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Implementing vertical and horizontal engineering students' integration and assessment of consequence academic achievement

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Abstract
Recent scholarship references indicate that integration of the student body can result in an enhanced learning experience for students and also greater satisfaction. This paper reports the results of a case study whereby mechanical engineering students studying at a newly established branch campus in Dubai of a British university were exposed to vertical and horizontal integration. Different activities have been embedded to ensure that students integrated and worked together with their peers and colleagues at different levels. The implemented processes and practices led to improved academic achievements, which were better than those of a similar cohort of students where no effort had been made to integrate. The analysis revealed that cooperative learning and the degree of academic support provided by teachers are positively and directly correlated with academic as well as the students' own sense of personal achievement. The results are discussed in light of previous research and with reference to the cultural context of the study.

Keywords
vertical, horizontal, engineering, implementing, integration, consequence, assessment, students, achievement, academic

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Implementing Vertical and Horizontal Engineering Students Integration and Assessment of Consequence Academic Achievement

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Abstract

Recent scholarship references indicate that integration of the students' body can result in an enhanced learning experience for students and greater satisfaction. This paper reports the results of a case study whereby mechanical engineering students studying at a newly established branch campus in Dubai of a British university, were exposed to vertical and horizontal integration. Different activities have been embedded to ensure that students integrated and worked together with their peers and colleagues at different levels. The implemented processes and practices led to improved academic achievements, which were better, than these of a similar cohort of students where no effort has been made to integrate. The analysis revealed that co-operative learning and the degree of academic support provided by teachers are positively and directly correlated with academic as well as students' own sense of personal achievement. The results are discussed in light of previous research and with reference to the cultural context of the study.

Keywords: Engineering education, vertical and horizontal integration, group work, students learning.

Notation

S	standard deviation
σ^2	variance
μ	algebraic mean
K	number of items for each factor
N	number of samples
df	degree of freedom
α	Cronbach's α
P	Statistical Significance
EE	Electrical and Electronic
ME	Mechanical
AY	Academic Year
M	Mandatory Course
E	Elective Course

1. Introduction

An important aspect of the classroom environment is vertical and horizontal integration. This integration may influence students' academic achievement. The availability of teachers and peers on whom students can rely for assistance to achieve academic support, is critical for productivity in higher education (Johnson 1994). Vertical integration among students can be defined as the provision of informational aid and sharing of learning roles through all learner stages, where students from higher levels are helping students from lower levels to understand engineering concepts and to work collaboratively on projects (Pai *et al.* 1998). This informational aid is most often a reciprocal process among students, mutual benefits are maximized as students work together to complete common tasks in a supportive environment. Moreover, vertical integration in learning has the potential to reduce time demands and stress on engineering students. Conversely, horizontal learning is defined as mere students from the same level, learn from each other (Orkwis *et al.* 1997). Hence, students share knowledge and resources among themselves in order to achieve common goals, ensuring that all members learn assigned material. Vertical and horizontal integration may also be an important factor in achieving improved student comprehension of topics and concepts covered in different courses during the years of study (Giralt *et al.* 2000, Snyman and Kroon 2005).

The literature includes strong evidence regarding the relative superiority of vertical integration of education in promoting greater social support in comparison with competitive and individualistic forms of study. For example, research on vertical integration has been conducted in General Practice (GP) education in Australia (GP Education and Training 2004). The General Practice Education and Training (GPET) a Commonwealth body to administer vocational general practice training in Australia, has developed a national framework which supports one of its objectives: to promote the vertical and horizontal integration of general practice education and training at a regional level (GP Education and Training 2004). GPET suggests that the application of this framework, which may be used by governments, education providers and policy-makers, will require flexibility and diversity in the use of vertical integration models. The GPET model (VITAL) involves the sharing of teaching and learning roles across all the learner stages. Its working operation is shown in Figure 1. VITAL was based on vertical integration education theory and its hypothesis is that teaching conducted by GP registers can help in two ways; by linking the different stages of learning and by alleviating some of the pressures on the teaching workforce (GP Education and Training 2004). The arrows in figure 1 indicate that learning is occurring for both the parties involved. The width of the arrows reflects the load of teaching between individuals. In this model, the GP trainer keeps a commitment to teaching medical students and junior doctors, at the same time he/she is not the sole person contributing to the teaching load. The VITAL model represents a vertical integration framework for GPET which has the potential to decrease stress and time demands on general practitioners, and to improve the learning experience for medical students (GP Education and Training 2004).

Along similar lines, Rosenthal *et al.* (2004) conducted research to improve medical education and service delivery in areas of poorly met medical needs. The authors concluded that vertical integration of medical education is a popular goal in many rural regions throughout the world. Moreover, vertical and horizontal integration was adopted by the faculty of dentistry at the University of Pretoria (Giralt *et al.* 2000). They have defined vertical and horizontal integration as the integration of basic sciences into the clinical curriculum, whereby, they have integrated knowledge and skills. They have used problem solving as the driving force behind the integration. They concluded that such integration will help in making learning more relevant and more available for use in clinical context. When considering implementing integration into the curriculum there is a concern that this model will require increased staff resources. A comparison of the outcomes of a problem based learning modules for large and small classes were conducted by Roberts *et al.* (2005). The results of this investigation found no significant differences in the learning outcomes of the two groups. This was mainly due to the availability of e-learning resources to both groups.

The ABET's (Accreditation Board for Engineering and Technology) Engineering Criteria (2010), the U.S. standard for accreditation, "*explicitly requires that engineering programs demonstrate that their graduates possess communication, multidisciplinary teamwork, and lifelong learning skills*" (Witt 2005)]. Project based and cooperative learning methodologies were both considered, since they would enable students to acquire technical and scientific knowledge and to simultaneously develop the social competencies needed in real life work settings (German federal Ministry of Education and Research 1999). During 2004-2005, the Departments of Electrical and Computer Engineering and Mechanical Engineering at Iowa State University, in collaboration with educational counter parts in the Research Institute for Studies in Education, piloted a new curriculum model to improve student learning through vertical integration of educational activities using new program structures (Feldman 2006). Overall the students felt that the vertical integration education program promoted student-to-student interaction, faculty-to-student interaction, continuity of class material, and encouraged a deep understanding of the course concepts (Feldman 2006). Similarly, two way integration of engineering education has been conducted by Giralt *et al.* (2000) at the School of Chemical Engineering (ETSEQ) of the University of the University Rovira Virgili at Tarragona.

