A quantitative analysis of students' perception of generic skills within an undergraduate electronics/mechanical engineering curriculum.

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Abstract Generic skills are considered as key essential skills which are required by all individuals in the engineering profession and are considered vital for success. Integrating generic skills into engineering education is a key concern for universities and colleges involved in delivering such courses. The accreditation criteria for engineering programmes in Ireland is quite strict on the importance of generic skills and require that important generic skills such as team work, communication skills, problem solving and critical thinking skills are adequately addressed in engineering programmes that are accredited by Engineers Ireland (EI). Employers are also continually seeking out employees who are proficient in the area of transferable skills. This paper presents quantitative findings from students regarding their perceptions of generic skills at a third level institution in Ireland.

Keywords generic skills; essential skills; engineering; transferable skills; Engineers Ireland; employability; mature students.

Existing Literature

Generic skills (soft skills or transferable skills) can be considered key essential skills which are required by all individuals and can enhance the individuals' employability prospects (Forfàs 2007). The accreditation criteria for engineering programmes in Ireland are governed by the professional body, Engineers Ireland (EI). These criteria demand the development of discipline specific knowledge as well as the development of non technical skills. EI recognise communication skills, problem solving skills, critical thinking, teamwork and lifelong learning skills as important attributes for Engineering graduates (Engineers Ireland, 2007), yet provides no guidance on how to achieve them. It can be argued that such skills are necessary for all graduates regardless of field of study (Barrie, 2004).

Nguyen (1998) discusses the main attributes which are important to the modern engineer. This information was gathered from surveys administrated to academic staff, students and industrial personnel. Nguyen (1998) identified four diverse areas including social science, business management, technology and science and emphasize that engineering is a profession that must embody skills from each of these areas. Interestingly, all three groups surveyed agreed on what skills are most important for the modern engineer, although there was variation on the importance placed on each skill. For example, industrial personnel consider attitude to be more significant, while academic staff consider technical knowledge to be more significant. Students' view on attitude and technical knowledge tended to overlap that of academics and industrial personnel. It was also found that academic personnel and students were inclined to 'think alike' in their answering, which can be attributed to both groups working in the same environment.

According to Rao, (2010, p8) 'generic skills build self-esteem and self confidence among the individuals' which in turn 'ensure both personal and professional advancement'. Rao (2010) also suggests that generic skills greatly enhance the employment prospects of individuals provided that core competencies in hard skills are adequately developed as well. 'Hard skills are also equally important along with soft skills to excel as competent and successful professionals' (p. 8).

Rugarcia et al. (2000) discuss the importance of teamwork skills within engineering education, and it is emphasised that engineering is very much a 'cooperative enterprise' (p 9) and the idea that an engineer works in solitary for example on the design of a bridge is just not realistic. Successful teamwork relies heavily on other important skills such as communication skills, the ability to listen to other team members, ability to delegate, ability to lead and not dominate, ability to accept responsibility and deal with conflicts.

Watson (2002) discusses the many benefits to be gained from introducing teamwork into first year at university, and the important role teamwork plays 'in developing and cementing social structures and support networks, reducing dropout rates, and informally functioning as a mentoring and monitoring scheme' (p.3).

Duffy and Bowe (2010) also emphasise the fact that in order to be successful in the engineering profession, engineers need to be creative, driven and possess the ability to learn independently, as there may be occasions whereby an engineer is presented with a problem not covered in their undergraduate studies. Duffy and Bowe (2010) stress that competencies in teamwork, problem solving and lifelong learning are crucial for success in such a dynamically evolving career.

Engineering educators stress the importance of communications both orally and written, Darling and Dannels (2003). Sharp (2012) states that the most important oral presentations that all engineering graduates will make is communications in a job interview. Sharp (2012) describes this interview as 'a potentially life changing presentation' and success is mostly based on oral communication skills. Patil and Riemer (2004) also discuss the issues concerning graduates completing their studies, in particular the lack of oral and written communications and the lack of interview skills. Patil and Riemer discovered a link between self confidence and communication skills. 66% of diploma graduates lack confidence in an interview situation, and the primary reason cited was lack of communication skills.

Information technology skills are often regarded as critical skills from an employers' perspective. Employers are seeking employees who are proficient in computing packages such as Excel, Word and Access. A basic knowledge of statistical packages such as SPSS is also highly desirable. Employers do expect employees to have sufficient research skills in order to conduct research, analyse the data collected and present the findings in a coherent manner (Selvadurai et al. 2012).

Schulz (2008) state that lecturers have a responsibility to raise awareness of the importance of generic skills to their students and to highlight the consequences of their shortcomings in regard to generic skills. Selvadurai et al. (2012) introduces the notion of conflict theory and the 'hypocrisy of employers' in not accepting responsibility in working with third level institutions and universities to instil generic skills (p 300). Fostering the development of generic skills must be a joint responsibility between the individuals, the third level college or university and the workplace (NCVER, 2003).

Recently there has been an increase in the number of mature students entering higher education in Ireland. Mature students tend to use a much deeper approach to learning when compared with their younger counterparts (Richardson, 1995) and because of previous life experiences, mature students tend to have a greater understanding of the importance of academic skills at third level (Buckler et. al. 2006). The purpose of this research is to add to the existing literature on generic skills. This research will specifically investigate the perceptions of engineering students to generic skills and also will investigate if mature students place a greater importance on generic skills when compared with their younger counterparts. This research will also investigate if there are any differences between genders in relation to generic skills.

Research Questions:
Are engineering students aware of the importance of generic skills within their course of study and are engineering students aware of the existence of generic skills within their course of study. Are mature students more likely to see the importance of generic skills when compared with their younger counterparts?

Null hypotheses
H1: There is no relationship between age and the respondent's belief that generic skills enhance employability.

H2: There is no relationship between age and the respondent's belief that interview skills are important for work in their profession.

H3: There is no relationship between year of study and the respondent's belief that teamwork skills are important for work in their profession.

H4: There is no relationship between course studied and the respondent's belief that basic computing skills are important for work in their profession.

H5: There is no relationship between gender and the respondent's belief that practicing generic skills enhance confidence.

H6: There is no relationship between gender and the respondent's belief that oral and written communications are important for work in their profession.

Methodology

The target population for this research consists of all electronics and mechanical engineering students currently enrolled at an Institute of Technology, approximately 153 students in total. It was also decided that a self-administrated questionnaire was the most appropriate choice for this research. The questionnaires were administrated to all mechanical and electronic engineering students. Access to this particular cohort of students was not an issue.

In order to increase validity of this research, the questionnaire was also distributed across other engineering courses, including civil engineering, building services engineering, architectural technology and fire technology. Of the 350 registered engineering students at this institute, 153 are registered on mechanical/electronics courses, and 197 are registered on the other engineering courses. In order to gain access to these 197 students, the questionnaire was emailed, and students were encouraged to participate in this research. The purpose of the research was explained to all participating students. It was also emphasised that students were not required to participate in this research if they did not wish to do so.

