Emotional Intelligence as a Support for Professional Development in Engineering Education

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ABSTRACT

Engineering education is an expanding field due to the globalization of the engineering profession. Such globalization is driven by the evolution of both the engineering sciences by themselves as well as the evolution of technology and the professional environment.

Approaching emotional intelligence as a support for professional development in engineering education is analyzed as a potentiation of necessary competences and abilities for academic performance in the engineering education environment as well as for reaching a high level of engineering professional performance in a diverse social context.

The article includes an analysis of the current state in the field of theory and scientific investigation of emotional intelligence as it is relevant for engineering education. Such an analysis has been developed by using the morphological matrix of ideas by associating the conceptual dimensions of emotional intelligence with human factors that are relevant for engineering education.

Based on the conclusions developed by the use of this instrument there have been developed possible scientific investigation objectives that are in coordination with the proposed theme.

Keywords: emotional intelligence, engineering education, academic achievement, professional development.

EMOTIONAL INTELLIGENCE AND PROFESSIONAL DEVELOPMENT

The concept of emotional intelligence (EI) has generated numerous debates and research both related to the scientific substantiation of the construct as well as in the field of human aspiration (Matthews, G., Roberts, R.D., Zeidner, M., 2004). This interest that is manifesting itself simultaneously in the scientific and journalistic perspective has generated investigation on the construct itself as well as on the development of research instruments adapted to measuring the level of emotional intelligence. The theoretic models that were developed operationalize the emotional intelligence concept either as an ability or as a trait. (Nelis, D., Quoidbach, J., Mikolajczak, M., Hansenne, M., 2009).

The theoretic model of emotional intelligence seen as an ability defines emotions as organized answers which transcend the borders of various psychological sub-systems and appear as a typical response with a negative or positive value for an individual in relation to an internal or external event. (Salovey, P., Mayer, J.D., 1990). From this perspective, emotional intelligence represents the ability to monitor your own as well as the others emotions, to differentiate and to use this information in order to direct thought and action (Brackett, M.A., Salovey, P., 2006). This model defines the EI as a type of social intelligence that includes elements such as evaluation and the verbal and nonverbal expressing of emotions as well as using emotional content in solving
problems. (Mayer, J.D., Salovey, P., 1993). In its first stage, this model included three categories of abilities arranged in a hierarchical manner from the most simple to the complex: evaluating and expressing emotion, self-regulating emotions and using emotional intelligence. (Salovey, P., Mayer, J.D., 1990, Mayer, J.D., 2004). Later, based on extended research a theoretical revisions, the model of the EI ability has been developed as having four dimensions, similarly ordered in a hierarchy: perceiving emotions, using emotions to facilitate thought, understanding emotions and managing emotions (Mayer, J.D., Salovey, P., Caruso, D.R., 2008). As the theoretical perspective has developed its fundament and has been expanded, so has the measuring instrument that supported the scientific legitimacy of EI as a form of intelligence has been developed. This was initially the MEIS-The Multifactor Emotional Intelligence Scale (Mayer, J.D, Caruso, D.R., Salovey, P., 2000). Later on, this was followed by a new version – the MSCEIT- Mayer-Salovey-Caruso Emotional Intelligence Test (Mayer, J.D., Caruso, D.R., Salovey, P., Sitarenios, G., 2001).

The theoretical model of emotional intelligence as a trait was developed due to the expansion of popularizing the concept of emotional intelligence. This has led to the association of this concept with a number of different traits and concepts, leading to the development of mixed models of IE (Mayer, J.D., Salovey, P., Caruso, D.R., 2008). These EI conceptualizations include elements such as recognition, understanding and expressing feelings and emotions; understanding what others feel and interacting with others; managing and controlling emotions; managing change, adapting and solving problems of personal and interpersonal nature; generating positive and self-motivating effects. (Bar-On, R., 2006). From the perspective of the Bar-On model, emotional intelligence is defined as an arrangement of emotional and social competences and abilities that determines for each individual how effective they express and understands themselves and others, how to react when interacting with others, how to meet the demands and challenges of everyday life (Bar-On, R., 2010).