Here, vertical and horizontal integration of engineering education has been achieved through an early-design project. The project is embedded into the undergraduate engineering curriculum as an activity that involves, horizontally, several first-year subjects and vertically a fourth-year project management practice course together with a related project management subject (Giralt *et al.* 2000). First year student teams are led by one fourth-year student enrolled in the project management practice course. This way, engineering skills that include project management and quality management are introduced from year one of the undergraduate programmes. The tools used to assess this integrated design projects were surveys, group discussions, individual interviews, and final reports and presentations. The feedback collected from the different groups was positive. Moreover, vertical integration of different technologies at different levels has been investigated by the electrical and computer engineering at Rowan University and has found encouraging results for students' comprehension (Ramachandran *et al.* 2010). Vertical integration has been achieved by laboratory exercises that start at lower levels and proceed as increasingly complex open-ended design projects at upper levels of the curriculum. The assessment results were very encouraging (Ramachandran *et al.* 2010).

The majority of the previous case studies were conducted in western countries apart from Gaith (2002), where the research of cooperative learning was conducted for English language students in the Middle East. The research investigated the relationship between cooperative learning, social support, academic achievement of learners, and feelings of alienation from school.

This paper explores the advantages of embedding vertical and horizontal integration into extra curricula activities and curriculum development of a number of engineering programmes at a British university (Heriot Watt) located in a multi-cultural, conservative Middle Eastern country (United Arab Emirates).

The authors recognize the complex relationships that exist between personal, cultural, social and economic factors and their impact on academic functioning. These factors can affect student learning through effect on one's emotions, and therefore one's intellectual functioning (Gold 1979, Nunn 2011). Since the multicultural nature of classes at the campus are comparable in our opinion with the main campus in the UK (where more than 30% of the total number of students are from outside the UK (Heriot Watt University Prospectus 2009)), we believe that it is reasonable to assume that socio-culture factors impact on the groups at the two campuses, Dubai and UK, are comparable. It is important to mention here that all other teaching and learning factors such as delivered material, pace of delivery, number of delivery hours, and exams are identical at both campuses. It was noted over the past five years that students transferring from Dubai campus to the main campus encounter no problems as both the system and delivery are identical. Furthermore, the Dubai campus operates under the same protocols and is governed by the same procedures with regard to the relationships between students and academic staff. Students to students' relationships are also comparable (Betz 1942).

2. Vertical and Horizontal Integration: A Case Study

Within any one stage of study within the Heriot Watt university four year engineering programmes at both campuses, the nature is such that students can interact with each other without the need to exert exceptional efforts because the group shares the same courses, lectures, laboratory sessions, etc.. These groups of students are therefore expected to integrate well with each other without strict guidance or specialist support. The issue faced at the university therefore is how to encourage students from different stages i.e. different levels of study, to interact vertically with their seniors and juniors, as well as they normally do horizontally with their class mates. Even if students from various stages are willing to vertically integrate, the pragmatics of timetabling, attendance criteria, lab sessions slots, site visits requirements, etc. make the interaction difficult to implement. Furthermore, our student population comes from a diverse backgrounds, ethnicity and nationalities (some 24 different nationalities). It is necessary that any implemented system does not lead to segregation along ethnic and nationality lines but to be cross these divides. To accomplish this aim, the following measures were implemented:

Following the ABET's Engineering recommendation (2010), the program was reengineered in such a way to include science and engineering knowledge together with the skills that will be gained from the vertical and horizontal integration. These skills can be classified as technical knowledge and skills in engineering, project management, decision making, teamwork and cooperation. The list of activities that were embedded into the mechanical engineering program is described below.

- **Multidisciplinary group projects**: First year students were given a group project with 3-5 students in each group. The groups were formed to include students from all disciplines such as mechanical, civil, automotive, engineering and management, etc.

- **Group projects that involve students from different levels:** Groups of students from the first year were given projects to work on with a team mentor from a senior level. The two projects that conducted were Sink or Swim project, requiring students to work on a design project related to the strength of materials, hydraulics and engineering mechanics, and the other project was related to dynamics and power generation.

- **Site visits**: Site visits were carefully designed so that the site trip involves students from across years 2, 3 and 4 and from across the programmes. For example, when a visit to Al-Aweer power station was conducted, students from mechanical engineering years 2, 3 and 4 took part with a carefully planned support to the courses of Mechanical Engineering Science (MechEngSc) 6 (year 2 module), MechEngSc 10 (year 3 module) and Thermodynamics 2 (year 4 module).

- **School open days**: Open day activities were designed in such a way that it required participation from all stages (years 1 - 4). Interaction with visitors and parents was done on equal footing among the team as it is often more effective for junior students talk to potential applicants and for senior students to discuss their studies with parents and guardians.

- **Peer mentoring system**: At the programme level, a peer mentoring system was developed where groups of students from lower levels were assigned mentors from senior levels. Feedback from students over the past four years was very positive and attributed specific benefits to the academic performance of the mentee and also to his/her professional development as an engineering student.

- **Competition projects support**: We developed a procedure that allows groups of students to work supervised on an engineering project of their choosing (mainly for competition participating purposes), with the stipulation that the group is multi-disciplinary and that members are representatives from all stages of that particular programme.

- **Student engagements with Honours project development:** Junior students were encouraged to visit the senior students' projects room. This way the junior students are introduced to the engineering practice in a personal way, they learn from their peers who have acquired skills over the four years of study.

- **Educational fair participation:** students from different levels were asked to participate in educational exhibitions that were held throughout the year. These students were given projects to work on that were then showcased at these exhibitions.