The questionnaire was designed to be completed within five minutes. The questionnaire consists of two sections. Section A deals specifically the demographic characteristics of the participants and consists of both nominal and ordinal variables. Section B deals with the variables concerned with students' perception of generic skills. The table consists of 20 generic skills and students were required to rate the importance of each of the skills and to determine the level to which each generic skill is developed within their course of study. A four point Likert scale was used to rate the importance level (ranging from "not important" to "essential"), and four point Likert type scale was also used to rate the level to which the student believes that each generic skill is developed in their course of study (ranging from "none" to "strong"). An open-ended question was also asked in order to determine three of the most important generic skills according to the students. Students were also asked to determine how much time should be spent developing generic skills, and this was measured using a scalar variable.

Once the questionnaire was designed, it was decided to administer it to a group of fourth year electronic engineering students, who were about to graduate. The questionnaire was also given to a few colleagues within the engineering department. Some useful suggestions for improvement were given to ensure face validity of the questionnaire. In particular since the number of mature students studying engineering has increased significantly in recent times, it was suggested to investigate mature students perceptions of generic skills. A few additional questions were added to the original questionnaire regarding students' reasons for returning to college and to determine if students had been previously employed. This would then provide a means of determining the number of mature students currently studying engineering.

A total of 122 questionnaires were completed, 87 of which were completed by electronics and mechanical engineering students, 10 were completed by civil engineering students, 8 were completed by building services students, 8 completed by architectural technology students and 9 completed by fire technology students. The sample size of 122 was deemed sufficient to conduct further analysis. The completed questionnaires were coded and data was transferred to SPSS statistical package.

Ethical Considerations
The main ethical issue concerned obtaining informed consent from the head of department of engineering. Once ethical clearance was given the questionnaires were administrated and students were informed that the questionnaires were anonymous and results would be dealt with in a confidential manner. Students were informed not to give their names on the questionnaires and individual responses would not be reported upon. The nature of the questions within the questionnaire did not provoke any ethical concerns.

Validity and reliability
External validity refers to the generalisation of the results from the research to the wider population. External validity is ensured through proper sampling, obtaining a sample across all four years of electronics and mechanical engineering students. To further increase validity, the questionnaire was administrated to students registered on other engineering courses. Mechanical and electronics students were informed of the time and place in which the research was to be conducted. Students from other engineering courses were provided via email with a link to the questionnaire and were given two weeks to complete. One week before the cut off point, these students were emailed again to remind them to participate in this research.

The internal validity of the instrument is ensured through content validity and face validity. Opinions of colleagues in the engineering department were obtained and in order to further enhance internal validity, the questionnaire was given to a group of fourth year electronic engineering students. This was done in order to ensure that the questionnaire items adequately addressed the hypotheses under test. SPSS was used to determine Cronbach's alpha values for the twenty generic skills in section B of the questionnaire. This was done to ensure reliability of the data collected. The reliability coefficients of Cornbach's alpha was determined for each of the items in the skills table.

Limitations
Of the 122 students who participated in this research 72% were completed by mechanical and electronics students. The response rate of students registered on civil engineering, building services, architectural technology and fire technology were approximately 8%, 7%, 7% and 7% respectively. Since the response rate for these courses were quite low, any generalisation to these groups of students must be done with caution. The number of female respondents was only 26, this is in contrast with 96 male respondents, so any generalisations in relation to female should also be treated with caution.

One of the reasons cited for the low response rate was the time at which this research was conducted. The questionnaire was administered during week 11 of a 13 week semester and students were busy during this late stage in the semester. The response rate of mechanical and electronics students was quite acceptable and since the questionnaire was self administrated, perhaps a better response rate would have been obtained from other engineering students if the questionnaire had been administered by colleagues who are directly involved with these students.

Results
The results for section A of the questionnaire indicate that of the 122 respondents, 26 respondents were female and 96 were male as shown in table 1, while table 2 provides more detailed information on the gender breakdown for each of the engineering courses. The number of mature respondents was based on the answer to the question regarding previous employment.

Gender	Frequency	Percent
Male	96	78.7
Female	26	21.3
Total	122	100.0

Table 1: Gender Breakdown

Gender	Elec.	Mech.	Civil	Archit.	Building Services	Fire Technology	Total
Male	47	29	6	3	6	5	96
Female	5	6	4	5	2	4	26
Total	52	35	10	8	8	9	22

Table 2: Gender breakdown per engineering course

Table 3 provides a breakdown of the number of respondents per course and it is clearly evident from this table that approximately 72% of the respondents were electronics and mechanical engineering students.

Course	Frequency	Percent of n
Electronics	52	42.6
Mechanical	35	28.7
Civil	10	8.2
Architecture	8	6.6
Building Service	8	6.6
Fire Technology	9	7.4
Total n	122	100.0

Table 3: Response rate per course

Table 4 indicates the number of respondents per year of study and it can be seen that approximately 36% of the respondents were first year students, while table 5 provides more detailed information on the number of respondents per year of study across the various engineering courses.

Year of Study	Frequency	Percent of n
First	44	36.1
Second	28	23.0
Third	27	22.1
Fourth	23	18.9
Total n	122	100.0

Table 4: No. of respondents per year of study

Course	1st year	2nd year	3rd Year	4th Year	Total
Electronics	22	9	11	10	52
Mechanical	11	9	8	7	35
Civil	6	2	0	2	10
Architecture	1	2	3	2	8
Building Services	2	3	3	0	8
Fire Technology	2	3	2	2	9
Total n	44	28	27	23	122

Table 5: Response rate per year of study for each course

Table 6 provides the breakdown of the number of respondents per age group and clearly shows that the most popular age group is the 20 – 29 age category.

Age	Frequency	Percent of n
<= 19	25	20.5
20-29	71	58.2
30-39	21	17.2
40-49	2	1.6
50-59	3	2.5
Total n	122	100.0

Table 6: No of respondents per age group

Table 7 indicates that approximately 35% of respondents have been previously employed, while table 8 indicates that the primary reason for returning to college is due to a lack of jobs or for up-skilling reasons. Of the 71 respondents in the 20-29 age group, only 17 had been previously employed as shown in table 9. These 17 respondents can be regarded as mature and therefore the total number of mature respondents is 43.

