Student's Characteristics as a Basis for Competency Development in Engineering Informatics Education

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Abstract—Current technological innovations and continuous change in the labor market have generated new challenges for higher education, and thrown new light upon the importance of competency development in engineering education. Responsibility, flexibility, communication and collaborative skills, self-motivation, problem-solving and innovation are the most required skills by employers. However, individual differences like personality traits or interpersonal skills of students can also be considered relevant factors influencing teachers' attitudes towards integration of effective methods into engineering education. The purpose of this paper is to examine the competencies of undergraduates attending Engineering Informatics education, and to identify their personal needs for development in the light of workplace demands. Personality characteristics of Engineering Informatics students are also addressed in this research in order to reveal possible ways of involving them into the teaching and learning process by implementing new methods or approaches in Engineering Informatics education in Hungary.

Keywords—Engineering Education, Competency Development, Students' Characteristics

1 Introduction

The competency development has become one of the main areas of research in engineering education in the last decade and it was recognized that non-technical and interpersonal skills are crucial for engineers [1,2]. Solid evidence indicates significant differences between the competencies developed by institutions of higher education, perceived by graduates and expected by employers. Competence has become a key concept in higher education, regarding the combination of knowledge, skills, abilities and personal attributes that contribute to enhanced academic performance and success in the workplace [3]. Higher education in engineering primarily focuses on the development of professional competencies and technical skills, and students are not appropriately prepared for the demands of the workplace and lack social, communicative or personal competencies [4].

There is a growing interest in the attributes and skills required by engineers in our rapidly changing information society [5-8], with particular regard to examining the characteristics of engineering undergraduates from different perspectives [1,9,10].

Globalization has intensified the demands for flexible, socially adept and communicative engineers [8]. The engineers' weaknesses in soft skills such as effective communication, cooperation, teamwork, project management, lifelong learning have been noted by industry and various professional organizations [1,7]. Other studies highlight the wider social context of engineers' work, arguing that there is a need for new engineers who are not only equipped with employability skills but who are also socially and environmentally responsible [6]. It is also reported in the literature that personality traits are important predictors of job performance and satisfaction, and are also key characteristics for the engineering profession. Engineers differ from members of other occupations as they are less likely to be assertive, extravert, emotionally stable and optimistic, yet they show more intrinsic motivation and tough-mindedness [10]. Nonetheless, employers of engineering organizations require for new engineering graduates to possess both technical and non-technical skills such as communication, people and team management, motivation, problem solving, etc. [11].

Several studies emphasize that along with changes in technology and work organization, traditional methods of engineering education should be re-evaluated and non-technical, generic competencies, including the interpersonal skills of the future engineers also need to be developed in order to reflect the changing demands of working life and industry [1]. However, developing competencies is different from teaching academic topics, which implies that significant change is needed in how teachers teach and students learn. Teachers should reconsider their instructional practices and their role in the learning process [12].

Many universities make attempts to integrate soft skills into engineering curriculum, and positive impacts of different teaching methods have been reported on the students' involvement in learning and personal development. Research results demonstrated that using the cooperative learning techniques, training and practice in social skills improved work cooperation and personal relationships with others [13]. Other study reported that a project-based learning approach was undertaken through a project work in a real workplace setting, which facilitated the students' employability skills such as teamwork, communication, problem solving, managing interpersonal conflicts [2]. A 2-years course was created in the area of computer science at a Swedish university with the aim to improve a wide range of personal and social competencies of engineering students using a dialogue method developed for learning from experience and through reflection. As a result of the first year program the students' awareness on the importance of soft skills and their own behavior was improved, and the drop-out rate decreased [14].

2 Method

The study was designed to measure a wide range of attributes and competencies (e.g. learning style, logical thinking, emotional intelligence, personality traits, achievement motivation and self-efficacy) at three time points among engineering informatics students during their academic careers. This paper focuses on the perceived workplace competencies of students, and on the personality aspects of competency development based on the first measurement.

The following research questions are addressed in the study:

1. How do undergraduates rate their proficiency in a range of competencies at the beginning of their academic career?
2. How do they rate the importance of these competencies for future employment?
3. What is the profile of Engineering Informatics students' personalities?

