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Comparative analysis of emotional competency within distinct student cohorts

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ABSTRACT: Student success within a university programme is impacted by a variety of factors. One possible factor is the Emotional Intelligence (EI) skill set of the student as they enter and progress through their programme. To obtain a better understanding of the EI skill set of university students, a longitudinal study was undertaken at the lead author's home university. Investigation of three distinct student cohorts of engineering, business and humanities students took place over a three year period. This was aimed at determining any differences between the cohorts, as well as any EI skill set development achieved over the three year period. This article reports that there were distinct differences and similarities between the engineering, business and humanities cohorts on several of the EI skills. In addition, there were no statistically significant improvements in all but one of the EI skills over the three year maturation period from first year to third year. Reasons for this are analysed and discussed.

Keywords: Emotional intelligence, emotional competence, learning environments, formation of engineers

INTRODUCTION

Anecdotal evidence shows that student achievement rates can vary significantly by programme at higher education institutions, and in particular, engineering programmes are historically known to have significantly higher attrition rates than others [1]. There are many potential reasons for this variance, such as student preparedness for university, student engagement with the programme of study or their peers and student aptitude for their chosen programme. An area of investigation that is of interest to the authors is the various skill sets and competencies students possess as they undertake their university undergraduate studies. Specifically, the students' Emotional Intelligence (EI) skill set, which details the emotional and social competencies of students. This study investigated the EI skills of students at the lead author's home university, by programme and further by year as the students progressed through three years of undergraduate education within their distinct cohorts. The primary objective was to determine if there were significant EI scale differences between the programme cohorts and if those differences were predictive of a student's interest or aptitude for the programme of study they choose to undertake. Second, the authors were interested in assessing if these, or other EI scales, improved with progression through three years of study at university. In other words are universities providing an educational experience that fosters growth of a skill set that might promote academic achievement?

Daniel Goleman, the person widely credited with bringing EI into the public consciousness, described a person's EI as possessing *abilities such as being able to motivate oneself and persist in the face of frustrations; to control impulse and delay gratification; to regulate one's moods and keep distress from swamping the ability to think; to empathize and to hope* [2]. Such skills and competencies are obviously highly desirable to facilitate students successfully navigating their way through an undergraduate education, particularly a time intensive engineering programme.

This study began with an assessment of the EI skill levels of students upon entry to their university career to determine a baseline of emotional and social competencies. In addition, the student EI skills were reassessed in second and third year to determine if the instruction methods within each distinct cohort provided EI ability improvement.

EMOTIONAL INTELLIGENCE

There are a few well established EI scale measurement instruments being used on a world-wide basis but they differ in how the emotional intelligence construct is defined and, hence, how it is measured. For example, the MSCEIT (Mayer-

Salovey-Caruso Intelligence Test) is a measure developed in the 1990s, which tests a person's ability to *perceive, use, understand, and regulate emotions. Based on scenarios typical of everyday life, the MSCEIT measures how well people perform tasks and solve emotional problems* [3]. The MSCEIT evaluation is generally conducted by an independent assessor. A second EI instrument is the EQ-i (Emotional Quotient Inventory), which is described as a mixed-model of EI as it encompasses both ability and (personality) trait characteristics [4]. It is a self-report measure, which was developed by Dr Reuven Bar-On who states *emotional-social intelligence is a cross-section of interrelated emotional and social competencies, skills and facilitators that determine how effectively we understand and express ourselves, understand others and relate with them, and cope with daily demands* [5]. The mixed-model instrument type was determined to be most applicable for determining the various attributes, abilities or characteristics that the students possessed and given the number of students that participated in this study (> 500 in the first year) a self-report instrument was the logical choice.

