

## Searching for alternative methods of training for engineers

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**ABSTRACT:** This article describes problems connected with the process of enriching technical studies with elective humanities subjects. One objective is to present a theoretical basis for psychological, pedagogical knowledge, and related sciences and their impact on the development of key competencies, values, attitudes and skills in young engineers. The other objective is to present results of the research carried out with samples of 176 students and 91 assistants and doctoral candidates, indicating the improvement in the key competencies during the study. Another issue under consideration related to elective humanities classes: which of these classes were considered to be needed the most by the test groups of students and assistants/graduates? The results indicate a significant role for key competencies with emphasis on several aspects of interpersonal communication in humanities education for young engineers. The research was carried out at the Centre for Pedagogy and Psychology at Cracow University of Technology, Cracow, Poland.

### INTRODUCTION

The concept of humanisation assumes that a certain domain of life is adapted for the needs and abilities of a person with principles of humanism [1] (Dictionary of the Polish Language - 1997-2013). Modern science is characterised by the integration of many areas and the formation of new border areas of knowledge. The development of mechatronics, nanotechnology or bionics is dynamic in nature and affects technological progress. The impact of life sciences on research methods used in many areas, for example, neural networks and genetic algorithms is of great importance. Modern technology is characterised by the intensive process of global communication and information processing.

Thanks to new technologies, the degree of automatic control and use of robotics in production processes is increasing. Machinery and equipment are of better quality, with more variants and a high degree of modularity. At the same time, the performance life of products (particularly of those in everyday use) is getting shorter, while the need to respond rapidly to market demand is growing. Technology news (especially on electronics) is now an attractive subject of exploration for the younger generations, but also the older generations adapt - at their own pace - to modern technologies in everyday use.

Undoubtedly, huge technological advancements are currently observed. Of course, despite the considerable benefits this technological progress brings, attention should be paid to risks and limitations connected with omnipresent stress, a serious risk of fast growing addictions not only to chemical substances but also to modern technology. Interpersonal communication and team work, which undergo civilisation transformations, pose another group of problems. These problems result, *inter alia*, from difficulty in understanding one's own emotions and those of other people, and difficulty in expressing them.

Adler and Rodman found it important to define a concept of emotional intelligence as a necessary ability in everyday life [2]. The above-mentioned aspects relate to people and their needs. On the one hand, the complexity of the problem is comprehensible, but on the other hand, there is a stereotype that people studying or working at technical universities have opted for this profile of higher education because humanistic values, though important to them, constitute only a small range of their intellectual needs compared with directional knowledge, preferences, interests and attitudes.

### TECHNICAL STUDIES AND HUMANITIES CLASSES

Technical studies mean more than acquiring knowledge and professional skills from the chosen faculty and narrow specialisation. The Pedagogy and Psychology Centre of Cracow University of Technology has for years provided pedagogical preparation for interested students, which allows them to work as a teacher of subjects in professional and vocational education. However, this is for a group of students that has chosen that calling, and a model of preparing a

graduate should also consider preparing him/her for work with people and the ability of lifelong education. Day observes that such skills and professional competence, and relevant knowledge can be acquired in classes conducted within humanities subjects [3].

Key competences now separate the members of the skill group. These competencies are defined as a combination of knowledge, skills and attitudes appropriate to the situation. Key competencies are those which all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment. The eight key competences are set out here:

1. Communication in the mother tongue;
2. Communication in foreign languages;
3. Mathematical competence and basic competence in science and technology;
4. Digital competence;
5. Learning to learn;
6. Social and civic competence;
7. Sense of initiative and entrepreneurship;
8. Cultural awareness and expression [4].

Under these conditions, the training should ensure that the graduate has acquired a set of knowledge and skills that would give them contentment and a sense of satisfaction with their studies, and would also create the opportunity to develop personality and, as a result, bring about the integration of experiences of different natures [5].

