Emotional Intelligence and Academic Performance of Engineering Students

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EMOTIONAL INTELLIGENCE AND ACADEMIC PERFORMANCE OF ENGINEERING STUDENTS

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Abstract

Professional expertise is no longer the only standard by which to evaluate college graduates. “Soft skills”, like emotional intelligence are viewed as effective ways to distinguish potential high-performance workers. The purpose of this paper is to attempt to correlate emotional intelligence with the academic performance of civil engineering students. A student’s grade point ratio (GPR) is the criterion that is used in this research to measure academic performance. It is anticipated that students with high GPRs will score better on measures of emotional intelligence (EI) than others.

In reviews of literature it was found that there is a growing area of research into emotional intelligence and its relationship to job performance, specifically through the research presented in Emotional Intelligence: Why It Can Matter More Than IQ (Goleman, 1995). There is a paucity of research, however, linking emotional intelligence with academic performance in engineering students. There is also little information on the degree to which engineering students understand the importance of EI or receive any training in emotional intelligence. Communication is accepted as an important skill required by engineering professions and is often cultivated in engineering curricula. It is shown in the literature that EI augments communication skills, and it is proposed that EI training should be a part of engineering education. The purpose of this study is to examine the relationship between EI and academic performance and examine the potential difference in emotional intelligence with respect to demographic and experiential characteristics. This research assumes the following principles: (1) There is a relationship between GPR and Emotional Intelligence, (2) the relationship can be measured, and (3) the participants in this research have anonymity and are guaranteed that their responses are not part of their individual academic evaluations, increasing the respondents’ ability to answer honestly.

In surveys of 140 civil engineering and construction management students from Clemson University and The Citadel it is suggested that EI increases along with increases in GPR. EI peaks at the student group of 2.51 to 3.0 GPR. After that, EI decreases as GPR increases. Also, a positive connection between work experience and emotional intelligence was identified. Based on the results of this analysis, the paper proposes
increased emphasis on co-op and extracurricular programs to help students develop their EI skills.

**Keywords**: Emotional Intelligence, Engineering, Academic Performance, Education
Introduction

The construction industry is very sensitive to economic downturns and thus suffers at times through cycles of “famine” in terms of work available while at other time it enjoys “feasts” of backlogs and work aplenty. The most recent economic downturn hit the construction industry in late 2008 and the industry has continued to suffer in the United States. In these leaner circumstances, construction companies tend to focus on improving the overall competence of the company and the effectiveness of their workforce to maximize their competitive opportunities. Their workforce must be qualified, skilled, and experienced—traits that are not normally associated with newly graduated students. For Civil Engineering students to have the qualifications and competence companies are seeking, they must receive and develop skills outside of those found in traditional classrooms.

Emotional intelligence has emerged as a relevant indicator of positive work outcomes. Current research on the importance and relevance of the relationship between emotional intelligence and work outcomes has been gaining momentum since the publication of Daniel Goleman’s Emotional Intelligence: Why It Can Matter More Than IQ (1995). Professional expertise is no longer the only standard by which to evaluate graduates. “Soft skills” such as emotional intelligence are viewed as effective ways to distinguish potential high-performance workers.

This paper attempts to correlate Emotional Intelligence with the academic performance of Civil Engineering and Construction Management students. It is anticipated that higher emotional intelligence will play a positive role in schoolwork, as measured by the student’s Grade Point Ratio (GPR). In addition, an analysis was done to identify any possible connections between demographic data such as age, gender, and EI. To evaluate Emotional Intelligence, “The Emotional Intelligence Appraisal®,” a skill-based self-reporting measure of emotional intelligence was utilized (Bradberry and Su, 2003). Based on the results of the analysis, the paper suggests that students receive training in the concepts and techniques related to emotional intelligence in college engineering education programs.

Emotional Intelligence (EI)

There are five main competencies of emotional intelligence, which can be grouped into two main categories: Personal and Social Skills. Figure 1 describes some details for each competence and sub-competence (Goleman, 1998).
Personality can be defined as a person’s pattern of internal experience and social interaction that arises from the action of that individual’s major psychological subsystems. Emotional intelligence is a part of human personality, and personality provides the context in which emotional intelligence operates. Emotional intelligence can be considered a mental ability that involves the ability to reason validly with emotional
information, and the action of emotions to enhance thought. Social skills are defined as social facility, which includes synchrony, self-presentation, influence, and concern. It is a capability that allows one to influence and inspire others, manage social relationship, solve conflict as well as adjust to surrounding environment. It is important to note that EI is based on an inherited set of traits, but the associated skills can be learned and improved. It is also suggested that the capability to acquire EI skills apparently increases with age due to increased experience (Goleman, 1998).