The open days, educational fairs, etc. involve demonstrating a working engineering system designed and built by students from all stages (systems included; dispenser, lunar vehicle and multi task robot). The approach used combines curriculum development and extra curricula activities that strengthen team work. The other activities such as school participation, peer mentoring, and educational fairs, help in improving team building skills and those of cooperation, client orientation, innovation, and engineering reasoning. These skills will enable students to meet the needs of changing market conditions.

3. Research Methods

The measure of the success of implementing vertical and horizontal integration into the curriculum was indicated by two measures; the overall experience of the students (which was measured by carrying out a survey at the end of the semester to rate the overall experience), and the academic achievements of participating students.

Three graduating cohorts with the same entry requirements totaling sixty nine (n=69) students, enrolled in the mechanical (70%) and electrical and electronic(30%) engineering BEng (Hons) programmes at Heriot-Watt University Dubai campus took part in this study. There were 57 males (82%), and 12 females (18%). The participants were from different ethnic backgrounds and English was not the first language spoken at home for most of the participants. The age of the participants ranged from 18 to 25 years. The participants' achievements were obtained from the factor (Academic Achievement AA) and this result is correlated with the responses to the survey questions as explained in section 3.1 below.
Two methods were used in this research, stated learning achievement surveys and actual academic performance. The data sources and descriptive statistics are given in the next sections.

3.1 Stated Learning Achievement Surveys

A modified version of the Classroom Life Measure (Johnson 1983) was administered to the participants in order to assess the connection of vertical integration to students' academic achievement. The modified version of the Classroom Life Measure used in the present study consisted of 29 items that measured these factors (variables) under investigation (see Appendix 1). It comprises 29 questions to which respondents indicate on a 4-point scale the truth of the statement, where a rating of ''1'' indicates that the statement is very untrue and a rating of ''4'' indicates that the statement is very true. The 29 items measure 5 factors that have been identified both theoretically and through previous factor analysis (Johnson 1983, Johnson *et al.* 1983, Johnson 1989). The five factors are Cooperation and Group work (CGW), Academic Staff Support (ASS), Peer Academic Support (PE) and Feeling of Association (FA) and Academic Achievement (AA). However, only four factors were used in the analysis as the Academic Achievement factor was obtained directly from the students' results over the period of their study.

Eight items (2.1, 2.5, 2.6, 2.7, 2.12, 2.13, 4.2, 4.4) measured the factor of Cooperation and Group Work (CGW) defined as the extent to which other students wished to help their fellow students to learn. Similarly, items (2.8, 2.10, 4.1) measured the factor of Academic Staff Support (ASS) defined as the belief that the teacher cares about students as individuals. Items (2.9, 3.1, 3.2, 3.3, 3.4, 4.3) measured the factor of Peer Academic Support (Personal Effect PE), and items (1.3, 2.2, 2.3, 2.4. 2.6, 2.11) measured the factor of Feeling of Association (FA) defined as student's sense of belonging to school, peers, and classroom activities.

Scores were computed for all participants by adding the scores on the sub-scales in the study instrument respectively measuring the variables of the different factors, AA, CGW, ASS, PE, and FA. The scores on the negatively worded items were reversed in order to ensure that high scores meant agreement with the truth of the statements. Descriptive statistics (means and standard deviations) and Simple Pearson correlation coefficients were computed between the scores on the scales of cooperative learning and achievement and the composite scores on the sub-scales used in the instrument in order to determine the degree of interrelatedness among the variables under investigation and achievement (Kinney 2002).

3.2 Actual Academic Performances

Data was gathered and results achieved from each academic year from 2006-2007 to 2010-2011 for three different cohorts, were collated (these include a graduating BEng mechanical engineering cohort in 2009-2010, a graduating BEng mechanical and electrical cohorts in 2010-2011). The mechanical engineering cohort that graduated in 2009-2010 experienced limited exposure to the vertical and horizontal integration practices (only after their 2nd year, the electrical engineering cohort was not exposed. The mechanical engineering 2010-2011 cohort was fully exposed and took an active part in the integration practices from the first year.

The items measured in this survey used the following relationships (Kinney 2002, Berg and Latin 200, Distribution tables).

Standard Deviation

$$S = \sigma = \sqrt{\sigma^2}$$

Variance

$$\sigma^2 = \frac{1}{(N-1)} \sum_{i=1}^{N} (X_i - \mu)^2$$

Mean

$$\mu = \frac{\sum_{i=1}^{N} X_i}{N}$$

Degree of freedom

$$df = \frac{\left(\frac{S_1^2}{N_1 - 1} + \frac{S_2^2}{N_2 - 1} \right)^2}{\left(\frac{S_1^2}{N_1 - 1} \right)^2 \left(\frac{1}{N_1 + 1} \right) + \left(\frac{S_2^2}{N_2 - 1} \right)^2 \left(\frac{1}{N_2 + 1} \right)} - 2$$

t score

$$t = \frac{X - \mu_X}{\sigma_X}$$

t critical

For known t, α and df, t critical can be found from distribution tables (Distribution Tables).

Pearson correlation

$$r = \frac{\sum_{i=1}^{N} (X_i - \overline{X})(Y_i - \overline{Y})}{(N-1)\, S_X\, S_Y}$$

Cronbach's α is defined as

$$a = \frac{K}{K-1} \left(1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_X^2} \right)$$

4. Comparison Analysis

4.1 Stated Learning Achievement Surveys

Table 1 presents the factors, the associated items, and their Cronbach' alpha reliability coefficients based on data collected from the previous study. The reliability coefficients are used as a measure of the internal consistency of the test scores for a sample of respondents.

Table 2 presents the correlation coefficients for the variables in the study. The data shows very good correlations between cooperation and group work and academic staff support $r = 0.807$, $P<0.05$, feeling of association $r= 0.807$, $P<0.05$, personal effect $r =0.679$, $P<0.05$, and a low correlation with achievement $r=0.305$, $P<0.05$. However, the data reveals that there is a high correlation between personal effect and academic achievement $r =0.711$, a moderate correlation between academic staff support and academic achievement $r=0.578$ and weak correlation between feeling of association and academic achievement $r=0.422$. Similarly, the data indicate good correlation between personal effect and feeling of association $r=0.788$, and academic staff support $r=0.646$. Furthermore, academic association factor shows a moderate correlation with feeling of association $r = 0.679$.