The most important objectives of humanisation shape one's broad outlook on life and capacity to acquire greater general knowledge resources, in accordance with one's own interests. It seems important for the development of the individual, as well as for the subsequent teamwork education to improve knowledge of one's mental predispositions, e.g. the type of intelligence, the dominant characteristics of temperament and personality to ascertain specifics related to learning and remembering the content or the role of motivation.

At Cracow University of Technology, classes in managing stress or in emotional development training, have been gaining in popularity. In recent years, training in creative thinking has also been of great interest. These classes are currently carried out within optional courses for students. For many years, classes in interpersonal communication, assertiveness, and self-presentation have been the most popular area of humanistic interest.

## RESEARCH OBJECTIVES

The first research objective was to determine the extent to which those interviewed identified their key skills. A further objective was to determine which of the 18 proposed objects in the humanities have been found to be the most-needed by technical university graduates.

## STUDY GROUP

The research was conducted on 176 students in construction and transport, and 91 postgraduate students and assistants who are graduates of Cracow University of Technology. The study was carried out in Cracow University of Technology during 2008/2009.

## METHOD AND PROCEDURE

The test method used a questionnaire containing 27 questions. The results presented have been selected to demonstrate responses to two questions directly related to the stated objectives: Questions 19 and 21. Below is the analysis of responses to these questions.

Question 19 asked: to what extent during the Master's degree and continuing to postdoctoral studies have improved skills been essential for:

1. Teamwork;
2. Using the computer high technology;
3. Communicating with other people;
4. Problem solving;
5. Active listening and taking a point of view into consideration other;
6. Using different sources of information;
7. Ability to communicate in a few languages;
8. Join and organise the knowledge;
9. Dealing with the untypical nature and the complexity with;
10. Organising and assessing the own work.

The items were evaluated on a scale of one (1) to four (4), with one indicating a lack of the ability to increase capacity, and four indicating a very high ability to increase capacity.

Question 21 asked: which elective object/modules in the humanities bloc would you recognise as the most needed for the graduate of a technical university?

1. Art of studying;
2. Interpersonal communication;
3. Self-presentation;
4. Preparation for the creative professional route;
5. Ethics of the student and the engineer;
6. Problems and threats in the life of the student;
7. Partner dialogue;
8. Pedagogy of the work;
9. Education opened in Europe;
10. Man in the contemporary world;
11. Public aspects of life of the man;
12. Technology versus human values;
13. Assertiveness;
14. Effective time management;
15. Effective negotiations;
16. Managing human teams;
17. Art of motivation;
18. Other (proposals than examined).

Participants had to choose five objects and to rank them from one (1 - means the most needed) to five (5 - least needed).

## RESULTS

The questionnaire included questions that were widely comprehended education issues. Questions about the process of studying dominated, and questions associated with it, such as choices of the development path of both the education and the acquisition of skills.

Figure 1 shows responses to Question 19, showing the highest percentage results obtained in the assessment of the degree of raising crucial abilities during studying (the third level).