Contrary to IQ, people can improve their EI by receiving feedback, practice and correct training and guidance. Findings suggest that IQ may be connected to as little as 4% of real-world success since IQ does not measure creativity or a person’s unique potential (Cooper and Sawaf, 1997). It has been stated that in industry, “IQ gets you hired, but EI gets you promoted” (Gibbs, 1995). Goleman proposed that EI plus IQ equal success. For example, a manager at AT&T Bell Labs was asked to rank his top performing engineers. High IQ was not the deciding factor, but instead how the person performed regarding answering e-mails, how good they were at collaborating and networking with colleagues, and their popularity with others in order to achieve the cooperation required to attain the goals (Gibbs, 1995).

**EI versus Leadership**

Leadership is always important but has recently become a very hot topic for organizations and management. It is widely suggested that emotional intelligence, the ability to understand and manage moods and emotions in the self and others, contributes to effective leadership in organizations. George found that work groups led by sales managers who tended to experience positive moods at work provided higher quality customer service than groups led by managers who did not tend to experience positive moods at work (George, 1995). Such findings can be explained in terms of emotional intelligence, in that emotion and moods can subtly (but systematically) influence certain components and strategies affecting problem solving.

In an emotional intelligence and leadership study conducted on 358 managers from a global manufacturer, results showed that the highest performing managers have significantly more “emotional competence” than other managers. The survey also found that in divisions around the world, those identified at mid-career as having high leadership potential were far stronger in EI competencies (Cavallo, 2002).

**Emotional Intelligence for Engineering**

Engineers are expected to have a high degree of technical skills, but to be successful and competitive in a changing work environment they need more than technical expertise. In assessing the needs of the Polish engineering industry, the Technical University of Czestochowa Poland identified various practical and psychological elements required of their graduates in engineering areas. Emotional intelligence “was seen as being of major importance in teamwork or in the management of a group of people” (Szkutnik, 2001).
The graph below (Figure 2) shows average EI scores across several professional areas. Those working in sales or customer service scored higher than those working in highly technical professions. Self-management and relationship management are requirements for survival in these professions. Engineers scored lower suggesting that they receive little (if any) training in emotional intelligence and do not focus on social-emotion competence as much as the other professions (Travis and Jean, 2003).

![Figure 2. Average EQ score across professions (Bradberry and Greaves, Date)](image)

**Research**

For this research, 140 students took part in the emotional intelligence test. The students participating were from Clemson University and the Citadel and are either Civil Engineering or Construction Management majors. The background of the students varies, including undergraduate and graduate students; both female and male students. A complementary questionnaire was handed out to each participant to collect biographic data such as age, gender, major, degree, work experience, familiarity with emotional intelligence, as well as how they would rate their own EI etc. Each Participant was guaranteed anonymity, to ensure honest answers were provided. Although gender differences were noted, the sample size of women was too small to provide statistically relevant information.
Emotional Intelligence Appraisal

Twenty-eight items are combined to obtain a total EI score and are divided into four sections, aimed to produce four composite scale scores- Self-awareness, Self-management, Social awareness, Relationship management. Questions are asked as to how often a person would have a certain behavior or thought. Table 1 shows a couple of sample questions, evaluating Self-Awareness. Table 2 outlines guidelines for interpretation of the overall EI scores.

Table 1: Sample Questions Evaluating “Self-Awareness”

<table>
<thead>
<tr>
<th>For each question, check one box according to: How often you...</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Almost Always</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) are confident in your ability.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) admit your shortcomings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Interpretive Guidelines for EI Appraisal

<table>
<thead>
<tr>
<th>Score</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>A strength to capitalize on</td>
</tr>
<tr>
<td>80-89</td>
<td>A strength to build on</td>
</tr>
<tr>
<td>70-79</td>
<td>With a little improvement, this could be a strength</td>
</tr>
<tr>
<td>60-69</td>
<td>Something you should work on</td>
</tr>
<tr>
<td>59 or below</td>
<td>A concern you must address</td>
</tr>
</tbody>
</table>

(Note: Scores on the Emotional Intelligence Appraisal® come from a “normalized sample.” The scores are based on a comparison to tens of thousands of responses to discover where a participant’s score falls relative to the general population.)