2.1 Sample

A sample of 188 first-year undergraduate Engineering Informatics students attending a Hungarian university participated in the study, of whom 166 males (88.3%) and 22 were females (11.7%). The ages of participants ranged from 18 to 26 years (Mean=20.07, SD=1.459). Sixty percent of the participants took their final secondary school examinations in 2016, 30% of them in vocational schools, 28% in high schools. Most of the participants (76%) have work experience, including summer work or student work, and 7 percent of them are working students.

2.2 Instruments

A set of questionnaires was used to assess different attributes and preferences of Engineering Informatics students before starting their academic career. The data was collected in September 2016.

The competencies of Engineering Informatics students were measured with a self-rating list of competencies consisting of 24 items which was constructed by using job vacancy advertisements and the results of previous competency assessments in higher education in Hungary. We examined, on the one hand, the extent to which these competencies are required for future employment according to the opinion of Engineering Informatics students, and, on the other hand, to the extent to which they possess these competencies at the beginning of their studies. Participants were asked to rate the importance of each competency in future employment using a 5-point Likert scale rating from (1) of minimum importance to (5) of maximum importance, and to self-evaluate their level of proficiency in the same competencies at the present moment rating from (1) at a minimum level to (5) at a maximum level.

The personality traits of Engineering Informatics students were assessed with the Hungarian version of Big Five Questionnaire [15,16]. The BFQ measures five personality factors, namely energy, friendliness, conscientiousness, emotional stability and openness. The questionnaire consists of 132 items, with five dimensions and ten sub-scales, and a social desirability scale. Each BFQ factor is measured by 24 items, 12 of which are positively phrased and 12 of which are negatively phrased. Table 1 shows the factors and sub-scales with examples of items. Participants were asked to rate their responses on a 5-point Likert scale, (1) meaning 'does not apply at all' and (5) meaning 'does apply entirely'. For the BFQ, norm data of a representative sample of Hungarian population was available [16].

Table 1. Factors, sub-scales and sample items of the BFQ, based on [15]

Factors	Sub-scales	Sample items
Energy	Dynamism Dominance	I am an active and vigorous person.
Friendliness	Cooperativeness Politeness	I hold that there's something good in every-one.
Conscientiousness	Scrupulousness Perseverance	I always pursue the decisions I've made through to the end.
Emotional Stability	Emotion control Impulse control	Usually I don't lose my calm.
Openness	Openness to culture Openness to experience	I'm fascinated by novelties.

3 Results

3.1 Perceived Competencies

Table 2 presents means and standard deviations of all 24 competencies, and the discrepancies between the self-reported proficiency and the importance level of competencies perceived by the Engineering Informatics students. As the distributional assumptions of parametric statistics were not met for the competency list, the Wilcoxon test was used to determine whether there is an association between the two set of variables. The two sets of competencies show acceptable internal consistency (Cronbach's alpha: 0.863 and 0.871).

The findings regarding the importance of competencies indicate that in the opinion of Engineering Informatics students the most necessary skills for their future profession are problem-solving skill (M=4.87, SD=.407), the ability to work precisely (M=4.78, SD=.496), understanding causal relationships (M=4.84, SD=.386), and the ability to apply knowledge (M=4.81, SD=.417). The students attributed less importance to self-expression and writing ability (M=3.01, SD=1.065), conflict management (M=3.24, SD=1.046) and self-knowledge (M=3.27, SD=1.212). Furthermore, four other competencies did not receive a 4.00 rating, namely self-evaluation, openness, the ability to organize, and the ability to connect and communicate effectively with others. These results show that first-year students consider cognitive skills and profession-related competencies much more important for employment than soft skills.