Previously Employed	Frequency	Percent of n
Yes	43	35.2
No	79	64.8
Total n	122	100.0

Table 7: Previous employment status

Primary Reason for attending college	Frequency	Percent of n
Natural Progression	79	64.8
Up-skilling	19	15.6
Like learning	0	0
Lack of jobs	24	19.7
Total n	122	100.0

Table 8: Reason for attending college

Age	Previously employed	Not previously employed	Total
<= 19	0	25	25
20-29	17	54	71
30-39	21	0	21
40-49	2	0	2
50-59	3	0	3
Total	43	79	122

Table 9: Number of mature respondents in the 20-29 age group who were previously employed

Table 10 provides a summary of the descriptive statistics for the table in section B of the questionnaire. Table 10 reports on the mean and standard deviation for the importance level for each of the 20 skills. It should be noted that a four point scale was used, namely, not important (1), somewhat important (2), very important (3), and essential (4). It is apparent from this table that most of mean values cluster around 3 on the instrument scale. The results in this table suggest that most respondents recognise the importance of generic skills.

Skill	Mean	Standard deviation
Oral and written communications	2.96	.904
Basic computing skills	3.33	.661
Time management skills	2.88	.799
Meeting deadlines	2.82	.882
Teamwork	2.66	.859
Problem solving	3.40	.700
Decision making	2.84	.866
Research skills	2.68	.912
Capacity to learn – lifelong learning	3.02	.909
Information management skills	2.81	.753
Creativity	3.06	.816
Accept criticism	2.77	.860
Be critical	2.75	.819
Being reflective	2.66	.859
Being self-confident	3.25	.637
Being motivated	3.21	.468
Being ethical	2.95	.770
Respectful of others heritage and culture	2.96	.743
Environmentally aware	3.09	.761
Interview skills	2.52	.920

Table 10: A summary of descriptive statistics for importance level for each skill

Table 11 provides a summary of the descriptive statistics addressing the level which respondents believe generic skills are covered within their course of study. The mean and standard deviation for each of the 20 skills are reported upon. It should be noted that a four point scale was used, namely, none (1), weak (2), considerable (3), and strong (4). It is apparent from this table that most of mean values cluster around 2 on the instrument scale. This table suggests that most respondents do not feel that generic skills are adequately addressed in their course of study.

Skill	Mean	Standard deviation
Oral and written communications	2.38	.731
Basic computing skills	3.20	.545
Time management skills	1.95	.759
Meeting deadlines	1.94	.753
Teamwork	2.35	.574
Problem solving	3.36	.561
Decision making	2.37	.752
Research skills	3.00	.793
Capacity to learn – lifelong learning	2.06	.912
Information management skills	2.34	.598
Creativity	3.01	.958
Accept criticism	1.93	.736
Be critical	1.92	.723
Being reflective	1.94	.956
Being self-confident	2.05	.283
Being motivated	3.01	.722
Being ethical	2.98	.738
Respectful of others heritage and culture	2.43	.953
Environmentally aware	2.80	.735
Interview skills	1.89	.741

Table 11: A summary of descriptive statistics for level to which respondents believe generic skills are covered in their course of study

Hypothesis 1

This involved comparing the respondent's answer to question 2 (age) with the results from question 8 (generic skills enhance employability). Table 12 illustrates the frequency table and demonstrates that about 60% of respondents either strongly agree or agree that generic skills enhance employability.

Generic skills enhance employability	Frequency	Percent of n
Strongly agree	35	28.7
Agree	38	31.1
Undecided	25	20.5
Disagree	20	16.4
Strongly disagree	4	3.3
Total	122	100.0

Table 12: Employability frequency table

Table 13 illustrates the age profile for question 8 of the questionnaire and clearly shows that only 5 of the 19 and under age category agree that generic skills enhances employability. Table 13 (a) clearly indicates that all 43 mature respondents either strongly agree or agree that generic skills enhance employability. Figure 1 illustrates the results in a clustered bar chart.

Age	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total
<=19	0	5	10	6	4	25
20-29	15	27	15	14	0	71
30-39	15	6	0	0	0	21
40-49	2	0	0	0	0	2
50-59	3	0	0	0	0	3
Total	35	38	25	20	4	122

Table 13: Age versus employability prospects

Previously employed	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total
Yes	34	9	0	0	0	43
No	1	29	25	20	4	79
Total	35	38	25	20	4	122

Table 13 (a): Employability versus previous employment status

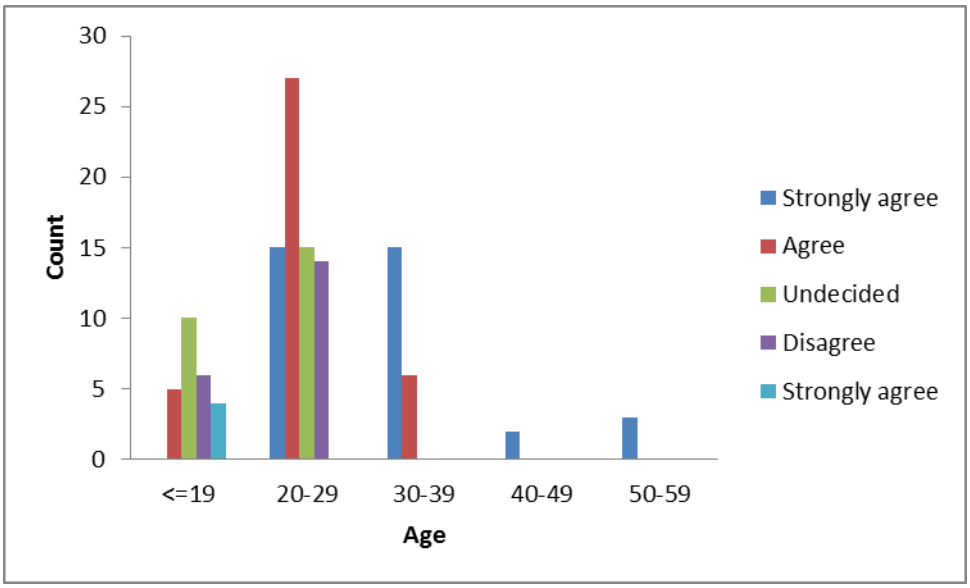

Figure 1: Age versus generic skills enhance employability prospects

In order to determine the relationship between the two variables under investigation and since both variables are ordinal, the Spearman Correlation test was performed and the results indicated a negative correlation (r_s = -.614, $p < 0.001$). These results suggest that the null hypothesis can be rejected in favour of the alternative hypothesis that there is a relationship between age and the respondent's belief that generic skills enhance employability.

Hypothesis 2

This involves comparing the respondent's answer to question 2 (age) with that of item 20 of the skills table (interview skills are important). Table 14 illustrates the frequency table while table 15 indicates that only 5 of the 19 and under age category believe that interview skills are important. Table 15(a) clearly indicates that all 43 mature students believe that interview skills are very important or essential. It is quiet apparent from analysing table 15 that as the age increases, the importance level of interview skills also increases. Figure 2 illustrates these results in a clustered bar chart.