The significance of the main effects of the factors under study on academic achievement has been investigated further and the results are shown in Table 3. The analysis shows significant effects for the factor of cooperation and group work ($t =-2.412$, $P=0.009$). On the other hand, the results reveal no significant effects for academic staff association ($t=-0.776$, $P=0.220$), and feeling of association ($t=-0.286$, $P =0.388$) and moderate effect on personal effect ($t=-0.918$, $P = 0.18$) on academic achievement. The survey results for the four factors are shown in Figure 2.

4.2 Actual Academic Performances

Figure 3 compares the average performance of the above three cohorts. It can be seen that the mechanical engineering cohorts' averages are much higher than the electrical engineering cohort. Also, the mechanical engineering cohorts fair the best in term of average class performance.

Figure 4 compares the A grade (the highest grade) for the three cohorts over the four years of the program. The highest number of "A" grades in the fourth year (the Honour year) was achieved by the current cohort of mechanical engineering students (ME AY 2009-2010). It is also interesting to note that after involving the 2009-2010 cohorts in the process following year 3, their performance also improved. The cohort that was not exposed to the practices outlined above scored the least. Figure 5 compares the results of several cohorts for the same course (Mathematics) to exclude the possibility of a random case. It would appear that all cohorts faced some difficulty in Math 3 and Math 4 but recovered well in Math 5. All other factors being equal we believe that high B grades achieved by the ME cohort 2010-2011 was due to the cooperative nature between the third and fourth year students in the ME discipline. This can be contrasted to the high C grades for EE students in the same year.
One also can see that the first cohorts (ME AY 2009-2010) achievement was better than other cohorts as in Figures 3 to 5. The reason for this was that initially the student staff ratio facilitated a more focused learning experience. This was also supplemented by excellent directed pastoral care via new media technology initiated by the main campus (in addition to the Dubai campus).

4.3 Comparison with Non-Integrated Cohorts

The above results were obtained from the three cohorts jointly. In order to estimate the effect of vertical and horizontal integration for a cohort at an early stage, a year 1 group design project involving ME students but not EE was monitored. Fourth year ME students were assigned as mentors to the various groups. The extracted relevant results from the comprehensive survey are shown in Figure 6. The results again support the success of vertical and horizontal integration for a single cohort of mechanical engineering students.

Figure 7 highlights the comparison how the percentage number of graduating cohorts from Dubai campus compared with that of the main campus. Notwithstanding Dubai students' percentage lower than the main campus but our students' performance (which could be considered a reflectiion of four years of study) are favorably compared (Number 1 in Figure 7 refers to first class honour, no. 2:1 and 2:2 refers to second class honour upper and lower respectively and 3 refers to third class honour). All graduating students have secured employment or pursued postgraduate studies. The results from performance analysis show that the second group, with full implementation of the scheme has scored the highest academic achievement. Figure 4 shows the top grades obtained by the three groups. The second group has achieved over 65% A grades compared with just under 55% for the first group which has partly implemented the scheme and below 10% for the third group that did not implement the scheme. These results were in support of the survey results discussed earlier.

Figures 8 is a comparison of the average grades of students enrolled in mandatory courses from year 1to year 3 in both campuses. It is interesting to note that the starting grade for Y1 M1 is relatively close between the two campuses. In the following years there is a noticeable upward divergence for Dubai students. It is our belief that with all things equal, vertical integration is responsible for that divergence. Similarly, Figures 9 and 10 show the average grade comparison for all the offered courses. It can be seen that an average of approximately 10% points is the difference between performances of the two cohorts for both semesters. This difference was made possible by our effort to integrate vertically and horizontally the teaching and learning process because everything else remained the same.

5. Discussion and Conclusions

For the students involved in this study, the results of the investigation reveal that cooperation and group work is positively related to academic achievement. The more the students are involved in group work the more their academic achievement is increased. The cooperation and group work among students from different levels was not part of the curriculum; rather some students on their own initiative have started study groups to help lower-level students in their coursework. The results of the survey questions are shown in Figure 2. Possible answers ranged on a four-point scale from "Strongly Agree" to "Strongly Disagree". The data show that most students enjoy group and cooperative work. These findings are in line with previous studies (Betz, 1942, and Johnson 1983) which reported that cooperative learning provides a classroom climate that is both academically and personally supportive. Similarly, group work and cooperation were found to be highly correlated with academic staff support and feelings of association, this indicating that the students value the academic staff support, these results are not in agreement with the research in (Johnson *et al.* 1983) but do correspond with the result of (Gaith 2002), which concluded that the importance of teacher support may vary across cultures. However, feelings of association were found to have little effect on academic achievement.

The students participated in the study have commented anonymously on the survey sheets and the academic achievement of the students was calculated from the survey sheets and not from students records. This might affect the results as students may underestimate or overestimate their academic achievement. Moreover, the sample size of the study was around 69; a larger sample size will give a better distribution of the results.

Based on the results of this research, vertical integration and group work is bringing the benefits of developing confidence in the ability of senior students to communicate and mentor to their juniors.

The recommendation is made for establishing further research in vertical integration for engineering students through supervised projects that incorporate students from different levels at the school of engineering and physical sciences.

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Figure captions

Figure 1: The Vertical Integration in Teaching and Learning (VITAL) in General Practice Model [6].

Figure 2: Survey results for Cooperation and Group Work (CGW), Survey results for Personal Effect (PE), Survey results for Feeling of Association (FA), and Survey results for Academic Staff Support (ASS).

Figure 3:The average results of the 4^{th} year for the three cohorts.

Figure 4: Comparison of the A grades for the three cohorts over the 4 year of study.

Figure 5: Comparison of the results for the Math course for the three cohorts.

Figure 6: Survey results for the mechanical engineering design project for three questionnaires.

Figure 7: Awards comparison (for academic year 2009/2010).