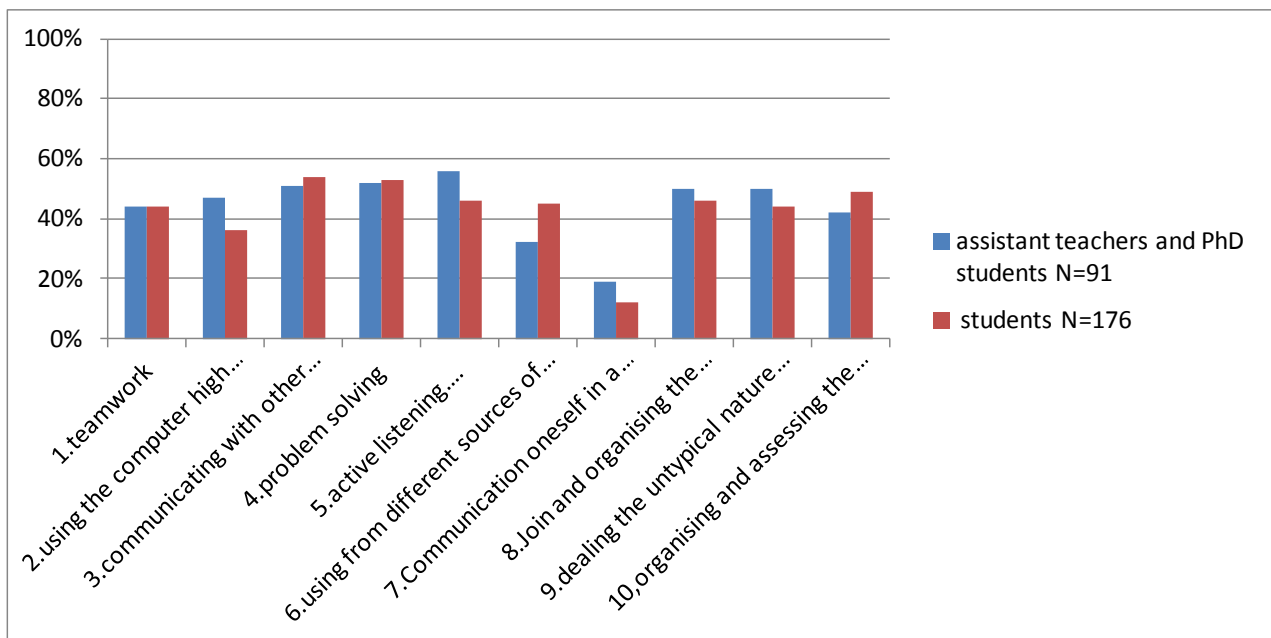


Figure 1: The highest percentage results.

The results presented in Figure 1 point towards two relevant aspects. The highest percentage indicators appeared on the third level of the examined persons. Those indicators pointed towards raising their crucial abilities in the high but not highest rank from possible.

This trend occurred among both the groups of students, and the assistants and doctoral students. In the group of assistants and doctoral students, the competence associated with active listening achieved the highest result; however, in the group of students the highest results fell to the competence associated with communicating. Results were high and similar with respect to the knowledge of solving problems. One should also note that the ability connected with communication in foreign languages was rated lowest by both groups examined.

Figure 2 shows which from the 18 humanities objects in the examined group of students have most often been chosen. The subject matter of these modules is concentrated around personal development and social communication.

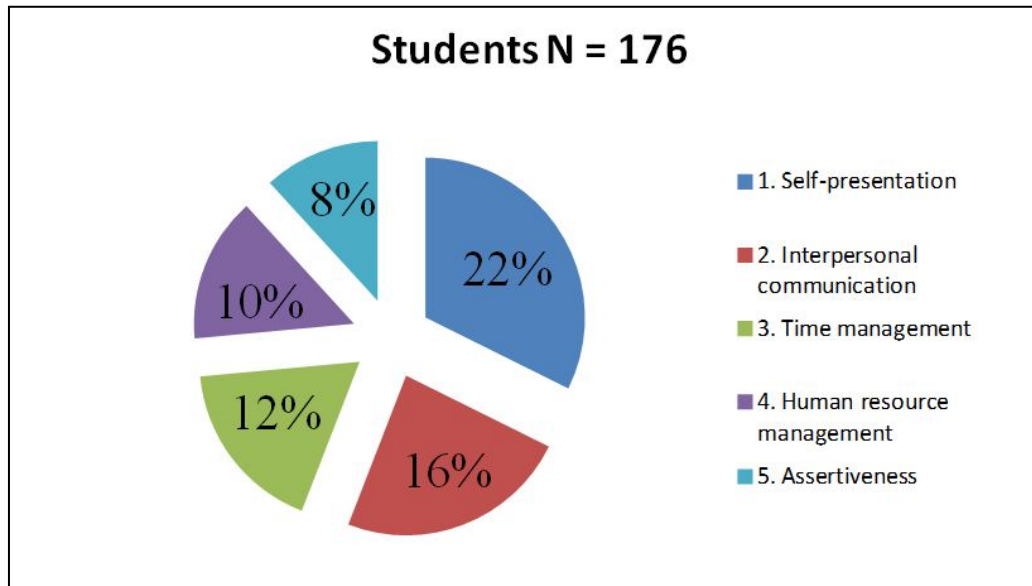


Figure 2: Most frequent choice of the proposed humanities class at the examined group of students (N = 176).