In the body of theories about EI, an important factor of propagating the term in the scientific and journalistic world was the publication of Daniel Goleman's Emotional Intelligence (1995). Describing the researches previously made by J.D. Mayer, P. Salovey, as well as R Bar-On, a new EI approach is proposed from the perspective of modeling competencies that separate top performers from mid-level individuals (Goleman, D., 2018). This theoretical model has been developed for application in theory, research and organizational practice. From this perspective, emotional intelligence is defined as a structure composed of four elements such as: the ability of the individual to understand their own emotions and emotional state, being able to manage and regulate the response to these emotions, recognizing the emotional state of others and reacting to them in order to interact effectively (Bradberry, T.R, Su, L.D., 2006).

The existence of many versions and approaches in the field of EI associated with different measurement methods and different outcomes can be interpreted as a sign of vitality, resulting in the emergence of increasingly sophisticated and evidence-based theories. (Cherniss, C., Extein, M., Goleman, D., Weissberg, R.P., 2006). Contrary to the assertions that EI test results can be a predictor for educational and professional fields more than intellectual skills, the EI construct needs clarification according to a set of criteria associated with scientific substantiation for intelligence in general: the definitions developed are not conceptually coherent , EI measurements do not fully meet psychometric criteria, EI distinction from other personality constructs is not clear, EI does not have all the elements in line with intellectual ability, EI is not for emotion what IQ is for thinking, EI measurement results are not a strong indicator for adaptation, there is not enough evidence for EI to be a decisive factor for success in life. (Matthews, G., Roberts, R. D., Zeidner, M., 2004).

In the body of research in the field of emotional intelligence, results of investigative steps that identify its "dark side" are highlighted and claim that a high level of IE can have negative effects both in relation to one's own person through the appearance of mental health problems and against others by manipulation and antisocial behavior. (Austin, E.J., Farrelly, D., Black, C., Moore, H., 2007; Côté, S., DeCelless, K.A., McCarty J.M., Van Kleef, G.A., Hideg, I., 2011; Monnier, M., 2015; Davis, S.K., Nichols, R., 2016)

Research results that established a relationship between emotional intelligence and education have led to the development of intervention and educational programs aimed at enhancing EI related
abilities and traits. Developing, implementing, and evaluating training programs aimed at
developing emotional intelligence can be argued for by the fact that general success and well-being
in the maturity stage can also be determined by learning how to engage social and emotional abilities learned while facing daily challenges. (Humphrey, N., Curran, A., Morris, E., Farell, P.,
Woods, K., 2007).
The introduction of such programs is not without limitations, obstacles and criticism. The main
obstacles concern the difference in scientific legitimacy of classical disciplines vs. the field of
emotions (Mayer, JD, Caurso, DR, Salovey, P., Sitarenios, G., 2001), the necessity of scientific
substantiation by clearly defining the fields of EI approached on studies and scientific results
demonstrating improvement in socially and emotionally effective behavior (Bar-On, R., 2010) or
arguing for the positive effect on healthy development and pupil performance, but, due to the fact
that they were of a short duration and were not correlated with the academic mission of the school,
they failed. (Bradberry, T. R., Su, L. D., 2006). The benefits of such programs are not supported by
consensus and evidence, and this has led to a diverse range of offers that, for example, aim to
increase the level of emotional knowledge of students in order to better prepare them for
approaching professional realities.(Goroshit, M., Hen, M., 2012).
The multidimensionality of the relationship between emotional intelligence and professional
development is determined by a complex set of elements of an epistemological nature, by research
that indicate contradictory and diverse outcomes regarding the predictive value of EI for
components of academic performance, professional performance, success in life and workplace.