Figure 8: Comparison of students' performance in mechanical science modules between the two campuses.

Figure 9: Comparison of performance in year 4; semester 1, between the two campuses.

Figure 10: Comparison of performance in year 4; semester 2, between the two campuses.

Table 1
Scales included in the Classroom Life Instrument

Scale	No. of items	Reliability	n
Cooperation and Group Work (CGW)	8	0.71	66
Academic Staff Support (ASS)	3	0.578	65
Personal Effect (PE)	6	0.479	67
Feeling of Association (FA)	5	0.82	69

Table 2
Pearson Correlation Coefficients[a]

	FA	CGW	ASS	PE	AA
FA	1				
CGW	0.863	1			
ASS	0.679	0.807	1		
PE	0.788	0.679	0.646	1	
AA	0.422	0.305	0.578	0.711	1
n	69	64	65	65	69
Mean	1.87	1.66	1.82	1.81	1.9
SD	0.59	0.41	0.52	0.3	0.71

[a] FA = Feeling of Association, CGW = Cooperation and Group Work, ASS = Academic Staff Support, PE = Personal Effect, AA = Academic Achievement.

Table 3
t-Test: Paired Two Sample for Means

	FA	CGW	ASS	PE	AA
Mean	1.867	1.658	1.815	1.813	1.899
Variance	0.351	0.168	0.271	0.092	0.504
Observations	69	64	65	65	69
Hypothesized Mean Difference	0	0	0	0	
df	132	110	125	93	
t Stat	-0.286	-2.412	-0.776	-0.918	
P(T<=t) one-tail	0.388	0.009	0.220	0.180	
t Critical one-tail	1.656	1.659	1.657	1.661	
P(T<=t) two-tail	0.775	0.018	0.439	0.361	
t Critical two-tail	1.978	1.982	1.979	1.986	

[a] FA = Feeling of Association, CGW = Cooperation and Group Work, ASS = Academic Staff Support, PE = Personal Effect, AA = Academic Achievement.

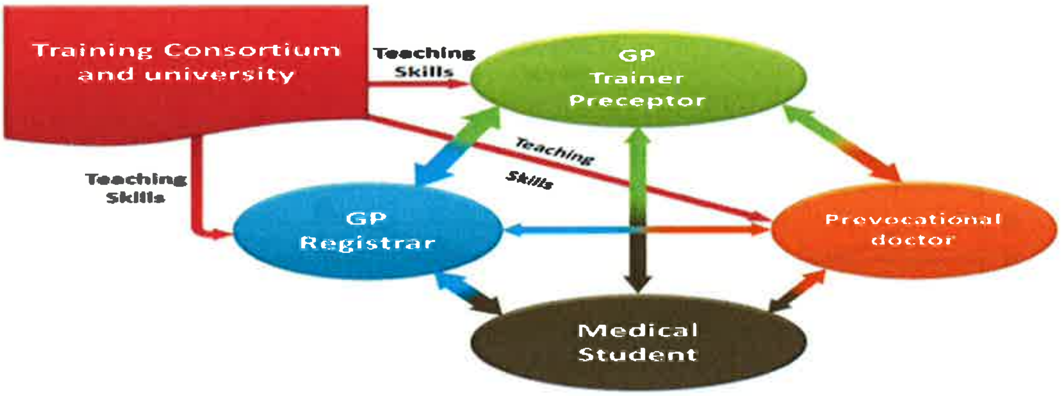


Figure 1.

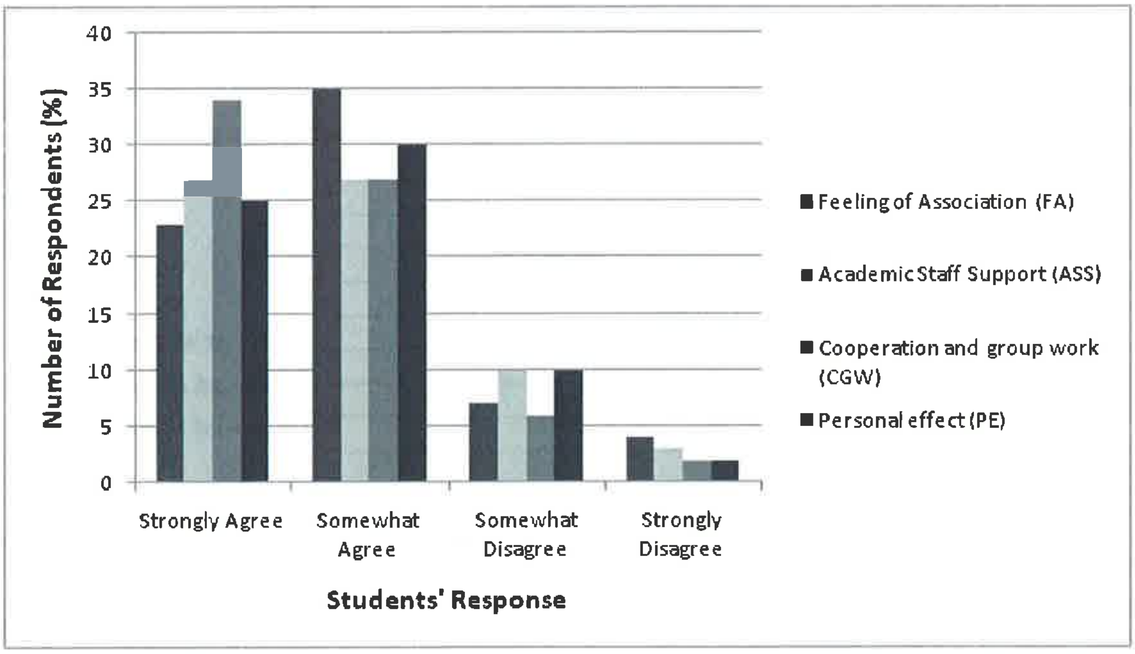
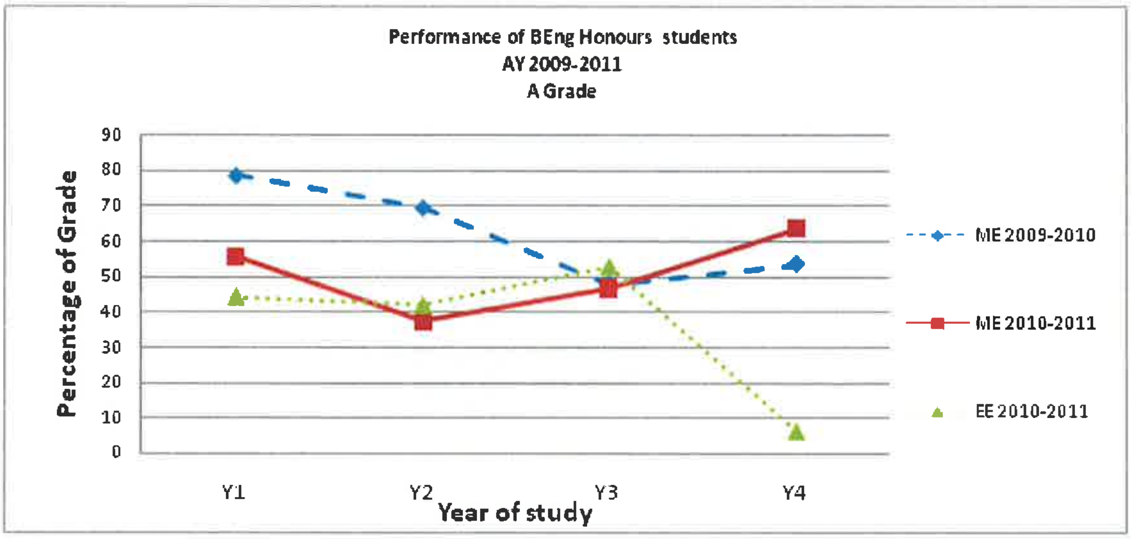