Interview skills are:	Frequency	Percent of n
Not important	21	17.2
Somewhat important	32	26.2
Very important	54	44.3
Essential	15	12.3
Total n	122	100.0

Table 14: Interview skills frequency table

Age	Not important	Somewhat important	Very important	Essential	Total
<=19	13	7	5	0	25
20-29	8	25	34	4	71
30-39	0	0	13	8	21
40-49	0	0	2	0	2
50-59	0	0	0	3	3
Total	21	32	54	15	122

Table 15: Age versus importance of interview skills

Previously employed	Not important	Somewhat important	Very important	Essential	Total
Yes	0	0	29	14	43
No	21	31	26	1	79
Total	21	31	55	15	122

Table 15(a): Importance of interview skills versus previous employment status

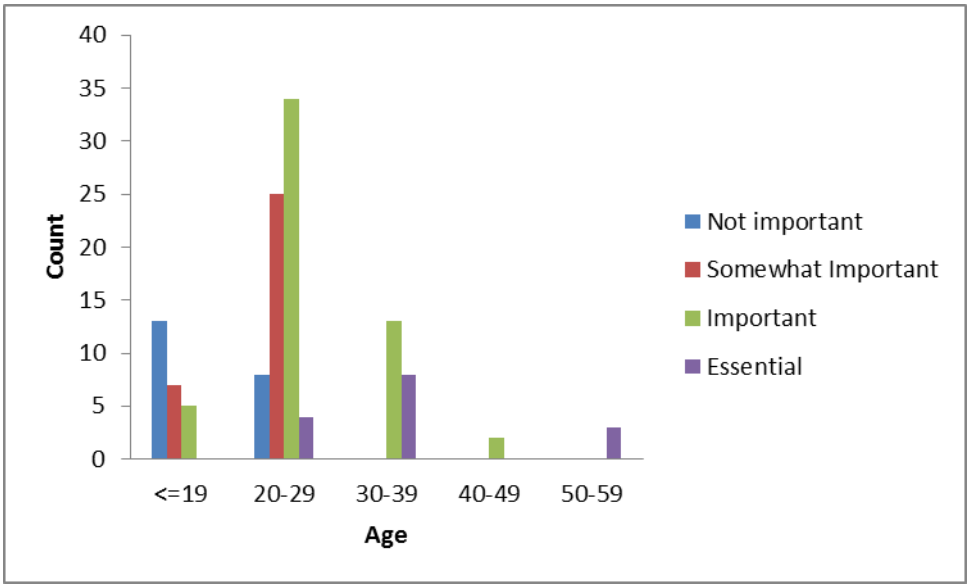

Figure 2: Age versus importance of interview skills

The Spearman Correlation Test was used to determine the relationship between these two variables. The results of the Spearman Correlation test indicates a positive correlation (r_s = 0.615, $p < 0.001$). These results suggest that the alternative hypothesis can be accepted that there is a relationship between age and the respondent's belief that interview skills are important for work in their profession.

Hypothesis 3

This involves comparing the respondent's answer to question 4 (year of study) with that of item 5 of the skills table (importance of teamwork). Table 16 illustrates the frequency table, while table 17 indicates that 40 of the 44 first year students rate teamwork skills as either very important or essential. Figure 3 illustrates the results in a clustered bar chart.

Teamwork skills are:	Frequency	Percent of n
Not important	11	9.0
Somewhat important	39	32.0
Very important	52	42.6
Essential	20	16.4
Total	122	100.0

Table 16: Teamwork skills frequency table

Year of study	Not important	Somewhat important	Very important	Essential	Total
First	0	4	26	14	44
Second	3	13	10	2	28
Third	6	12	8	1	27
Fourth	2	10	8	3	23
Total	11	39	52	20	122

Table 17: Year of study versus importance of teamwork skills

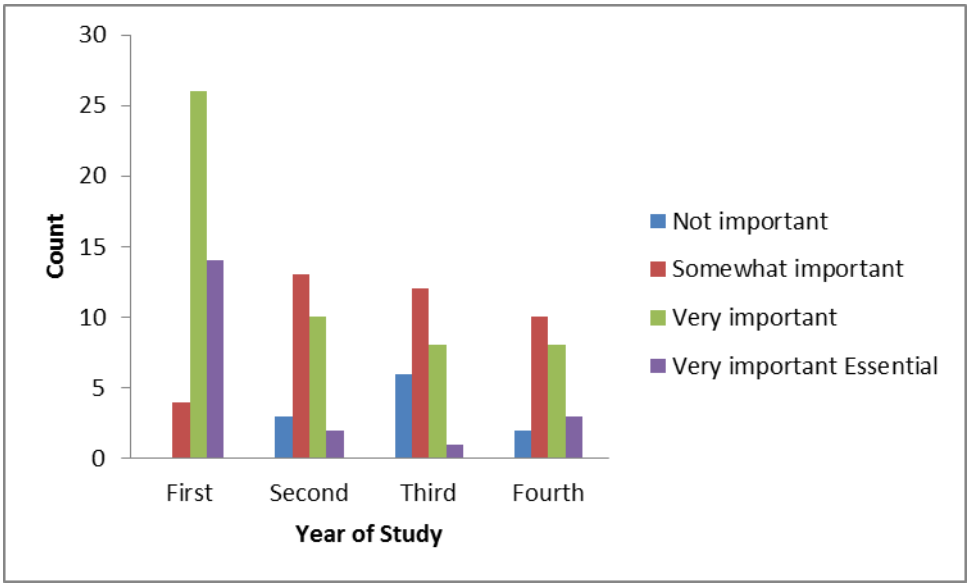

Figure 3: Year of study versus the importance of teamwork skills

Since both year of study and teamwork are ordinal variables, the Spearman Correlation test was used. The results of the Spearman Correlation test indicate a negative correlation, (r_s = -.420, $p < 0.001$), which suggests that as year of study increases the importance of teamwork skills decreases. From these results the alternative hypothesis can be accepted, that there is a relationship between year of study and the importance of team work skills.

Hypothesis 4

This involves comparing the respondent's answer to question 4 (course studied) with that of item 2 of the skills table (importance of computing skills). Table 18 illustrates the frequency table while table 19 indicates that 113 of the 122 respondents believe that computing skills are either very important or essential for work in their profession. Figure 4 illustrates the results in a clustered bar chart.