In Figure 3 one can find which from 18 humanities objects have most often been chosen by the group of assistants and doctoral students. The subject matter of these modules is also focussed personal development and social communication, although in these choices, other directions of interests and the preference of the examined group of graduates can be noticed.

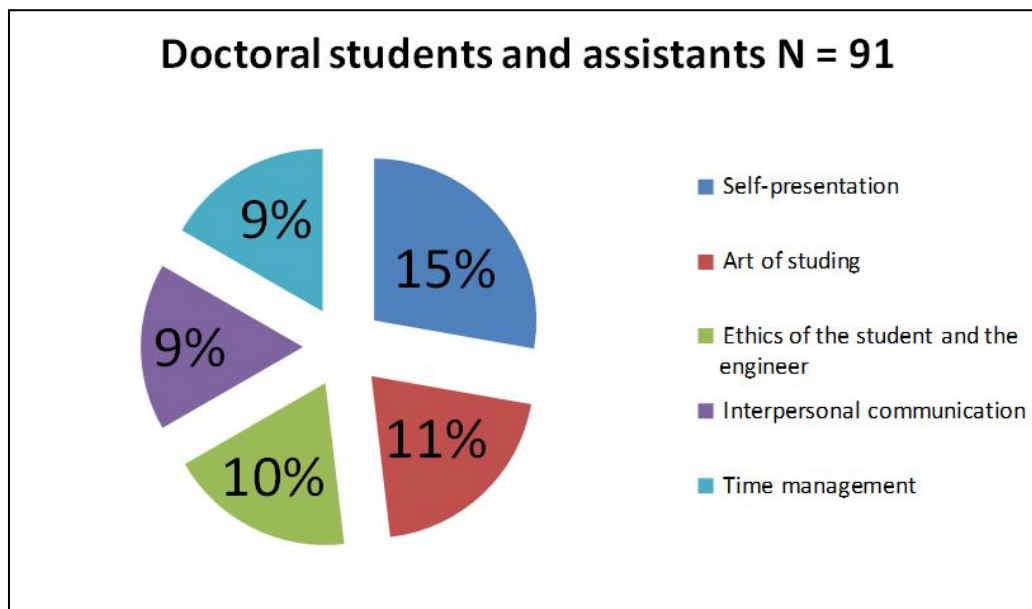


Figure 3: Most frequent choice of the proposed humanities class at the examined group of assistants and doctoral students of Cracow University of Technology (N = 91).

## CONCLUSIONS

The results point towards the material meaning of crucial competence in technical studies courses from the perspective of students and assistants/graduates. This competence was defined as the combination of knowledge, ability and

attitudes. For both groups, classes in self-presentation and social communication outweighed the others. Results from the student group show communications competence manifesting itself in interpersonal relationships.

What can facilitate a good start for them in the engineering profession? Aspects connected with personal development directed at self-assessment and the self-realisation are becoming important. Crucial abilities and the content of humanities subjects are most often acquired during training and technical classes.

The introduction of a structured system of humanising the process of technical education, which is attractive to students ensures the personal development of an engineer-creator. Apart from traditional theoretical lectures, training and workshops play a major part in this process. Using a range of methods and techniques, e.g. educational games, art activities, communication exercises, exercises in pairs, work with the body (self-massage), psychodrama and relaxation techniques, pedagogical work can be used to activate different ways of receiving and processing information by students [6]. A variety of proposals in humanities subjects will make graduates more effective in their professional and personal lives.

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