Table 2. Means, standard deviations (SD) and differences between the perceived importance and self-reported proficiency level of competencies

	Importance Mean (SD)	Own level Mean (SD)	Difference	Wilcoxon (Z)
Oral communication	3,87 (.752)	3.24 (.989)	.622	-6.523**
Problem solving	4.87 (.407)	3.79 (.674)	1.080	-11.213**
Ability to work precisely	4.78 (.496)	3.73 (.798)	1.053	-10.495**
Cooperation	4.17 (.733)	3.87 (.883)	.303	-3.866**
Teamwork ability	4.23 (.792)	3.84 (.973)	.388	-4.780**
Working independently	4.56 (.568)	3.87 (.811)	.691	-8.489**
Analytical thinking	4.68 (.589)	3.73 (.810)	.947	-9.542**
Learning ability	4.66 (.567)	3.58 (.871)	1.080	-10.163**
Innovation	4.66 (.575)	3.70 (.905)	.963	-10.125**
Conflict resolution	3.24 (1.046)	3.49 (.989)	-.250	-2,169*
Organization	3.48 (.967)	3.18 (.951)	.309	-3.863**
Persistence	4.20 (.885)	3.64 (.831)	.559	-6.171**
Written communication	3.01 (1.065)	3.29 (1.015)	-.277	-3.237**
Openness	3.94 (1.048)	3.82 (.986)	.117	-1.768
Goal orientation	4.62 (.614)	3.97 (.824)	.644	-7.863**
Self-knowledge	3.27 (1.212)	3.61 (.973)	-.340	-3.376**
Stress tolerance	4.27 (.892)	3.55 (1.046)	.713	-7,123**
Responsibility	4.36 (.779)	3.92 (.820)	.441	-5.889**
Adaptation to change	4.39 (.734)	3.98 (.821)	.415	-5.561**
Concentration	4.80 (.464)	3.64 (.824)	1.154	-10.710**
Understanding causal relation-ships	4.84 (.386)	3.87 (.690)	.963	-10.586**
Appling knowledge	4.81 (.417)	3.97 (.701)	.846	-10.241**
Flexibility	4.31 (.739)	3.85 (.807)	.457	-5.853**
Evaluation and self-evaluation	3.59 (1.033)	3.57 (.865)	.016	-.129

* Significant at the 0.05 level.
** Significant at the 0.01 level.

Regarding the proficiency level of these competencies, higher ratings were revealed for adaptation to change (M=3.98, SD=.821), goal orientation (M=3.97, SD=.824), applying knowledge (M=3.97, SD=.701) and taking responsibility (M=3.92, SD=.820). Lower ratings were found for organization (M=3.18, SD=.951), oral communication (M=3.24, SD=.989) and written communication (M=3.29, SD=1.015). The mean ratings of the self-reported levels of competencies ranged from 3.18 to 3.98, indicating that development of these competencies would be necessary during academic courses.

In accordance with previous studies (e.g. [1]), students rated the importance of the competencies higher than their actual level of proficiency in most cases. The Wilcoxon signed rank test was used to analyze the median difference. Significant differences were found between ratings of all competencies, except for "openness" and "self-evaluation", so there is a gap in 22 of the 24 analyzed competencies. The most evident differences were found for concentration, learning ability, problem-solving skill, working precisely and innovation, and the following eight other competencies obtained mean differences greater than 0.50: analytical thinking, understanding causal relationships, working independently, ability to apply knowledge, stress tolerance, goal orientation, oral communication, and persistence.

There are three competencies for which the Engineering Informatics students estimated their proficiency higher than the perceived importance for future work, namely self-knowledge, written communication and conflict resolution. However these skills also received lowest ratings regarding the importance of competencies.

Comparing these results with studies previously conducted in Hungary regarding student competencies, some differences have been revealed. In the opinion of new graduates the most important competencies in the labor market are related to working ability like precise, autonomous and hard working, while employers seek graduates who are enterprising, have knowledge of foreign languages and analytical thinking [17]. Although the competency list used in the mentioned study was not the same as the one applied in our research, there was a conspicuous difference between the opinions of the two samples regarding the communication skills. Kiss [17] reported that graduates ranked the communication skills as the fourth most important skill (M=4.63 on a 5-point scale), however Engineer Informatics students positioned this skill at the bottom of the list with a nineteenth place rating (M=3.87 on a 5-point scale).

These results show that engineering undergraduates lack of awareness of skills acquired by engineering profession and they underestimate the importance of communication skills in their future work. Several studies demonstrated that communication skills, problem solving and interpersonal skills are among the most valued employability skills or generic competencies and considered more important than hard skills in engineering profession [5,18].

