this presage variable had an indirect relationship with students’ satisfaction. All other standardized regression coefficients where statistically significant, suggesting that each of them made unique contribution to students experience. The independent variables that accounted for largest proportion in students’ satisfaction were process variables related directly to teaching (I2, I11) while workload (I4) and infrastructure (I10) accounted for the smallest variance in overall satisfaction.

Table 4. Hierarchical regression of students’ satisfaction and experience: Model summary

<table>
<thead>
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1. Predictors: I8

Table 5. Hierarchical regression of students’ satisfaction and experience: Coefficients
The scale reliability coefficient Cronbach alpha for the 11 experience items was .839. However, reversed I4 correlation with the rest of the scale was low (.139), suggesting that this item does not belong to the scale. After deleting I4, Cronbach alpha increased to .857 (a very high reliability). When these 10 items were further examined with factor analysis for possible underlying smaller sub-components, only one underlying factor with eigenvalue more than 1 was found. This confirmed that these 10 items form one factor and measures general students’ learning experience, while item 4 (I4) measures their experience specifically with the workload. For this reason, an average for 10-items (Av10) was further used in the analysis, while items 12 (satisfaction) and 4 (workload) were examined separately.
VIII. REFERENCES


IX. AUTHORS BIOGRAPHIES

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