Results

Figure 3 displays the random distribution of the total EI score for the 140 participating students. The participants’ average scores for the main EI Dimensions are shown in Figure 4. The students scored highest in the area of Social Awareness and lowest in the area of Self-Awareness. Although all four EI competences contributed numerically to the total EI score, it is self-awareness- the ability to detect and understand one’s own emotion by recognizing verbal and nonverbal information- that accounts most behaviorally for emotional intelligence. Emotional intelligence is impossible without the competencies involved in self-awareness (Saarni 1990). Self-awareness is affected by “how well one person knows about emotional intelligence”. This is evident by the participants’ mediocre EI scores and their lack of familiarity with EI and their own self-awareness.
Figure 3. Scatter plot of Total EI score

Figure 4: Average EI scores by dimensions
EI versus GPR

To test the validity of whether “high emotional intelligence contributes to high academic performance”, the GPR of (X) students are classified into six scales, 0.00-2.0, 2.1-2.5, 2.51-3.0, 3.1-3.5, 3.51-4.0. Figure 5 shows a box plot of the EI scores for each GPR scales. The average total EI score is calculated within each GPR scale.

Figure 5: Box plot of EI score by GPR Scale

Figure 6 below indicates that average Emotional Intelligence scores gradually increase as GPR increases, peaking in the 2.51 to 3.0 student group. After that the average EI score decreases as GPR increases. It should be noted that Figure 5 above also reveals that the box plot for the highest academic group of 3.51 to 4.0 has a bigger range and more variation than the 2.51 to 3.0 group. Clearly some of those high academic performers do also have high EI scores.
A positive relationship between emotional intelligence and GPR was not statistically substantiated, with a regression equation shown in Figure 7. Our hypothesis that high emotional intelligence predicts outstanding academic performance was not proven statistically but perhaps with a larger sample size a more robust regression analysis could be conducted.

Figure 6: Average EI score by GPR Scale

Figure 7: Scatter plot with Regression of Total EI versus GPR
It is notable that, as GPR increases the average total EI score increases gradually, with a peak at the 2.51 to 3.0 GRP range. After that as GRR increases, EI decreases. The reasons underlying this relationship between GPR and Emotional Intelligence are intellectual attributes (e.g., long term memory, ability to think abstractly) and non-intellectual attributes (e.g., motivation, self-discipline). Both contribute to a student’s academic performance, however, non-intellectual capacity accounts for more than twice as much variance as IQ in final grades (Angela and Martin, 2005). Students who outperform their peers academically are usually supposed to be highly self-disciplined or, in terms of EI, be highly self-aware and self-managed. These students, as a result, can promptly become conscious of the change of their emotion, react positively to conflicting moods and take the initiative to control inertia, slackness and negativity, as well as frustration. Even though IQ also plays a significant role in harvesting outstanding academic outcomes; EI, otherwise, predicts gains in academic performance over school years so as to obtain a higher cumulative GPR. It is particularly noteworthy that within the fifth GPR scale, which is from 3.51 to 4.0, there is a sharp decline of the average EI score. To determine the cause of this drop, other factors such as age, nationality and gender were examined. Disparity between these factors was not remarkable, but the difference in familiarity with Emotional Intelligence and working experience are the most significant.

Table 4 shows the average quantified familiarity with EI by GPR scale and the scores achieved both the “Familiar” group, which consist of students who are more than neutrally familiar with EI, and the “Unfamiliar” group, in which students’ acquaintance is either “Little” or “Not at all”, are summarized in Figure 8.

Table 4. GPR, Work Experience and Familiarity with EI

<table>
<thead>
<tr>
<th>GPR Scale</th>
<th>N</th>
<th>Working Experience (Months)</th>
<th>Familiarity with EI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 – 2.0</td>
<td>1</td>
<td>6</td>
<td>4.0</td>
</tr>
<tr>
<td>2.1 - 2.5</td>
<td>21</td>
<td>11</td>
<td>2.0</td>
</tr>
<tr>
<td>2.51 - 3.0</td>
<td>35</td>
<td>19</td>
<td>2.6</td>
</tr>
<tr>
<td>3.1 - 3.5</td>
<td>34</td>
<td>9</td>
<td>2.7</td>
</tr>
<tr>
<td>3.51 – 4.0</td>
<td>45</td>
<td>14</td>
<td>2.3</td>
</tr>
</tbody>
</table>
EI versus Experience

Figure 8 Scatter plot with Regression of EI vs Work Experience

Figure 8 shows a scatter plot of EI scores compared to work experience. The regression equation suggests a positive relationship between work experience and emotional intelligence. Work experience influences the development of various emotional intelligence dimensions in that more attention is focused on social awareness aspects and relationship management. As one is involved more in the “real world”, he or she becomes more capable of sensing, understanding, and reacting to others’ emotions while comprehending social networks. The more complicated the relationship network gets, the more the social awareness dimension is developed and improved. Relationship management can be viewed as a “stage” where people utilize the other three EI dimensions to display their overall emotional intelligence. A well-established relationship network can demonstrate an enhanced emotional intelligence. Work experience would provide the opportunities for students to develop and utilize relationship management skills.