Principal component analysis was used for further examination, and four components were derived for both the perceived importance of the workplace competencies and the level of proficiency of these competencies estimated by the students (KMO=0.824 and 0.839). Regarding the competencies required for the future work based on the opinion of the Engineering Informatics undergraduates the first principal component was the "personal efficacy" including self-awareness, self-evaluation and self-control, and it was revealed that the women were characterized markedly by this component (the mean of principal component scores is 0.477). The second component was connected to learning, thinking, in other words to "cognitive function". The third component was labeled "initiative" in which adaptation, flexibility and openness were the dominant competencies. This component was found mostly in the case of younger students (the mean of principal component scores is 0.131). Finally, the fourth component was related to the management of relationships with people which was denominated "cooperation". These interpersonal skills along with openness and flexibility were more important for elder students or who had some work experience previously.

3.2 Personality traits

Table 3 contains the means and standard deviations of the participants on the five personality dimensions and the social desirability scale. For comparison, average scores of the Hungarian norm group [16] are also provided. Note that the scores of the BFQ scales are represented in raw scores although standardized T scores were used for further analysis.

Table 3. Means and standard deviations (SD) of Engineering Informatics students in five personality factors and social desirability scale compared with the Hungarian norm group (raw scores)

	Engineering informatics students Mean (SD)	**Hungarian norm group (N=774) Mean (SD)**
Energy	74.74 (12.20)	77.51 (11.85)
Friendliness	79.22 (10.43)	82.25 (10.09)
Conscientiousness	82.65 (10.43)	81.34 (11.11)
Emotional stability	74.12 (12.39)	68.60 (15.83)
Openness	79.83 (10.78)	85.52 (6.88)
Social desirability	34.49 (5.00)	29.54 (6.88)

Engineering Informatics students obtained lower scores on energy, friendliness and openness dimensions, but higher scores on conscientiousness and emotional stability than Hungarian norm group.

Higher scores were found on the lie (validation) scale indicating that the participants tend to distort their profile in a positive way, and to present themselves in a better light than in reality.

Regarding factor scales, gender differences were revealed using an independent samples t-test (the normal distribution of the data was confirmed by the Kolmogorov-Smirnov test).

Its result shows that men obtained significantly higher scores on emotional stability compared with women (M_{men}=75.23, SD=11.92, M_{women}=65.73, SD=12.86, t=3.479, p=0.001), but lower scores on openness (M_{men}=79.15, SD=10.53, M_{women}=84.95, SD=11.52, t=-2.401, p=0.017).

The internal consistency coefficients of the dimensions ranged from .78 (openness) to .84 (energy), and .621 for the lie scale (social desirability) which is also feasible.

Based on the standardized T scores (provided in the BFQ Manual, [15]) personality profiles may be portrayed. T scores for each factors and sub-scales may be categorized as low (below 45), average (between 45 and 55) and high (above 55).

Engineering Informatics undergraduates in general achieve average scores for energy (M=48.26), friendliness (M=48.88), conscientiousness (M=52.6) and emotional stability (M=52.81), but low scores for openness (M=44.01), although they achieve high scores for social desirability (M=54.8).

4 Discussion

Our findings based on perceived competencies and personality traits suggest that Engineering Informatics students have several attributes, skills and competencies before starting their academic career which are relevant to the selected specialty in the university and crucial for their future profession as Engineering Informatics, for example they are capable of working both independently and dependably, meeting with high standards, controlling their emotions and showing consistent and coherent behavior without oscillating because of emotional states. However, they show a lack of social competencies such as effective communication, self-expression, organization, learning ability and cooperation which are important aspects for successful employment.

Based on the results related to the Big Five personality traits, the Engineering Informatics students display a low level of social skills, activity and dominance, implying that most of them are introvert and inactive, prefer working independently and tend to avoid interactions with others. They are characterized by moderate friendliness, helpfulness, tolerance and cooperation, but in contrast, they obtained higher than average scores for conscientiousness, meaning that they show accuracy and precision in various activities, have great respect for order and discipline, hence responsibility and reliability may be considered as their strengths. The participants also show emotional stability, indicating that they are rather calm and relaxed, and capable of controlling anxiety and impulses and coping with associated emotions.

These findings are in line with other studies that confirm existing evidence on emotional stability and conscientiousness among engineers together with lower levels of agreeableness compared with a norm population [9], and found that engineering students are more orderly, tough-minded and conventional than students in other disciplines [19].