COLLEGE ACHIEVEMENT INVENTORY - REVISED (CAI-R)

Dr J.D.A. Parker and his Emotion and Health Research Laboratory (ERHL) at Trent University, Peterborough, Ontario, Canada, have used the EQ-i since 1999 in many studies, which they have undertaken into student academic achievement upon entering university programmes [6][7]. In addition, the EHRL developed an emotional intelligence measure called the College Achievement Inventory (CAI -Revised) [8], which has been tested on over 3,500 students in the past decade. The CAI-R correlates highly with the Bar-On EQ-i [8]. The CAI-R measures five EI Scales: Emotional Understanding, Psychological Mindedness, Attentiveness, Emotional Self-Control and an averaged summation scale of Total EI. The measure also evaluates four Social Competency scales: Optimism, Social Integration, Performance Anxiety and Social Anxiety. The CAI-R was specifically designed for use with a college and university population and so this measure was adopted for the study reported in this article. The CAI-R manual [8] provides definitions as follows:

EI Skills:

1. *Emotional Understanding,* which relates to one's understanding and expression of his/her feelings;
2. *Psychological Mindedness,* which relates to the understanding and awareness of oneself and others;
3. *Attentiveness,* which pertains to one's ability to focus on a task and keep focused, tuning out distracting stimuli and keeping organised;
4. *Emotional Self-Control,* which relates to one's ability over various types of emotional behaviour, such as waiting patiently or engaging in activities quietly when necessary;
5. *Total EI (TEI),* which is an overall indicator of one's EI and is the averaged sum of the scores from the previous four EI scales.

Social Competencies:

6. *Optimism,* which relates to positive expectations, feelings of equal worth to others and contentment with oneself;
7. *Social Integration,* which relates to feelings of connectedness with peers, feeling able to depend on others for support, in effect satisfying interpersonal relationships;
8. *Performance Anxiety,* relates to one's level of concern or comfort in situations in which one is the centre of attention;
9. *Social Anxiety,* relates to the worry or discomfort one experiences in social situations or how secure one is with their in your social abilities.

METHODOLOGY

Students in the three distinct programmes of engineering (all disciplines), business (Information Technology Management programme) and humanities (Arts and Contemporary Studies programme) at the lead author's home university participated in the study. The students in each cohort completed the CAI-R measure in the autumn of year one, two and three within their programme. In addition, the participating students provided permission for the investigator to access their academic records (specifically their cumulative grade point averages (CGPA) for each year of their undergraduate career).

RESULTS

The Emotional Intelligence composite scales were evaluated for each distinct cohort at each yearly assessment stage. An analysis was, then, conducted to determine if there were statistically significant differences between the cohorts on the scales. It was determined that there were significant differences on two of the five EI scales, specifically Psychological Mindedness [$F(2,155) = 41.73$, $p < 0.0001$] and Emotional Self-Control [$F(2,155) = 5.90$, $p = 0.003$]. In addition, there was a statistically significant difference between the cohorts on the social competence scale of Performance Anxiety [$F(2,155) = 8.52$, $p = 0.0002$]. Figure 1 provides visualisations of these three scales by cohort and by year along with the mean and standard deviation data, while Table 1 provides the results of the group analysis conducted between the cohorts.

The humanities students were assessed to have consistently higher valuations than the engineering and business students on the psychological mindedness scale. Indeed the humanities cohort was the only cohort that was above the normative

mean for the scale in the first year of assessment, as well as the second and third years. The engineering and business cohorts never increased to the normative mean value of the scale in any year of the assessment. Not surprisingly, for the psychological mindedness scale the engineering and business cohorts were determined to be within the same grouping, while the humanities students were in a distinct and separate grouping. In other words, engineering and business students were significantly below the humanities students with respect to their ability to *use their feelings to guide their behaviours, and place great importance on self-awareness* [8].

Normative analysis for the CAI-R conducted on 3,500 university students determined that females score higher on the psychological mindedness scale than males [8]. The psychological mindedness covers similar skills and abilities that are detailed on the interpersonal relationship scale of the EQ-i and the technical manual for the EQ-i instrument documents norming data from a significant database of 3,831 individuals. *Based on this sample, females seem to have stronger interpersonal skills than males* [9]. Therefore, given that females comprise 73% of the humanities cohort a grouping distinction between the humanities students and the male dominated engineering (13% female) and business student (18% female) cohorts is not unexpected.