Computing skills are:	Frequency	Percent of n
Not important	2	1.6
Somewhat important	7	5.7
Very important	62	50.8
Essential	51	41.8
Total	122	100.0

Table 18: Computing skills frequency table

Course	Not important	Somewhat important	Very important	Essential	Total
Electronics	0	1	21	30	52
Mechanical	2	6	15	12	35
Civil	0	0	6	4	10
Architecture	0	0	6	2	8
Building serv.	0	0	6	2	8
Fire Tech.	0	0	8	1	9
Total	2	7	62	51	122

Table 19: Course versus the importance of computing skills

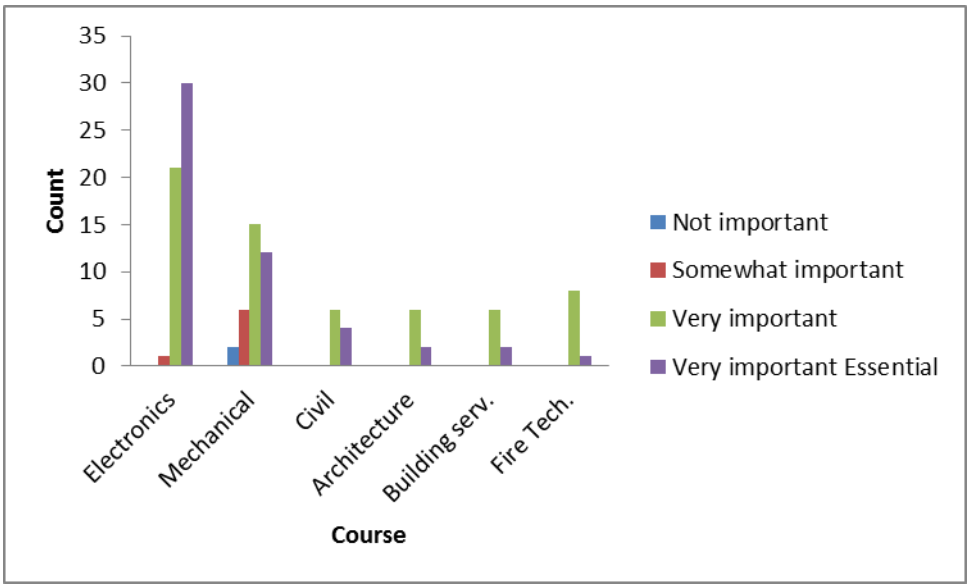

Figure 4: Course versus importance of computing skills

Since course is a nominal variable and consists of more than two categories and computing skills is an ordinal variable, the Kruskal-Wallis Test was used. The results generated from the Kruskal-Wallis test suggests that there is no relationship between course studied and the importance of computing skills (p =.030, Kruskal-Wallis H statistic = 12.353, df = 5, so it was decided to investigate this further. It was decided to conduct a Mann-Whitney U Test to determine the differences between electronics and mechanical engineering respondents and their beliefs that computing skills are important for work in their

profession, the results generated were (p= .005, Mann-Whitney U = 619.500, Z = -2.783) and effect size = .298. Since the number of respondents in the civil, architectural technology, building and fire courses was quite low, it was decided to group these respondents as one group called civil/construction. A Mann-Whitney U test was conducted to determine the differences in mechanical and civil/construction respondents and their beliefs that computing skills are important for work in their profession, the results generated were (p= .609, Mann-Whitney U = 574.5, Z = -.512) and effect size = .06119. A Mann-Whitney U test was also performed in order to determine any differences in electronics and civil/construction respondents and their beliefs that computing skills are important for work in their profession, the results generated were (p= .002, Mann-Whitney U = 606.500, Z = -3.036) and effect size = .3254. These results are shown below in a clustered bar chart in figure 5. To reduce the chances of a type 1 error occurring when using multiple Mann-Whitney U tests, it was decided to apply the Bonferroni Correction. This simply consists of setting the statistical significance level to be used and since 3 Mann Whitney U tests, the statistical level is set to p=0.017.

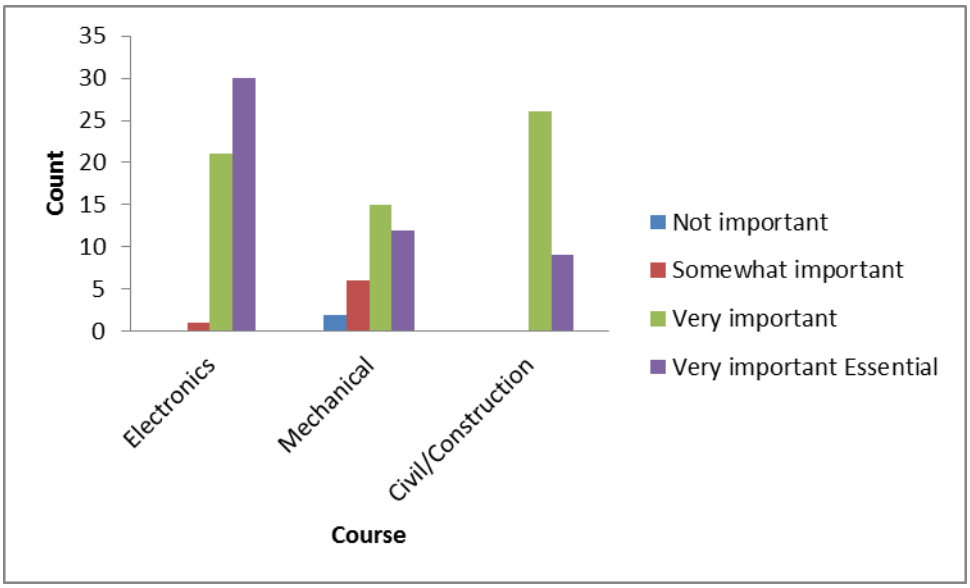

Figure 5: Electronics versus Mechanical versus Civil/Construction versus importance of computing skills

Hypothesis 5

This involves comparing the respondent's answer to question 1 (gender) with the results of question 9 (practising generic skills enhances confidence levels). Table 20 illustrates the frequency table, while table 21 indicates that of the 26 females studying engineering, 25 either strongly agree or agree that practising generic skills enhances confidence levels. Of the 96 males, 36 either agree or strongly agree that practising generic skills enhances confidence levels.

Practising generic skills enhances confidence levels	**Frequency**	**Percent of n**
Strongly agree	16	13.1
Agree	45	36.9
Undecided	19	15.6
Disagree	37	30.3
Strongly disagree	5	4.1
Total n	122	100.0

Table 20: Confidence levels frequency table

Gender	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Male	10	26	18	37	5	96
Female	6	19	1	0	0	26
Total	16	45	19	37	5	122

Table 21: Gender versus confidence levels

These results are illustrated in figure 6 and figure 7. Since gender is nominal and confidence level is ordinal the Mann Whitney U test was used. The results of the Mann Whitney U test can be reported as ($p < .001$, Mann- Whitney $U = 512.000$, $Z = -4.808$), while the strength of the relationship between gender and opinions towards generic skills enhancing confidence levels can be reported as ($r = .4353$.) There is sufficient evidence to reject the null hypothesis in favour of the alternative hypothesis and conclude that there is a relationship between gender and the respondents' belief that generic skills enhance confidence levels.