Surprisingly, Engineering Informatics students obtained very low scores on the openness scale, indicating that they are neither interested in cultural and intellectual activities and events, nor open to change and to innovation, and that rather they have a traditional and conventional way of thinking.

These findings are in accordance with Holland's vocational personality types [20], which are based on the assumption that correspondence between key personality characteristics and work environments leads to important vocational outcomes (such as satisfaction, performance, etc.). Although it was not possible to identify clear types, 32 percent of the sample of Engineering Informatics undergraduates could be labeled as realistic or conventional types. Realistic individuals prefer to work with things rather than ideas or people, they enjoy physical activities, and they are skilled in mechanical and physical activities. Typical realistic careers include electrician and engineer (in their BFQ profile they score low in E and F, high in C, low in S and O factors). Conventional individuals are more likely to be conformist, they are organized and conscientious, they prefer organized, systematic activities and well-defined instructions, and are persistent and reliable in carrying out tasks. Typical conventional careers include secretary, accountant and banker (in their BFQ profile they score low in E, average in F, high in C, average in S and low in O factors). It seems that only a third of the first-year Engineering Informatics students selected the university specialty in accordance with their personality traits.

The findings of the study suggest that many of the Engineering Informatics students are not aware of the expectations of the selected profession, and of a mismatch of the attributes required for the job and their personal needs and skills. Practical implication of our findings for engineering education would suggest that the competency development of engineering informatics students should include the development of self-knowledge and several personal and interpersonal skills which mainly contribute to the students' academic career and future success in the workplace. The improvement of learning abilities, concentration and problem-solving skills are also crucial for preventing dropout among the students. Reforms in Engineering Informatics education are necessary, emphasizing the key role of the students' activity in the learning process.

Considering the personality traits and perceived skills of the Engineering Informatics students, diverse learning organization methods and appropriate pedagogical techniques within the framework of student-centered learning approaches (e.g. problem-based learning, case studies, students' presentations and projects) [21], need to be implemented in engineering education in order to motivate students and to prepare them for the employment challenges of today.

Some recommendations provided by Riemer [22] for improving a set of personal and interpersonal skills in the context of emotional intelligence of engineering undergraduates are in line with the student-centered teaching approach, and applicable for Engineering Informatics education as well. It is suggested to incorporate the development of non-technical competencies and soft skills across curricula [22]. For example, the students' communication skills can be augmented by the delivery of oral communication and presentations in engineering studies. Opportunities for reflection are useful way to improve critical thinking and self-awareness (e.g. writing a reflective essay after fulfilling a task). Teamwork and collaboration in the context of cooperative learning help to form a proactive, rather that reactive attitude and support more active participation in learning.

It seems that not only the teaching methods need to be changed, but also the evaluation process of students' achievement, and as Yorke [23] argued, formative assessment is critically important in higher education. The purpose of formative assessment is to contribute to student learning through the provision of information about performance [24]. Positive feedback from the teacher on student performance encourages the student and builds on strengths [22]. The constructively structured comments from peers also have a positive learning effect, as these encourage perspective-taking skill.

There are several possibilities for implementing new teaching methods and approaches into engineering higher education towards competency development of the students, however, it is essential for the teachers and instructors to create a new mindset and to develop their competencies that enable them to be prepared for teaching the new generation.

5 References

[1] Direito I, Pereira A, Olivera Duarte AM (2012) Engineering Undergraduates' Perceptions of Soft Skills: Relations with Self-Efficacy and Learning Styles. Procedia Social and Behavioral Sciences 55: 843-851. https://doi.org/10.1016/j.sbspro.2012.09.571

[2] Berglund A, Heintz F (2014) Integrating Soft Skills into Engineering Education for Increased Student Throughput and more Professional Engineers. Proceedings of LTHs 8:e Pedagogiska Inspirationskonferens (PIK), Lund, Sweden: Lunds university

[3] Wheeler P, Haertel GD (1993) Resource handbook on performance assessment and measurement: A tool for students, practitioners, and policymakers. CA: The Owl Press, Berkeley

[4] Schomburg H (2007) The professional success of higher education graduates. European. Journal of Education 42:35–57. https://doi.org/10.1111/j.1465-3435.2007.00286.x