EI versus Familiarity

All participants were divided into two groups based on their familiarity with EI- a “Familiar” group, students of which are equally or more than neutrally familiar with EI and an “Unfamiliar” group, in which students’ acquaintance with EI is either “Little” or “Not at all.” Average scores achieved by both groups are summarized in Figure 9.
Students more familiar with the concept of Emotional Intelligence tend to be more emotionally intelligent.

![Average EI scores by “Familiar” group and “Unfamiliar” group](image)

Figure 9 Average EI scores by “Familiar” group and “Unfamiliar” group

It is interesting to note that students tend to be more assertive and thus may overestimate their own emotional intelligence skills. In answering the question “How do you rate your own emotional intelligence” in the pre-test questionnaire, all students (except those who were “Not sure”) chose answers equal to or more than “Fair”, regardless of their response to the question of whether they knew about emotional intelligence (“Very Well” or “Not At All”). There is a common misconception about emotional intelligence that leads students to assume that they are emotionally intelligent as long as they think they get along well with others.

Students whose GPR is in the 3.51-4.0 scale are overall less acquainted with Emotional Intelligence than their peers, and the “Familiar” group outperforms in all EI dimensions and total EI. It can be interpreted that the lack of familiarity with EI leads to lack of awareness of the significant casual-role of being emotionally illiterate and its influence on various personal and social related problems.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this research was to determine if there was a relationship between academic performance (as measured by GPR) of Engineering students and EI score.
There is an inherent relationship, although from our small research sample it is not statistically relevant, and it indicates that as GPR increases, EI increases with a peak at the student group of 2.51 to 3.0 GPR. After that, EI decreases as GPR increases. These results indicate that as GPR increases past 3.0 those students may be more focused on self and academic success rather than on their relationships with their fellow students and friends. Anecdotally, these results are consistent with comments made by some employers who express concerns about hiring students with exceptional academic performance records.

The research indicates that work experience is an indicator of higher EI score. The data shows that as GPR increases, work experience also increases, reaching a peak with the 2.51 to 3.0 GPR group of 19 months’ work experience. As GPR increases beyond 3.0, those students have lower amounts of work experience. These results indicate the real life value of work experience in helping students mature and be better aware of their relationships with fellow students and employees. Students who do not have to work, or choose not to may have higher grades, but they have lower EI scores.

Engineering, due to the highly technical and qualitative focus of the field, faces unique challenges in producing students with improved EI scores. Figure 2 reports that of the professions surveyed, Engineering has the lowest EI score of any field of workers in the survey. Unfortunately, undergraduate engineering education remains highly demanding, and in most cases precludes students from part time work or even, in many cases, from summer employment. Those students who must work their way through school will frequently transfer to a less demanding major. The research supports this view by indicating that those with lesser work experience have lower EI scores.

Recommendations

The current trend of the American Society of Civil Engineers (ASCE) and the Accreditation Board for Engineering and Technology (ABET) is to place more emphasis on soft skills such as leadership and the role of engineers in society. These trends should continue and be supported as they may lead to enhanced EI in engineering students and Engineers in the work force.

Many employers are providing co-op opportunities for undergraduate and graduate engineering students. These programs provide an excellent opportunity for potential employers to observe the technical and non-technical skills of potential employees before offering a permanent position. Likewise, these co-op programs afford students the opportunity to gain valuable real life experience as well as further developing their EI and other soft skills. These programs should be supported and expanded whenever possible.

Most colleges and universities offer challenging extracurricular programs that may also serve to increase student EI scores. For example, at Clemson University the Civil Engineers for Developing Countries program offers students the opportunity to work as a team and gain valuable real life experience in overseas cultures. At the Citadel,
many students are under military contract where they undergo rigorous military training during the summer. All these opportunities may serve to increase the students EI scores and ultimately improve their performance in the work force. Both Clemson University and The Citadel are focusing some attention on providing leadership training and instruction for their undergraduate students, consistent with the unique culture of each school. This leadership instruction should be expanded to include training in emotional intelligence.

Although this research did have 140 samples, it is clear that further research with an expanded sample size would be valuable. A larger sample size may offer gender comparisons, as well as enable a more refined study of specific GPR groups. Finally, further research may afford the opportunity to evaluate the differences between freshman engineering students and seniors, to see how or if EI evolves over time.

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