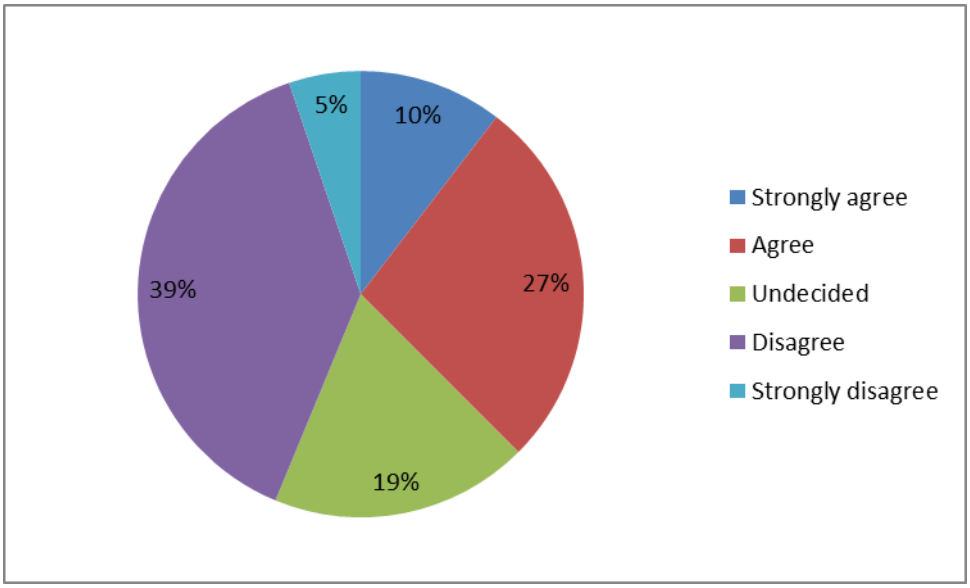

Figure 6: Male perceptions that generic skills enhance confidence levels

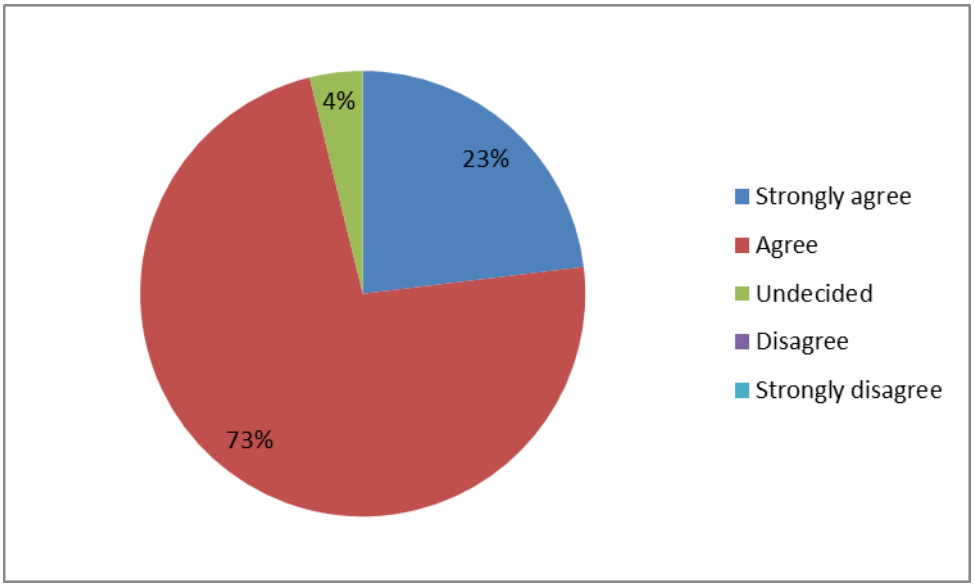

Figure 7: Female perceptions that generic skills enhance confidence levels

Hypothesis 6

This involves comparing the respondent's answer to question 1 (gender) with that of item 1 of the skills table (importance of oral and written communications). Table 22 illustrates the frequency table, while table 23 indicates 25 of the 26 females and 40 of the 96 males believe that oral and written communications are important for work in their profession.

Oral and written communications skills are:	**Frequency**	**Percent of n**
Not important	12	9.8
Somewhat important	45	36.9
Very important	32	26.2
Essential	33	27.0
Total	122	100.0

Table 22: Oral and written communications skills frequency table

Gender	**Not important**	**Somewhat important**	**Very important**	**Essential**	**Total**
Male	12	44	18	22	96
Female	0	1	14	11	26
Total	12	45	32	33	122

Table 23: Gender versus the importance of oral and written communications

These results are illustrated in figures 8 and 9. Since gender is nominal and importance of oral and written communications is ordinal the Mann Whitney U test was used. The results of the Mann Whitney U test can be reported as ($p < .001$, Mann- Whitney $U = 617.000$, $Z = -4.133$), while the strength of the relationship between gender and opinions towards importance of oral and written communications can be reported as ($r = .3742$). There is sufficient evidence to reject the null hypothesis in favour of the alternative hypothesis and conclude that there is a relationship between gender and the respondents' belief that oral and written communications are important for work in their profession.