Figure 2.



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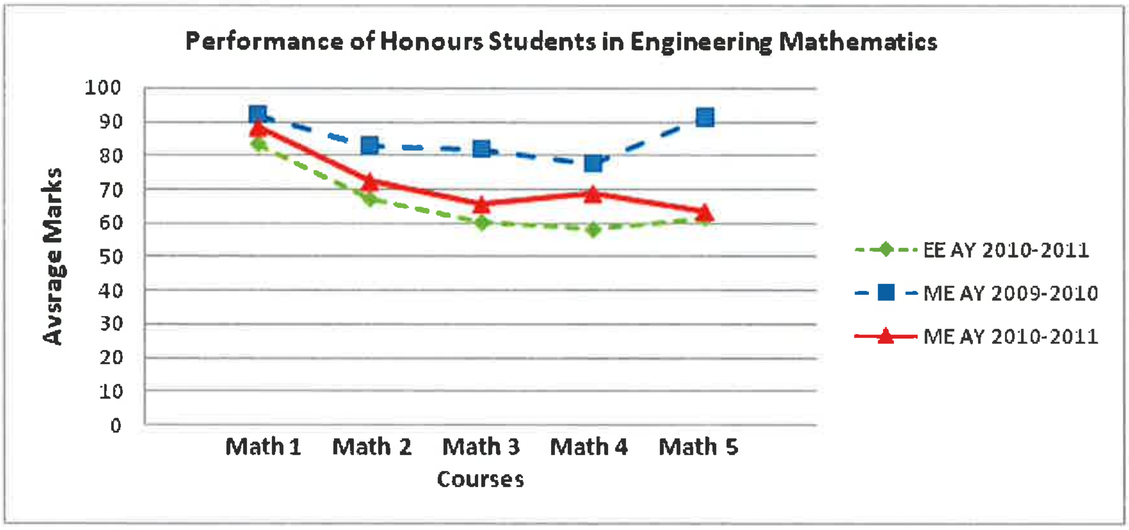

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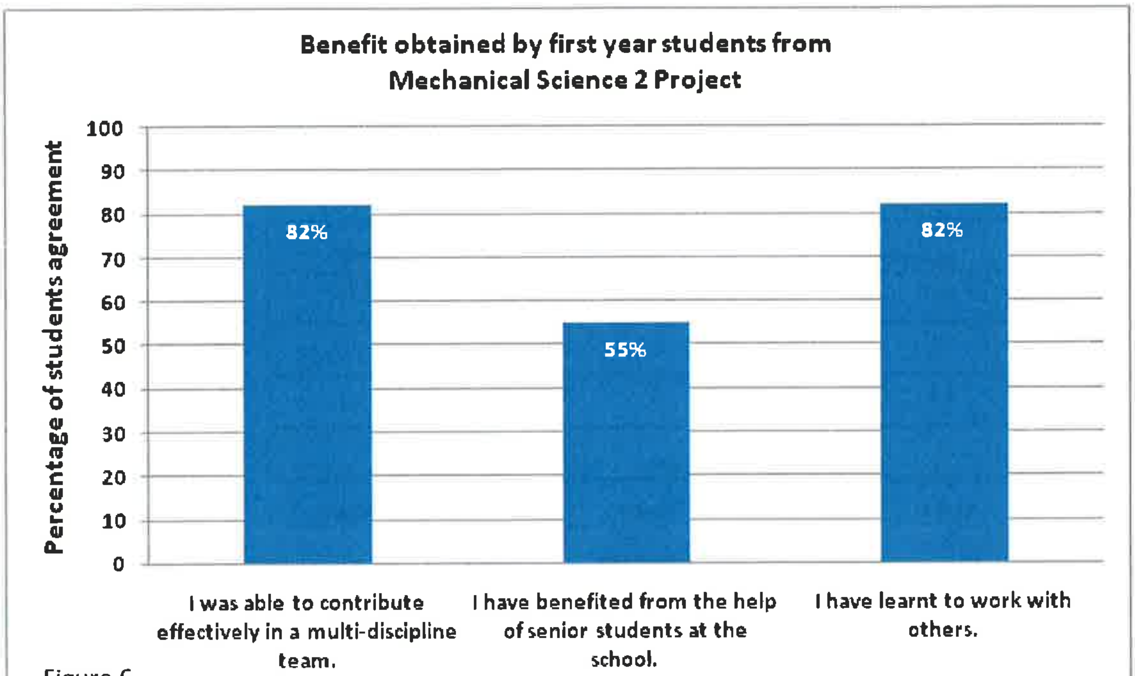