On the emotional self-control scale, the engineers were distinctly different from the humanities students but the business cohort was determined not to be distinctly different from either of the humanities or the engineering students. The mean value was highest for the engineering cohort and so the engineers were determined to have better developed abilities, such as *waiting patiently, engaging in activities quietly when necessary, remaining still, listening and waiting for the appropriate time to respond* [8]. This finding may be contributory to the traditional passive style of instruction to which science, mathematics and engineering students are subjected. The fact that the engineering students do not experience any significant growth on this scale over a three year period suggests that the instruction methodology adopted by engineering professors does not foster an engaging and developmental learning environment. This teaching method is the traditional mode of delivering a continuous monologue at the front of the classroom, which requires passive, even indifferent, attention from the students.

The engineering students had the lowest performance anxiety evaluation in each year, with progressively slight decreases year over year. The humanities students had the middle value of the three cohorts on the performance anxiety scale in the first year with a slight decrease in second year and, then, an increase in the third year to a value above the normative mean for the scale. The business students had the highest performance anxiety in year one at a value higher than the normative scale mean with a small decrease from year one to year two and a slight increase from year two to year three but not reaching the level of year one again. The grouping assessment determined that the humanities students were in a distinctly different group from the engineers and business students. Therefore, the humanities students had *a higher level of concern or discomfort in situations in which they were the centre of attention* [8].

It is of significance that for all the remaining scales of Emotional Understanding, Attentiveness, Total EI, Optimism, Social Integration and Social Anxiety scales not one of the three different cohorts' mean values reached the value of the scale normative mean in any year of assessment. In other words, all students, in all years, were evaluated as achieving a lower mean value on each of these scales. In addition, no group distinction was determined between the three student cohorts for the remaining scales.

A further analysis was conducted to determine if there was a significant improvement on each scale over the three year period of the study. This analysis determined that there was no statistical significance for any of the social competency scales and all but one of the EI scales. The only scale that had statistically significant change over the three year assessment period was the Emotional Understanding scale [$F(2,308) = 5.31$, $p = 0.005$]. A subsequent repeated measures analysis of variance determined that notable variance occurred between year one and year three [$F(1,154) = 6.86$, $p = 0.01$] but not between year two and year three [$F(1,154) = 0.01$, $p = 0.92$]. Figure 2 provides a visual of the Emotional Understanding scale along with the mean and standard deviation table.

Table 1: Between cohort variance analysis.

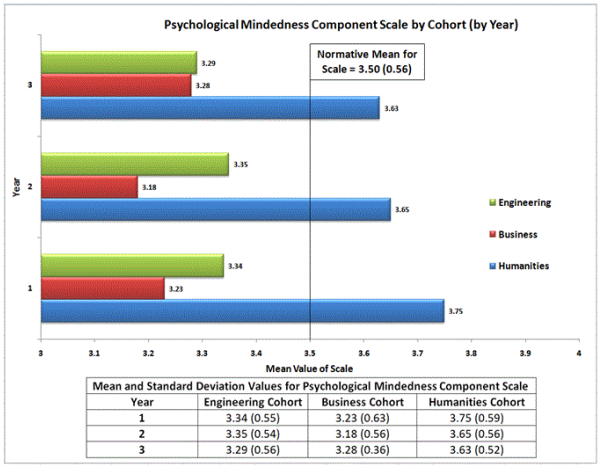
Cohort	Engineering	Business	Humanities	Engineering	Business	Humanities
Psychological Mindedness				Emotional Self-Control		
Scale Mean	3.36	3.27	3.75	3.47	3.36	3.31
Group	B	B	A	A	A, B	B
Performance Anxiety						
Scale Mean	3.89	3.95	4.11			
Group	B	B	A			