INTEGRATING EMOTIONAL INTELLIGENCE IN ENGINEERING
EDUCATION

Integrating emotional intelligence into engineering education and engineer training for effective
insertion into the labor market is justified both by the growing awareness of engineering practice in
the context of transcending cultural and national borders as well as by the challenge to teachers and
educators in the engineering field to develop for students a package of knowledge and abilities
associated with emotional competence (Chisholm, CU, 2010). The analysis of the relationship
between academic performance and the level of emotional intelligence for students should take into
account that they have specific / individualized levels of emotional and cognitive qualities practiced
and developed during previous schooling periods, and the introduction of EI into the university
curricula should not be interpreted as way to fundamentally change students' EI level. (Saibani, N.,
Muhamand, N, Wahab, D.A., Sahari, J., 2012).
The analysis of the opportunity of integrating emotional intelligence into engineering education was
based on the study of specialized articles that followed the relationship between these concepts. This
approach was achieved by using the morphological matrix of ideas and the following dimensions
and associated characteristics have been set:
• Emotional intelligence:
The use of this dimension offers the various possibilities of identifying the analysis criteria within the morphology matrix of ideas: the theoretical origin of the construct (the Mayer-Salovey-Caruso model, the Bar-On model, the Goleman model), the operationalization of the concept (ability, skill, trait), measuring the concept (as performance or as self-evaluation). In view of these aspects, an option has been formulated by identifying the levels of IE ability measurement in the field of engineering education that indicates opportunities for development and intervention: management of emotions, external and internal relationship management (Dușe, C.S., Dușe, D.M., 2009, 2010). Variable levels of EI abilities may be associated with drop out of university studies and academic success, indicating a tendency for male EI students to drop out of university courses (Parker, J.D.A., Hogan, M.J., Eastabrook, A.O., Wood, L.M., 2006) whereas higher scores of EI dimensions (intrapersonal, adaptability, stress management) may be indicators of academic high-performing/non-performing students (Parker, J.D.A., Summerfeldt, L.J., Hogan, M.J., Majescki, S.A., 2004).

• Engineering education
The university is a complex environment that facilitates both substantiation and development of specialized knowledge as well as the practice and development of abilities that are not expressly included in the university curriculum. The implementation of programs or courses focusing on these aspects of EI can be taught/learned in the university environment by using innovative pedagogical methods and by the experiential practice of emotion management. (Gillar-Corbi, R., Pozo-Rico, T., Sanchez, B., Castejon, J.L., 2018). The necessity to develop training programs within universities aimed at developing EI components can also be determined by the employers' perspectives that point to shortcomings in some social and emotional skills of graduates who are integrated into the labor market (Jameson, A., Carthy, A., McGuinness, C., McSweeney, F. (2016).

Considering the two dimensions of EI and engineering education from the morphological matrix of the ideas and following the analysis of the studies that regarded the investigation of the relationship between the two concepts, the following information was obtained:

a) a 11: Students in engineering show variable levels of scores obtained for distinct EI fields. Although they can achieve a high level of attention and self-control of emotions (as EI areas), interventions on the dimension of emotional knowledge / knowledge of emotions are needed (Chisholm, C.U., 2010).