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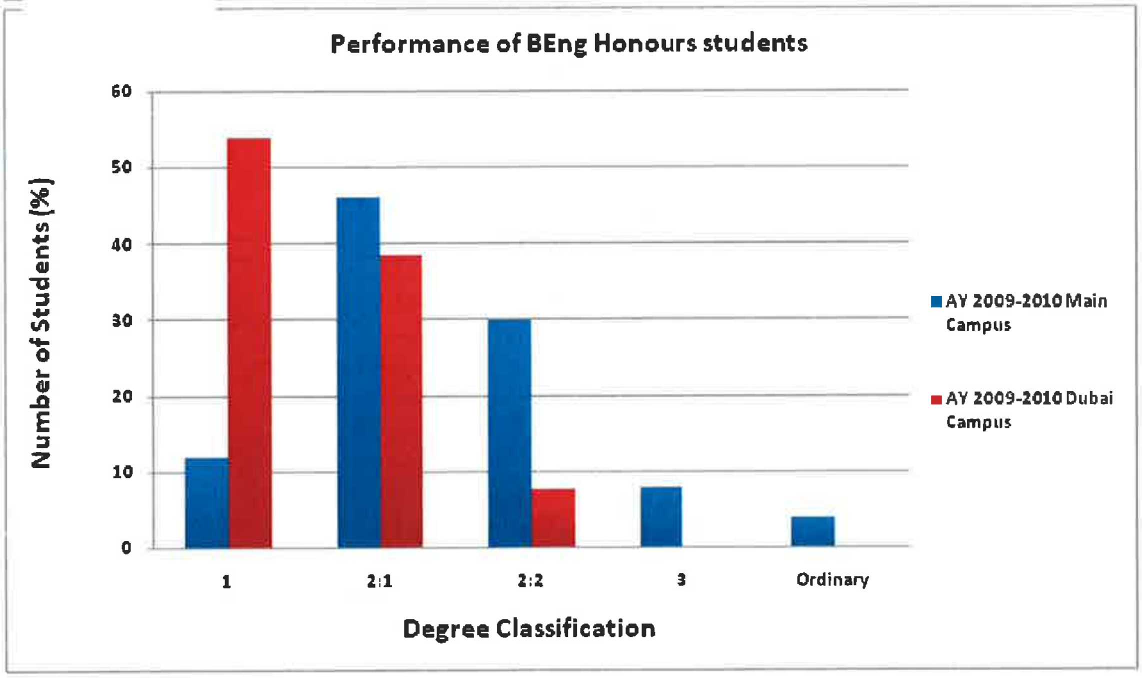

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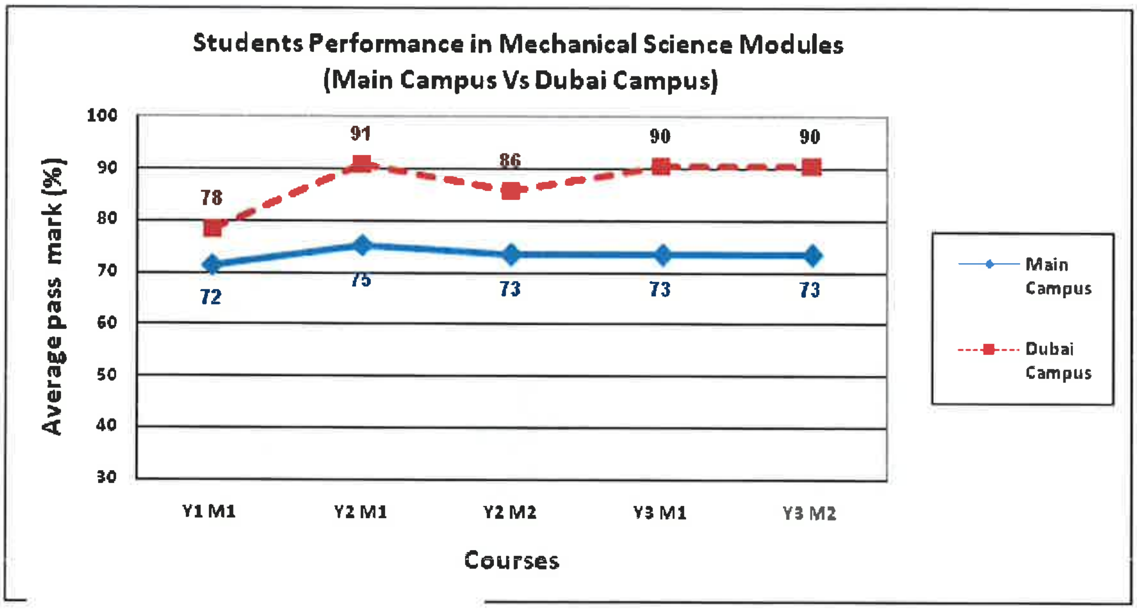
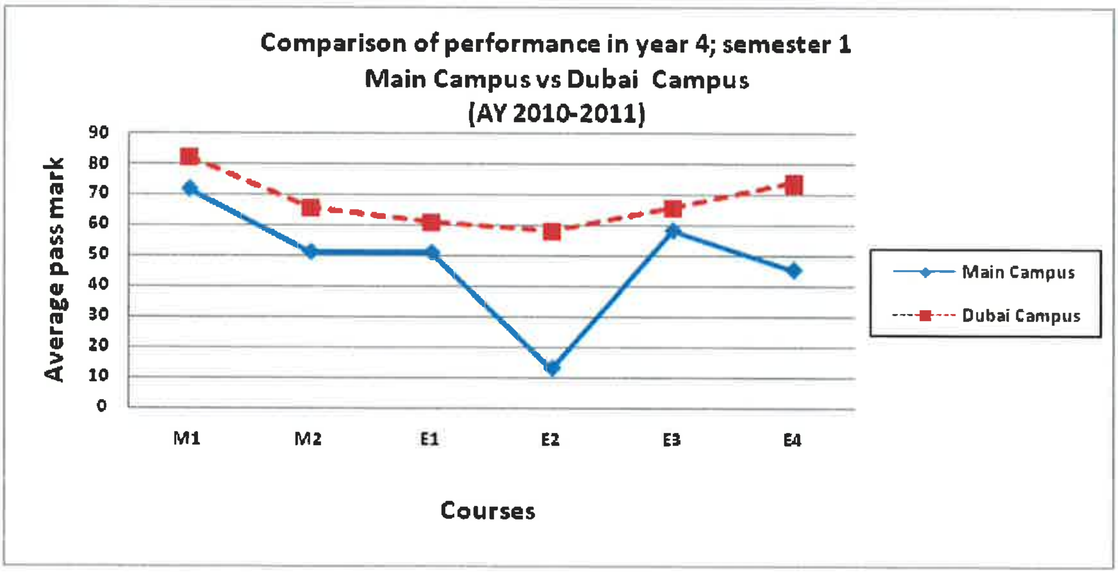