DISCUSSION

EI scales are often quoted as being distinct from a person's IQ valuation because they are said to increase with age, not maturity, but rather simple chronological ageing [2][8][10]. Indeed, the Bar-On EQ-i measurement instrument instruction manual provides data that indicate a shift in emotional quotient evaluations between the age ranges of 16-19

and 20-29, see Figure 3. Most summary discussions on emotional intelligence state that EI levels increase with age (as opposed to IQ, which levels out around age 17) but they do not draw a distinction between chronological age and maturity [8][10][11]. This distinct shift in EQ levels between the 16-19 age group and 20-29 age group occurs at a significant transition period of a person's life, which is expected to have an impact on their maturity development.

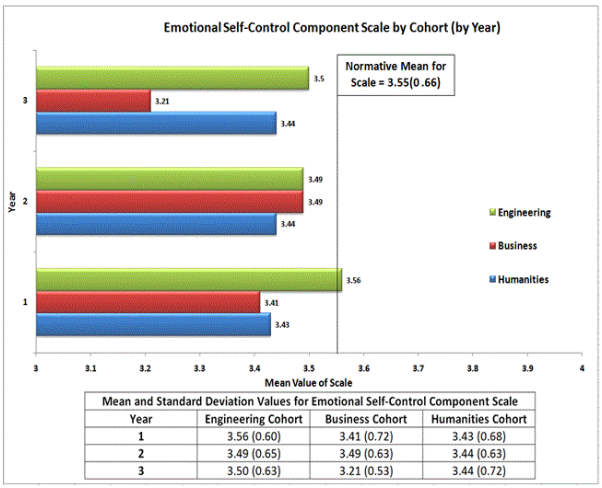
The developers of the MSEIT and the EQ-i also recognised the significance of this major transition and created instrument versions specifically for students in the post secondary environment. The aim of the higher education version of the EQ-i is to *assist students in adapting to the environmental demands and pressures of the college environment. Investing in the emotional development of students also impacts leadership effectiveness, both on campus and in the future. Finally, emotional competency development benefits the career development process, promoting a successful transition from college into the workplace* [12].



Mean and Standard Deviation Values for Psychological Mindedness Component Scale

Year	Engineering Cohort	Business Cohort	Humanities Cohort
1	3.34 (0.55)	3.23 (0.63)	3.75 (0.59)
2	3.35 (0.54)	3.18 (0.56)	3.65 (0.56)
3	3.29 (0.56)	3.28 (0.36)	3.63 (0.52)

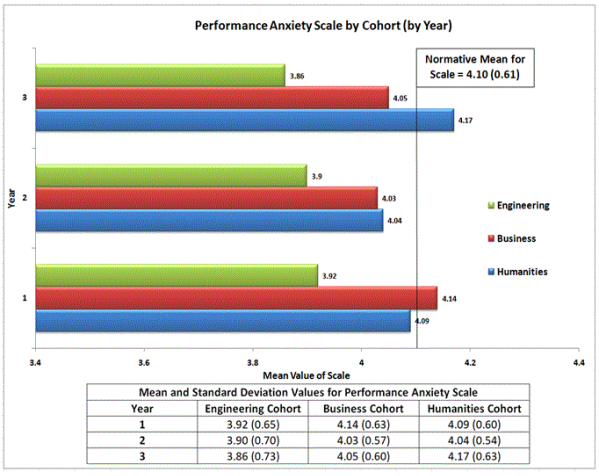
a)



Mean and Standard Deviation Values for Emotional Self-Control Component Scale

Year	Engineering Cohort	Business Cohort	Humanities Cohort
1	3.56 (0.60)	3.41 (0.72)	3.43 (0.68)
2	3.49 (0.65)	3.49 (0.63)	3.44 (0.63)
3	3.50 (0.63)	3.21 (0.53)	3.44 (0.72)

b)