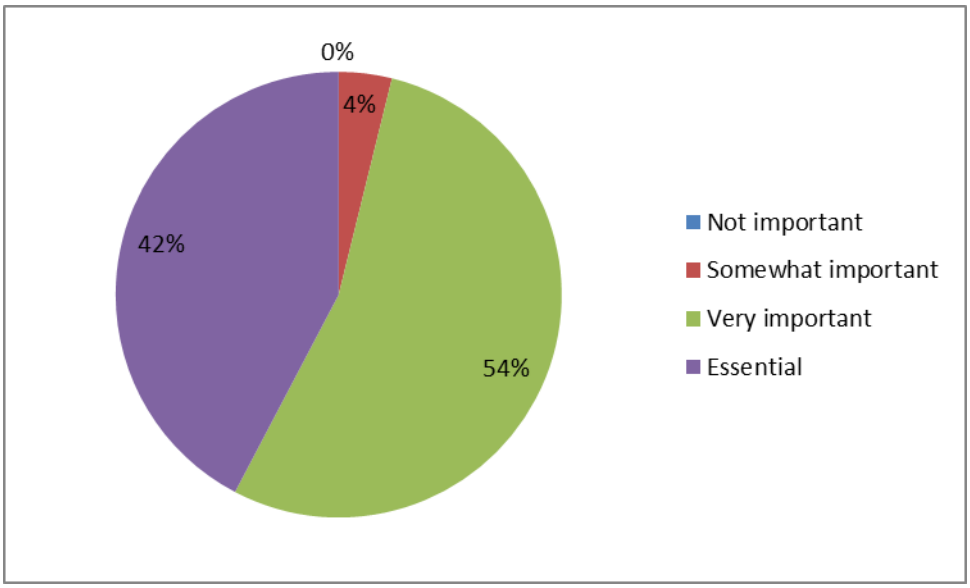

Figure 8: Male perceptions of the importance of oral and written communications

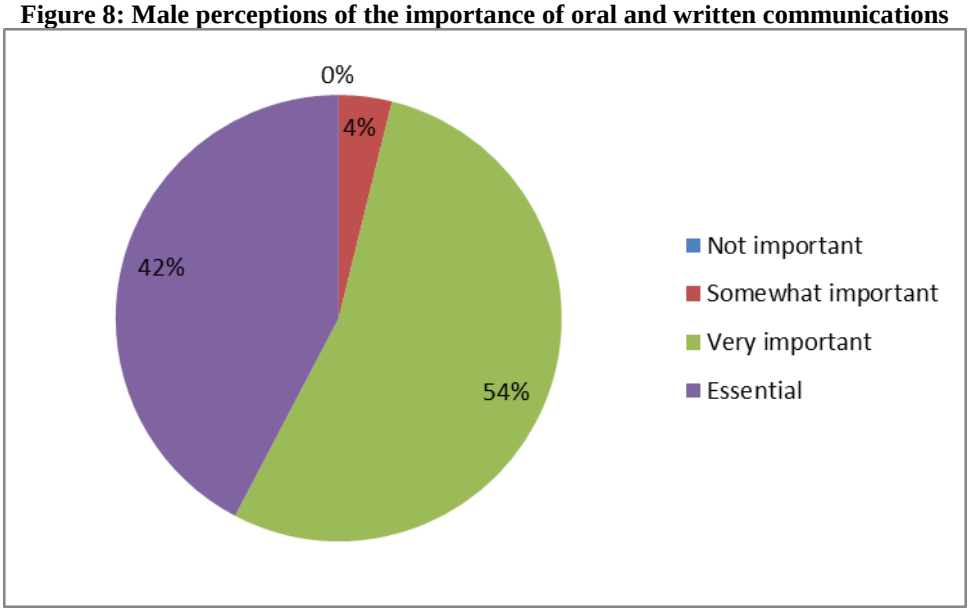

Figure 9: Female perceptions of the importance of oral and written communications

Cronbachs' alpha

In order to determine internal reliability, SPSS was also used to determine the Cronbach's alpha values for the 20 skills listed in the table. The test was run twice, once to measure internal consistency of the scale measuring the importance of each skill and also to measure the internal consistency of the scale used to measure the level to which each skill is developed. Cronbach's alpha can be reported as 0.834 for the scale measuring the importance of each skill, and 0.748 for the scale measuring the level to which each skill is developed. A high value is alpha indicates a high variance in the respondents answers, which indicates a wide spread of scores. According to Hair et. al. (1998: 118), Cronbach's alpha value can be reduced to 0.6 for exploratory research. However, since Cronbach's alpha values is greater than 0.7 in both cases, it can be concluded that all factors are internally reliable (Bland and Altman, 1997).

Discussion

It is clearly evident from analysing the results from hypothesis 1 that mature students recognise the importance of generic skills in enhancing employability. It is also quite apparent from analysing table 13 that as age increases, the respondents are more likely to agree or strongly agree that generic skills enhance employability. This also supports the findings from the Spearman Correlation test, r_s = -.614 indicates a strong relationship between the variables. Connolly (2007), states that a correlation coefficient above 0.6 indicates a strong relationship. The negative correlation is due to the way in which employability was coded in SPSS, 1 was strongly agree while 5 was strongly disagree. Since negative coefficients are treated in the same manner as positive coefficients, the percentage of variation that the two variables share in common is 37.69%.

The results from hypothesis 2 are quite similar to hypothesis 1. Only 5 respondents in the 19 and under age category believe that interview skills are important for work in their profession, this coincides with the results from hypothesis 1. It may be concluded that since employability and interview skills are invariably interlinked, the 19 and under age group are quite young and new to third level education and employment and interview skills may be viewed as irrelevant at this particular point in time. The results from the Spearman Correlation test also supports the findings that as age increase, the importance of interview skills also increases and since r_s = 0.615, this indicates a strong relationship between the two variables. The positive correlation is due to the way in which importance of interview skills were coded in SPSS, 1 was not important while 4 was essential. The percentage of variation that the two variables share in common is 37.82%. The findings from hypothesis 1 and hypothesis 2 is consistent with the literature from Buckler et. al. (2006), who state that mature students tend to have a greater understanding of the importance of generic skills.

Watson (2002) discusses the benefits to be gained from introducing teamwork into first year at university, so it was decided to investigate if there was a relationship between year of study and the importance of teamwork. The results from hypothesis 3 indicate that first years rate teamwork skills highly when compared with respondents in later years of study. This may be attributed to the fact that there was a significant change in the way that first year engineering courses were delivered. There was a major shift from the traditional lecture based approach to a project based approach. Students were expected to work individually and collaboratively on the design and construction of a small project. However, as year of study increases, students must complete individual project particularly in third and fourth years. This supports the findings of this hypothesis that as year of study increases, respondents are less likely to see the importance of teamwork, and this is why there is a negative correlation for this hypothesis, r_s = -.420. This suggests that there is a 'moderate' relationship between the two variables. The percentage of variation that the two variables share in common is 17.64%.

Lawson and De Matos (2000) state that many employers are seeking employees with basic computing skills regardless of discipline of study, it was for this reason that it was decided to investigate if there is a relationship between the importance of computing skills and course of study. The findings from hypothesis 4 indicate that regardless of course of study, basic computing skills are either very important or essential. The results generated from hypothesis 4 indicated that 113 of the 122 respondents believe that computing skills are either very important or essential, it was decided to investigate this further. Further investigations revealed a statistical significance between electronics and mechanical respondents (p= 0.005). Likewise a statistical significance was discovered between electronics and civil/construction respondents (p=0.002). However, due to the small sample size, these results should be treated with caution. Walkington (2001) emphasise that mature students who have worked previously in industry, may not have had access to a computer and therefore it should not be assumed that these students have basic computing skills. Perhaps, a better hypothesis would have been to investigate, if there are any differences between age and the respondents' perceived confidence levels in relation to basic computing skills.

Hypothesis 5 and 6 specifically address any gender differences in relation to generic skills. The results from hypothesis 5 indicate that 96% of females believe that practising generic skills enhances confidence levels, while only 38% of males believe that practising generic skills enhances confidence levels. The effect size for hypothesis 5 was reported as 0.4353, which suggests that the strength of the relationship between the

two variables is moderate. The results from hypothesis 6 indicates that again 96% of females believe that oral and written communications are either very important or essential for work in their profession. This is in comparison to only 42% of males believing that oral and written communications are either important or essential for work in their profession. The effect size for hypothesis 6 was reported as 0.3742 which again suggests that the strength of the relationship between the two variables is moderate. These findings are also supported by the research conducted by Ong et. al. (2003), who found that engineering female students assigned a much higher importance on written communications. As mentioned earlier since the number of female respondents was quite low in comparison to males, any generalisation in relation to gender should be treated with caution.

