

SOCIAL SCIENCES IN EDUCATION OF ENGINEERS

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Abstract

The objective of this paper "Social Sciences in Education of Engineers" is to outline possibilities for gaining information about the position of the graduates of the CTU and their opinions on the educational process. The study is based upon the author's long-term research (1996, 2003, 2005 – 681, 1357, 828 number of respondents from CTU graduates) and concentrates on three main aspects of this problem: the professional position of the graduates, its feedback for the faculty as to the evaluation of acquired knowledge and impulses for the development of their education during regular and postgraduate study within the process of life-long education. After the introduction paper describes the basic methods of sociological research in the above field, especially inquiry, analysis and comparison that ensure reliable conclusions serving the faculty as a foundation for further decision-taking. The results of researches summarises the most important results of the author's research relating above all to the professional position of the graduates on the employment market, inquires into the problem of the application of knowledge acquired at the university. It relates not only to theory but also to practice, knowledge in the field of humanities and social sciences. The results show that the graduates of CTU appreciate the technical way of thought developed during their study that enables them to solve technical problems in the course of decision-taking. In addition, they appreciate theoretical and practical knowledge. On the other hand, communication with colleagues, team-work and so-called soft skills are evaluated as insufficient. The conclusions and discussions summarises the results of research relating to the further development of education during regular and postgraduate study within the process of life-long education, mainly in social sciences. They are based upon the author's experience and long-term pedagogical practice as well as information gained during the implementation of research projects.

Keywords: education, graduates, university, social sciences.

Introduction

The aim of this treatise is to sum up the existing knowledge of how the graduates of the CTU assert themselves on the labour market, present the methods of acquiring knowledge and utilising its results in the practice of faculties as well as complete educational processes on the basis of the needs of the labour market. The treatise is based on the conception of education at technical universities, especially on the results of sociological researches of the graduates of respective faculties. The possibilities for the graduates of technical universities including the CTU to assert themselves on the labour market are still influenced by the transformation of the society. Market environment necessitates the graduates to adapt themselves on the labour market when they look for an employment; at the same time this influences their decision-making of work either in their line or out of it.

Every university and its management is interested in organisations, enterprises or companies where their graduates work, i.e. whether they work in their line of study and how they apply knowledge acquired at a university. With respect to the feedback it is important for a faculty to dispose of information about knowledge which the graduates lack and with which this faculty should provide

them or its students. This problem has to do with the combination of theoretical and practical, practicable, knowledge with which a university can and should provide students during their study. This continuous dialogue between university pedagogues, practice and students relates to the position and role of a university in the system of education. The aim of study at a university is now to graduate with broad professional horizon. A graduate does not become an expert immediately by his graduation, but after he applies the methods of work in his line. The graduates of the CTU differ from the others with respect to possibilities to assert themselves and utilise knowledge acquired in the course of study. The faculties gain valuable information especially from students who work in their line or in a similar one. After the graduation from a university the graduates have many possibilities to assert themselves. Various companies, offering employment, differ in their capacity, property, specialisation, location and even position with respect to competition ability. They offer the graduates good salary, self-realisation, creative work, career, the application of skills, social benefits - but also psychological enervation. The graduates in larger towns, namely in Prague, have more options than those in smaller towns.

The results of researches help the managements of faculties to collect basic information about the possibilities of students to assert themselves. It can be useful during the preparation of entrance examinations for individual lines of study, the modification of curricula and the creation of the professional profile of a student and a graduate of the CTU.

Methodology of Research

In the course of finding out the feedback following methods are applied:

1. Sociological methods, especially questionnaires, interviews or group discussions, workshops in which the graduates of a faculty, its personnel managers and members of the management take part;
2. The methods of the long-term comparison of students' opinions;
3. The comparison of the results of researches at individual faculties with those at the CTU or other universities in the Czech Republic or abroad.

After 1990 three researches of graduates were implemented, in 1996 – 681 respondents, 2003 – 1357 respondents from the CTU (10% of number of all CTU graduates from 1994 to 2000) and 2005 – 828 respondents from graduates from 1985-1993), one research of ones about to take a doctor's degree (2006) and seven researches of students (1993-2006) within the framework of researches that have been organised at the whole CTU in Prague since 2000.

The results of researches answer to following questions: which are the possibilities of graduates to assert themselves? How are they adaptable? Do they work in their line or out of it? How do they apply practically their knowledge gained at a university? Which knowledge is insufficient and needs to be completed out of a university? In addition, they give information that is useful for the curricula of a faculty and the creation of the professional profile of a student.

With respect to the development of educational methods at a faculty, following instruments can be used for comparison:

1. The analysis of the educational system within the framework of pre-gradual and post-gradual study at universities or a faculty;
2. The long-term conception of the development of a faculty or the CTU in accordance with the documents of the Ministry of Education, Youth and Sports, international documents on the development of universities (Sorbonne, Bologna and Lisbon Declarations);
3. The results of the comparison of the educational system and curricula at technical universities abroad, especially in EU, U.S.A. Canada and Australia.