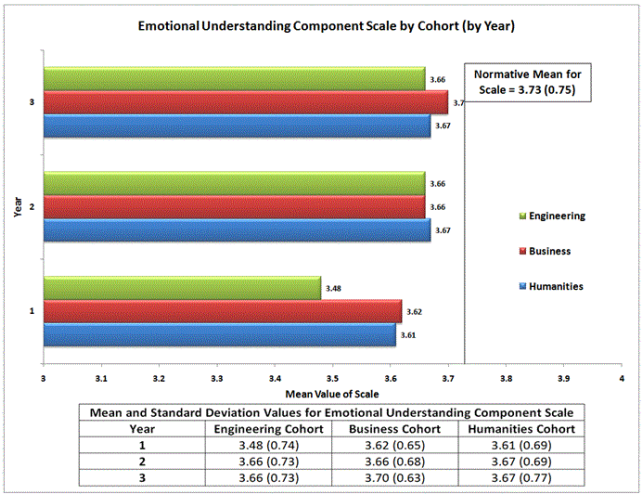


Mean and Standard Deviation Values for Performance Anxiety Scale

Year	Engineering Cohort	Business Cohort	Humanities Cohort
1	3.92 (0.65)	4.14 (0.63)	4.09 (0.60)
2	3.90 (0.70)	4.03 (0.57)	4.04 (0.54)
3	3.86 (0.73)	4.05 (0.60)	4.17 (0.63)

c)

Figure 1: Psychological Mindedness, Emotional Self-Control and Performance Anxiety Scales by cohort and by year.



Mean and Standard Deviation Values for Emotional Understanding Component Scale

Year	Engineering Cohort	Business Cohort	Humanities Cohort
1	3.48 (0.74)	3.62 (0.65)	3.61 (0.69)
2	3.66 (0.73)	3.66 (0.68)	3.67 (0.69)
3	3.66 (0.73)	3.70 (0.63)	3.67 (0.77)

Figure 2: Emotional Understanding scale by cohort and by year.

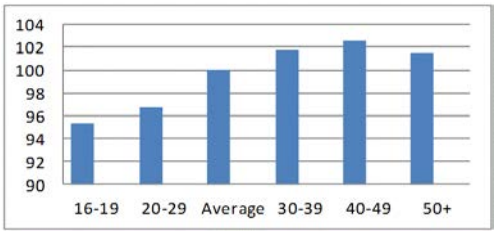


Figure 3: EQ-i score as a function of chronological age [10].

If maturity can be defined as *the ability to react, cope and reason in an appropriate way for the situation* [13], then, one would expect a change in EI skills due to the transition period undertaken from late teens to early twenties. However, this expectation was not corroborated by the current study results. Therefore, if *maturity is learned through experiences* [13], then, the learning experiences to which students are exposed need to be reassessed for their effectiveness.

It had been posited that one scale in particular, in effect Attentiveness, would have seen significant change over these critical three years of student development. Attention to detail, completing tasks, maintaining focus on a job at hand and listening attentively are all skills that are exercised every day when going through a university programme and meeting deadlines with respect to assignments, tests, projects. It is interesting to note that there was no statistically significant improvement on this scale as the students progressed through the years. This would suggest that some skills do not simply develop or improve with age and experience but rather steps have to be taken to make the cohort aware of these skills and provide active training to constructively develop these competencies.

Undergraduate engineering education in the United States is holding on to an approach to problem solving and knowledge acquisition that is consistent with practice that the profession has left behind [14]. The traditional teacher centred learning environment promotes a passive experience for the student, which does not encourage the development of EI skills that could scaffold improved further academic achievement.