[5] Markes I (2006) A review of literature on employability skill needs in engineering. European Journal of Engineering Education 31: 637-650 https://doi.org/10.1080/03043790600911704

[6] Conlon E (2008) The New Engineer: Between Employability and Social Responsibility. European Journal of Engineering Education, 33(2): 151-159. https://doi.org/10.1080/03043790801996371

[7] Lappalainen P (2009) Communication as part of the engineering skills set. European Journal of Engineering Education 34: 123-129. https://doi.org/10.1080/03043790902752038

[8] Kolmos A (2006) Future Engineering Skills, Knowledge and Identity. In: Christensen et al. (eds): Engineering Science, Skills, and Bildung. Aalborg University, Denmark, pp 165-186

[9] Van Der Molen HT, Schmidt HG, Kruisman G (2007) Personality characteristics of engineers, European Journal of Engineering Education 33: 495-501. https://doi.org/10.1080/03043790701433111

[10] Williamson JM, Lounsbury JW, Hanc LD (2013) Key personality traits of engineers for innovation and technology development. Journal of Engineering and Technology Management, 30(2): 157–168. https://doi.org/10.1016/j.jengtecman.2013.01.003

[11] Tong LF (2003) Identifying essential learning skills in students' Engineering education. Learning for an Unknown Future, Proceedings of the 26th HERDSA Annual Conference, Christchurch, New Zealand, 6-9 July 2003, pp 388.

[12] Velasco PJ, Learreta B, Kober C, Tan I (2014). Faculty perspective development in Higher Education: An international study. Higher Learning Research Communications, 4(4), 85-100. Smith et al., 2005 https://doi.org/10.18870/hlrc.v4i4.223

[13] Smith KA, Sheppard SD, Johnson DW, Johnson RT (2005) Pedagogies of Engagement: Classroom-Based Practices. Journal of Engineering Education 94: 87–101. https://doi.org/10.1002/j.2168-9830.2005.tb00831.x

[14] Musa F, Mufti N, Latiff RA, Mohamed M (2012) Project-based Learning (PjBL): Inculcating Soft Skills in 21st Century Workplace. Procedia - Social and Behavioral Sciences, 59: 565-573. https://doi.org/10.1016/j.sbspro.2012.09.315

[15] Caprara GV, Barbaranelli C, Borgogni L, Perugini M (1993) The "big five questionnaire:" A new questionnaire to assess the five factor model. Personality and Individual Differences. 15:281-288. https://doi.org/10.1016/0191-8869(93)90218-R

[16] Rózsa S, Kő N, Oláh A (2006) Rekonstruálható-e a Big Five a hazai mintán? (Is it possible to reconstruct Big Five in a Hungarian sample?), Pszichológia (Psychology) 26: 57–76

[17] Kiss P (2010) Diplomás kompetenciaigény és munkával való elégedettség (Competency evaluation of graduates and job satisfaction). In: Diplomás pályakövetés IV. Frissdiplo-

mások 2010 (Graduate Follow up Survey IV. New Graduates 2010). Educatio Ltd., Budapest. pp 105-130
[18] Zaharim A, Yusoff Y, Omar MZ, Mohamed A, Muhamad N (2009) Engineering Employability Skills Required By Employers In Asia. Proceedings of the 6th WSEAS International Conference on Engineering education. pp 195-201
[19] Kline P, Lapham SL (1992) Personality and faculty in British universities. Personality and Individual Differences, 13: 855–857 https://doi.org/10.1016/0191-8869(92)90061-S
[20] Holland JL (1985) Making vocational choices: A theory of vocational personalities and work environments. (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall
[21] Mykrä T (1995) Learner-centered Teaching Methods. Indiana University Bloomington, Bloomington
[22] Riemer MJ (2003) Integrating emotional intelligence into engineering education. World Transactions on Engineering and Technology Education, 2: 189-194
[23] Yorke M (2003) Formative assessment in higher education: Moves towards theory and the enhancement of pedagogic practice. Higher Education, 45: 477-501 http://www.jstor.org/stable/3447452, https://doi.org/10.1023/A:1023967026413
[24] Sanda ID (2016): Fejlesztő értékelés (Formative assessment). Typotop Ltd., Budapest

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