b) a 12: In the absence of teaching methods and learning methods based on the development of EI, there is no stimulating climate for exercising emotional competences and abilities. Results
indicating that classroom management implemented by science and engineering teachers is not in line with their EI level is a prerequisite for reconsidering EI as a relevant factor for the educational environment. (Hisó-Lligo, J., 2017).
c) a 13: Managing emotions and expressing them in a predominantly male environment, such as engineering, can be perceived as inappropriate (Lindebaum, D., Casell, C., 2012). This dimension aims to efficiently use the perception of one's own emotions and others for managing interactions and conflicts (Bradberry, T., Greaves, J, 2016). An organizational culture based on power and masculinity may be an impediment to implementing programs and interventions designed to integrate EI into the professional activity.
d) a 21: Measuring the level of EI abilities in engineering students reveals the strong areas in which they can excel but also the areas in which students are deficient. Although abilities such as conflict management, interpersonal communication, and the development of public communication are not the main subjects of study in engineering specialties, they prove to be relevant in their professional activity (Saibani, N., Muhamand, N, Wahab, DA, Sahari, 2012). The introduction of EI into the academic route of students enrolled in engineering specialties indicates, in longitudinal studies, that EI develops both in relation to age as well as to the efficiency of teaching / learning (Saibani, N., Sabtu, MI, Harun, Z., Wan Mahmoud, WMF, Muhamand, NI, Wahab, DA, Sahari, J., 2015).
e) a 22: Measuring the general level of EI and the specific dimensions of this construct in the case of engineering university teachers indicates variations that could substantiate the intervention for the development of EI skills and competences. Given that high scores for the emotional awareness dimension are identified, but just average levels for emotional management and relationship management are recorded, then the need to introduce EI into the training of teachers in engineering education can be concluded. (Dușe, D.M., Dușe, C.S., Deac, C., 2015). These results, when they are underlined by evidence showing that the EI level of engineering teachers is lower than colleagues from other specialties and correlating these results with organizational culture (which may be a facilitator / barrier), are all the more relevant to the argumentation for the need EI field development. (Dușe, C.S., Duse, D.M., 2019, 2010).
f) a 23: Given the context of globalization, of industry and technology development, of the exercise of the profession in complex social contexts, the graduate and engineer's profile must include sets of abilities extended beyond the technical training (Riemer, MJ, Jansen, DE , 2003). These technical and social developments require engineer training in areas such as cross-cultural abilities (Del Vito, C., 2008), intercultural (Riemer, M.J., 2003), non-verbal communication (Riemer, M.J., 2004). The effectiveness of the engineer's professional work on the labor market as well as the sustainability of engineering disciplines can be achieved by introducing practical learning and combining specialized knowledge with the emotional intelligence abilities (Burns, GR, Chisholm, CU, 2003), introducing e-learning and e-guidance along with aspects of EI (Chisholm, CU, 2003).
g) a 31. This intersection of the morphological matrix of ideas represents the maximum desirability level: the association between high levels of internal EI management with components of engineering education. From this perspective, a high level of EI for students from engineering specialties appears to support the above-mentioned research on the positive correlations between EI and academic performance, but students with high academic performance and reduced EI appear to be those who are more focused on getting results rather than establishing social relationships and friendship with colleagues (Brandenbrug, Š., Zhou, X, Bell, L., Skipper, C., 2011).
h) a 32. This dimension implies awareness of emotions and the targeting of this awareness towards the effectiveness and positive directing of behavior (Bradberry, T., Greaves, J., 2016). In the case of engineering teachers, a low score for this dimension affects the educational interaction with the students (Dușe, D.M., Dușe, C.S., Deac, C., 2015)
i) a 33. The development of this dimension of emotional intelligence can redefine and ensure the sustainability of engineering education from the point of view both of the social perception of the engineering profession as well as of the reconfiguration of engineering disciplines (Chisholm, C.U., 2003).
Using the morphological matrix of ideas is a useful tool in analyzing the perspective of integrating emotional intelligence in engineering education. Going through the criteria of both dimensions
indicates some areas where future investigations and research can be directed. If specialized studies addressed the relevance of emotional intelligence to engineering students and teachers, the impact of this type of intelligence in the field of engineering is a fertile field of scientific research.

RESULTED RESEARCH OBJECTIVES

Arguments and ideas generated by the morphological matrix of ideas have determined possible research objectives that can bring additional data into the study and/or the scientific investigation of the relevance of emotional intelligence as a support to professional development in engineering education. The possible proposed objectives are developed both in line with the theoretical milestones and the analysis of the current state of research in the EI field.

• Measuring the level of emotional intelligence of students, faculty members and engineering professionals in order to identify areas of intervention to increase academic performance and professional performance.
• Identification of the skills and emotional competences profile of the successfully integrated into the labor market engineer.
• Identifying and analyzing training /education programs based on emotional intelligence for students in engineering university environment.
• The scientific substantiation of a training program aimed at developing the abilities and attributes specific to the appropriate level of emotional intelligence which is correlated with the educational environment and the engineering professional environment. This program can also be developed taking into account the specific idiosyncrasies of the two backgrounds: educational and professional

CONCLUSIONS

Addressing emotional intelligence as a support to professional development in engineering education is a field of scientific research effervescence. The results of emotional intelligence scientific studies focused on EI area impacting on the academic performance of students from engineering specialties and the data obtained on the array of EI skills and competences of teachers from engineering universities offer a fundamental premise in the developing of curriculum programs focused on this theme.

The engineering profession tends to become a global profession, which is influenced by rapid changes in the field of science itself, the technology and the pursuit of the profession in increasingly diverse cultural environments. Emotional intelligence in relation to professional development in engineering education should not be interpreted as an aspect that could supplement certain professional and human skills and competences, but as a potentiation factor for enhancing the professional and educational effectiveness of the student engineer as well as the engineer.

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