In the first year of the engineering programme at the study university, students take the fundamental building block courses in mathematics and science typically in a large class format. In addition, laboratories and tutorials comprise approximately 40% of the overall course delivery. Traditional blackboard centred lecture delivery and similar tutorial delivery methods do not promote student engagement with the subject matter, while first year laboratories are focused on demonstrating the theories covered in lectures with no open ended questions that foster independent thought. Course assessment is overwhelmingly a recall and application exercise (the lower scales of Bloom's taxonomy) on midterm and final course examinations. In upper years, students complete discipline specific courses, which again tend to follow the traditional blackboard centred delivery format. Group work is introduced in upper years but it is debatable if the spirit of design group work is embraced and enforced by the faculty. It is the experience of the authors that when assigned a group design project, engineering students tend to subdivide the work and assign it to group members to be completed separately and, then, combined into a final hand-in report. A reference on student centred learning states that *overriding emphasis on teaching technical knowledge focuses on learning that knowledge per se and not enough on learning the knowledge so that it will be usable toward effective professional practice* [14]. In engineering courses, there is no explicit content which addresses EI skills set elements.

In the humanities programme, lectures are delivered in a teacher centred format that again promotes a passive learning experience for the students. These courses are predominantly comprised of lectures without any tutorial or laboratory component. Assessment is comprised of individual term tests and midterms but, in addition, humanities courses have a

higher term paper component that engineering and business do not. Term papers provide an assessment instrument that, if managed appropriately, could assist the growth of EI skills related to intra (Emotional Understanding) and interpersonal skills (Psychological Mindedness). In addition, the course content in several of the humanities courses encompasses specific elements of EI skills (e.g. Learning and Development Strategies), which should make the student aware of this skill set and it's benefits.

The Information Technology Management (ITM) programme is different in that there is an extensive variety of courses for students to take after the first year, hence, each student can undertake a significantly different programme of study within the same programme. Predominantly, the courses have solely lecture delivery with only a few tutorials or laboratories. Course delivery uses case study evaluation extensively in business courses. In addition, some course content covers certain elements of EI skills (e.g. Organisational Behaviour and Interpersonal Skills), which should increase awareness of the skill set.

Several previous studies are noteworthy with respect to this discussion. At Loughborough University, UK, an EI study was conducted in 2007 on 400 undergraduate engineering students. Their EI was scored at the beginning of an academic year and, then, rescored at the end of the same year. *Overall, EI score declined for most engineering programmes over the test-retest period. This suggests that the way in which we currently educate our students does little to enhance EI* [15]. The fact that eight of the nine EI scales did not significantly change for all three programmes over the three year period of the study supports the previous statement that current instruction methods are not effective in promoting growth of EI skills; particularly, the engineering programme and even in the humanities and business programmes, where some of the courses cover topics actually related to EI skills. The authors seriously question whether the required level of metacognition was consciously fostered in the students as they progressed through their courses. It has been shown that *students who think about their own thinking (a practice called meta-cognition by psychologists) learn better than students who do not employ this strategy* [12].

The Emotion and Health Research Laboratory (ERHL) and Dr J.D.A. Parker at Trent University conducted an interesting study in which incoming students completed the EI instrument as they entered the university. This assessment was used to determine students who were low on EI scales and, hence, identified as *at risk* for poor academic performance and possible programme drop-out. These students were, then, provided with mentoring services by peers and an EI skill workshop. At the end of the year, it was determined that the students who accepted intervention had a lower drop-out rate (17%) than those who did not (27%) [7]. This is surely evidence of the need to provide a work-based learning environment on campus to develop EI skills.

As stated in the results section, only one out of the nine EI and additional skills increased significantly over the three years of the study; namely, the Emotional Understanding scale. Additional analysis determined that this notable change occurred from year one to year two. This scale covers intrapersonal skills, which relate to one's understanding and expression of his/her feelings [8]. However, it is debatable whether the educational environment has contributed to the improvement on the scale or if it is attributable to the social and personal experience that a student acclimatising to the university environment undergoes.