Conclusion and future work

One of the research questions poised in this research was to investigate if engineering students are aware of the importance of generic skills within their course of study. It is quite obvious from analysing the results in table 10 that engineering students are aware of the importance of generic skills. The low values of standard deviations suggests that respondents do not vary much in their responses to the importance level of each of the 20 generic skills. The second question was to investigate if engineering students were aware of the existence of generic skills within their course of study. It is apparent from analysing the results in table 11, that engineering students do not feel that certain generic skills are adequately covered within their course of study. These results are quite surprising, particularly time management and meeting deadlines which has a mean value of less than 2. It seems that engineering students do not feel that these generic skills are adequately covered, since 2 is rated as 'none' on this particular scale. This suggests that the lecturer must play a more active role in emphasising the importance of generic skills.

Additionally, investigations into mature students' perceptions of generic skills to determine if they perceive generic skills as been more important, in comparison to their younger counterparts. Hypothesis 1 and 2 suggested that mature students do believe that generic skills are more important when compared with their younger counterparts. It would be interesting to investigate this further by exploring if there are differences in maturity in relation to any of the other generic skills in the table[1], besides interview skills. It was also decided to investigate any gender differences in relation to generic skills, and it was found that there are significant differences in the importance of oral and written communications. This could be further investigated by exploring how female engineers perceive the importance of any of the other skills in the skills table besides oral and written communications.

A limitation of this research was the low response rate from certain engineering courses. Perhaps this could have been avoided if the questionnaire had been administered earlier in the year. The fact that very few engineering students in civil, building services, architectural technology and fire technology, took part in this research could have been addressed by requesting lecturing staff directly involved with these students to self administrator the questionnaires. The self administrated questionnaires worked well for the electronics and mechanical engineering students as the response rate was 57%, although this figure could have been improved upon by administrating the questionnaire earlier in the year. The response rate for females was also low in comparison to males, perhaps the questionnaire should have been administrated across other departments, such as science and computing, in order to reach the wider female population.

As further research in the area of generic skills, it would be most interesting to investigate the perceptions of engineering students at university and compare with engineering students at Institutes of Technologies. Are their differences in how these groups of students perceive generic skills? Another interesting study would be to ask employers of our engineering students, which skills are more important to them? It would also be extremely interesting if employers could determine if there are any differences between an Institute of Technology graduate and a university graduate in terms of the generic skills competencies.

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[1] Refer to Section B in Questionnaire

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Appendix A Generic Skills Assessment Student Questionnaire

This questionnaire presents a series of questions related to the skills that may be important for success in the engineering profession. The purpose of this questionnaire is to determine what generic skills are important to the student, and if they feel that these generic skills are addressed in their course of study.

Instruction to student: Please answer all the questions.

Section A: Background information

1. Are you male or female?
   - Male [ ]
   - Female [ ]

2. What age are you?
   - 19 and under [ ]
   - 20 – 29 [ ]
   - 30 – 39 [ ]
   - 40 – 49 [ ]
   - 50 – 59 [ ]
   - 60 or over [ ]

3. What course are you registered on?
   - Electronic [ ]
   - Computer [ ]
   - Mechanical [ ]
   - Civil [ ]
   - Building Services [ ]
   - Other [ ] Please specify ----------

4. What year of study are you currently in?
   - First [ ]
   - Second [ ]
   - Third [ ]
   - Fourth [ ]
   - Other [ ] Please specify ----------

5. Have you been previously employed long term?
   - Yes [ ]
   - No [ ]
   - Other [ ] Please specify ----------

6. What is your primary reason for attending college?
   - Natural progression after school [ ]
   - Up-skilling [ ]
   - Like learning [ ]
   - Lack of jobs [ ]
   - Other [ ] Please specify ----------

Section B: Generic Skills Assessment
For each of the skills listed below in the table, please estimate:
—the **importance** of the skill, in your opinion, for work in your profession;

Please use the following scale:
1 = Not important; 2 = Somewhat Important; 3 = Very important; 4 = Essential.

—the **level** to which each skill is developed by your course;
Blank spaces have also been provided for other skills which are important to you and are not on the list.

Please use the following scale:
1 = None; 2 = Weak; 3 = Considerable; 4 = Strong.

Skill	**Importance**	**How well do you feel this skill is developed in your course of study?**
1. Oral and Written Communication	1 2 3 4	1 2 3 4
2. Basic Computing Skills	1 2 3 4	1 2 3 4
3. Time Management Skills	1 2 3 4	1 2 3 4
4. Meeting Deadlines	1 2 3 4	1 2 3 4
5. Teamwork	1 2 3 4	1 2 3 4
6. Problem Solving	1 2 3 4	1 2 3 4
7.Decision Making	1 2 3 4	1 2 3 4
8.Research Skills	1 2 3 4	1 2 3 4
9.Capacity to learn – lifelong learning	1 2 3 4	1 2 3 4
10.Information management skills- ability to retrieve and analyse information from different sources	1 2 3 4	1 2 3 4
11.Capacity to be creative – generate new ideas	1 2 3 4	1 2 3 4
12.Capacity to accept criticism	1 2 3 4	1 2 3 4
13.Capacity to be critical	1 2 3 4	1 2 3 4
14.Being reflective	1 2 3 4	1 2 3 4
15.Being self-confident	1 2 3 4	1 2 3 4
16.Being motivated	1 2 3 4	1 2 3 4
17.Being ethical	1 2 3 4	1 2 3 4
18.Respectful of others heritage and culture	1 2 3 4	1 2 3 4
19.Environmentally aware	1 2 3 4	1 2 3 4
20.Interview skills	1 2 3 4	1 2 3 4

7. Referring to the above table, please indicate three of the most important skills according to your opinion. Write in the space provided.

---

8. Generic skills enhance employability
   Strongly Agree [ ]
   Agree [ ]
   Undecided [ ]
   Disagree [ ]
   Strongly Disagree [ ]

9. Practising generic skills can enhance my confidence levels.
   Strongly Agree [ ]
   Agree [ ]
   Undecided [ ]
   Disagree [ ]
   Strongly Disagree [ ]

10. How much hours per week do you think should be dedicated to generic skills within your course of study?
    < 1 hour [ ]
    2 hours [ ]
    3 hours [ ]
    4 hours [ ]
    5 hours [ ]
    Other Please specify _____

Thank you for your cooperation