Figure 8.



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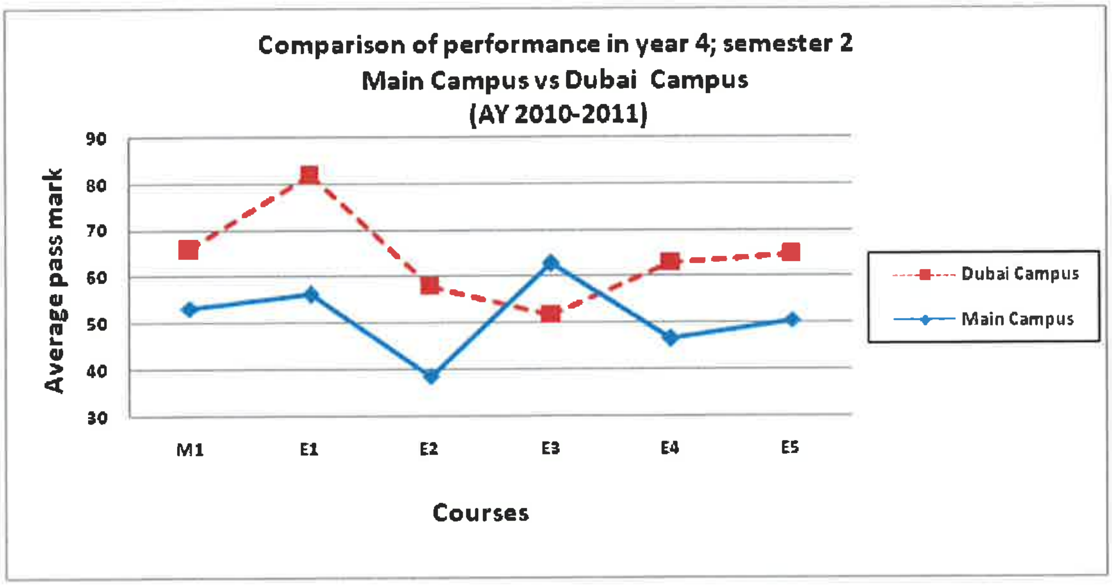

Figure 10.

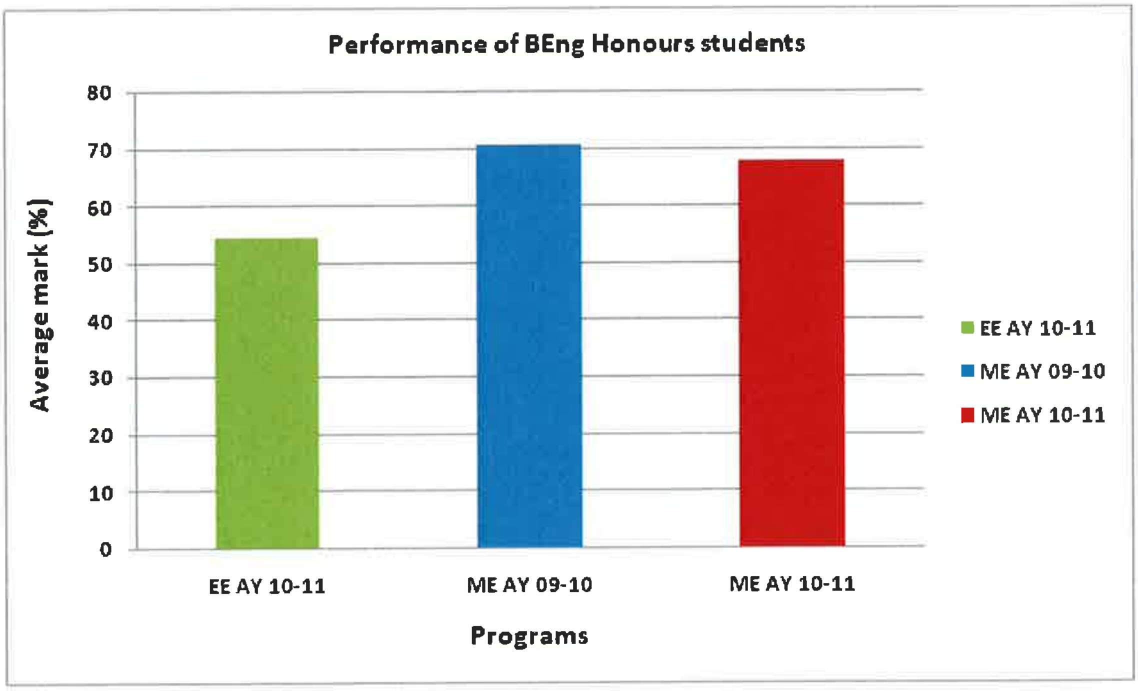

Figure 3.