The learning experience and educational environment provided to the students should encourage development of EI skills that can scaffold a student's academic achievement. Adopting a student centred learning focus versus the current teacher centred focus could advance the goal of developing student EI skill sets. Such a focus shift would compel students to synthesise their own learning and develop several of their EI skill levels; emotional understanding, psychological understanding and attentiveness. In addition, conscious instruction and coverage of EI skills should be included within course delivery and addressed in particular assignment requirements. A focus shift would also improve critical thinking skills, a topic of interest globally in student success assessment. As a recent text on engineering education states: *We are concerned that the pedagogy and assessment that are common to the core courses are not designed to help students move farther along the continuum of cognitive development, toward reflective thinking* [14].

CONCLUSIONS

The longitudinal study of EI skills conducted on the three distinct student cohorts showed that only one of the scales, Emotional Understanding (intrapersonal skills) improved over the duration of the study, specifically from year one to year two. This supports the conclusion that current instructional delivery methods (i.e. teacher centred teaching) do not support improvement of EI skills. As shown in the mentoring programme of at-risk students referred to in the discussion section, a conscious inclusion of EI instruction and assessment could be advantageous to students in all programmes.

Students within the different programmes were in the same grouping except for three of the nine scales. Engineers were in the same class as business students on the Psychological Mindedness scale and the Performance Anxiety scale, while the humanities students were in a distinct and different group. Humanities had a higher level of development on Psychological Mindedness (interpersonal skills) and a higher level of Performance Anxiety. Engineers were distinctly different from humanities students on the Emotional Self-Control scale (a higher level of capability over emotional behaviour such as waiting patiently or engaging in activities quietly when necessary), while business students were not distinctly different from either of the other two cohorts.

According to the NSF (National Science Foundation)*, there are unintended consequences of too much emphasis on teaching at the expense of learning, including graduates who are not prepared to solve real-world problems and lack of skills and motivation to continue to learn beyond their formal education* [16]. Therefore, movement towards the adoption of a more student centred learning environment with the inclusion of workplace learning periods, where specific attention is paid to EI skill instruction/development and the use of critical thinking practice is highly recommended. This conclusion is in line with analysis that states: *when the focus becomes student learning, colleges attain higher rates of student retention and have better-prepared graduates than those students who were more traditionally trained* [16].

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BIOGRAPHIES

Mary Frances Stewart graduated in mathematics and engineering from Queen's University, Kingston, Canada, and completed a Master of Engineering at the University of Toronto, Toronto, Canada, in 1986. She has been a lecturer and currently is a professor in the Mechanical and Industrial Engineering Department at Ryerson University, Toronto, Canada. She has previously served as the Director of the First Year Engineering Program, Co-ordinator of Engineering Enrichment and Outreach Office for the Faculty and is a founding member of the Women In Engineering Programs at Ryerson. Her research and publications are in the area of engineering education and currently she is conducting research on emotional competencies and learning styles. She has received numerous institutional and provincial awards for her teaching and in 2012 was awarded the University's President's Award for Teaching Excellence. In 2010, she was appointed, and currently serves, as the inaugural Engineering Teaching Chair and provides leadership on the scholarship of teaching and learning within the Faculty of Engineering.

Colin Urquhart Chisholm graduated in metallurgy from Strathclyde University and completed a PhD at St Andrews/Dundee University. He is Emeritus Professor at Glasgow Caledonian University (GCU), where he continues to research and publish. He led the establishment of work-based learning, leading to awards up to Professional Doctorate. He has published around 300 scientific/education papers in refereed journals and conference proceedings. He has researched a range of engineering and educational developments and collaborated with the then UNESCO International Centre for Engineering Education (UICEE), Melbourne, Australia, setting up the first *UICEE satellite centre* at GCU. He was awarded the UICEE Silver Badge of Honour in 1998, the Gold Badge of Honour in 2000, and the inaugural *UICEE Order for Excellence in Engineering Education* in 2006. He has been Associate Editor of a number of international journals and is a member of the editorial boards of a number of journals. He is currently a member of the editorial advisory boards of the World Transactions on Engineering and Technology Education (WTE&TE) and the Global Journal of Engineering Education (GJEE) of the World Institute of Engineering and Technology Education (WIETE), based in Melbourne, Australia.