Results of Research

The possibilities of the graduates of the CTU to assert themselves on the labour market

The aim of presentable sociological researches is to collect information about the possibilities of the graduates of the CTU to assert themselves on the labour market, their working position, career and successfulness, find out their opinions of the practical application of their knowledge gained at a university and bring the gaps in knowledge into light. The graduates evaluate their adaptability, work in their line and out of it and practical experience, considering the labour market and the possibility to assert themselves on it. As mentioned above, the researches focused on the possibility of the graduates of faculties to assert themselves on the labour market in the period 1985-2003. They showed that the working position of them has changed evidently. Among those who graduated from a faculty in 1985-1993 there are more businessmen and managers. In comparison with younger graduates they have higher salaries too.

In the field of the possibilities of the graduates of individual faculties to assert themselves on the labour market, their working position, employment or business, work in their line, the property of an organisation where they work or their experience with employment rate. Most of the graduates of the CTU are employees. Three quarters of respondents say that they are employees (two thirds of them have no other income, about one tenth of them are both employees and businessmen). More than one tenth of younger graduates and about one third of older ones are businessmen. One fifth of the graduates who graduated in the monitored period have experience with unemployment. In the time of the research none of them was unemployed. One thirds of the responding graduates of the CTU work in building industry, 11% in firms of transporting and logistic and almost 5% of them work in state or public administration and 2-6% in the field of education, trade and services (real estate agencies).

The graduates of CTU work in various lines. Most of them work in the field of administration, management and design. Two fifths of the graduates from the period between 1993-2003 and more than one half of those from the period between 1985-1993 are managers. Two or three fifths of these graduates are businessmen. The percentage of engineers who work as managers has been increasing proportionately to their age and experience. Two fifths of these graduates are heads of departments and one tenth of them are general managers of enterprises. With respect to the individual aspects of their work, the graduates stress independence and responsibility. While their ideas of creative work come true very often, those of career, higher salary and professional development are accomplished rarely. The knowledge of the official position of the graduates is enlarged with information about the possibilities to apply their line of study. One quarter of the graduates state that their recent work corresponds fully with their line of study and two fifths of them state that their work has to do with it. It means that more than three quarters of the graduates of faculties work in the line that they studied. The working position of individuals can change all the time. With respect to the nature of such changes, two fifths of the graduates change their employer after graduation. A part of them do so because of changes in the organisational structure of a firm, the need of better salary and the absence of professional perspective. About one half of the graduates state that their working position has improved in the same organisation in which they took up their post, and the second half of them state that it has improved after the change of their employer. Three quarters of the graduates are now satisfied with their work.

One of important factors that influence the life of man is comparison between ideas and opinions on one hand and reality on the other. Do ideas about work correspond with reality? The graduates lay stress on workload, the kind and intensity of work, salary, the improvement of qualification and social position, self-realisation and social benefits. The results of this comparison represent an important source of knowledge both of the personality of a graduate and the needs of practice. Most of the graduates expect above all that they will have possibility of creative work and self-realisation. These two factors are combined with professional development, better salary, and the security of employment, independence, career and the efficiency of work. All these factors represent important values of life with respect to both ends and means. They reflect a certain degree of a graduate's awareness of his role at work and in the society. In most of factors expectations outweigh reality.

The graduates expect above all creative work, the improvement of qualification, career and better salary. But the practice necessitates personal responsibility, team work ability, routine and the power of psychical resistance. The ideas and expectations of the graduates differ in many ways from their demands. The ideas of career, good salary, the improvement of qualification, the possibilities of self-realisation and creative work have not come true contrary to expectations. On the other hand, the power of psychical resistance, routine and flexibility are required.

Table 1. The comparison between ideas and reality according to the expectations of the graduates of CTU (the results of the research in 2005). The sequence of items follows the criterion of importance.

Ideas	Reality
1. creative work	1. independence
2. self-realisation	2. responsibility
3. good salary	3. creative work
4. qualification improvement	4. employment security
5. independence at work	5. self-realisation

In the ideas of the graduates the expectations of creative work, self-realisation, independence, the possibility of the improvement of qualification, good salary and the security of employment dominate. In fact, the graduates lay stress on independence, responsibility, creative work, self-realisation and the security of employment. In the scale of criteria there are not big differences among the graduates who graduated in the period between 1985-2003. One of other factors that characterise the social position of man is his income. The monthly gross wage of the graduates serves as supplementary information.

The gross wage of three quarters of “younger” graduates is 10-30 000 crowns, it is 350 -1100 EURO (1EURO is about 28 crowns in 2007) while that of 15% of them is 30-50 000 crowns (1100 -1800 EURO). The gross wage of 60% of “older” graduates is 30 000 crowns or less, while that of 25% of them is 30-50 000 crowns. The gross wage of 14% of responding CTU engineers is higher. The results illustrate the fact that the income increases proportionately to working position depending on age and experience. There are differences of income within various groups of graduates. Among employees the gross wage of one third of employees is 20 000 crowns or less, while that of one third of them is 20 000 crowns, that of 23% of them is 30-50 000 crowns and that of 15% of them is more than 50 000 crowns. The gross wage of two fifths of the graduates who work as employees is 20-30 000 crowns, that of one third of those graduates is 10-20 000 crowns and that of another one third of them is more than 30 000 crowns. The gross wage of two fifths of businessmen is 20-30 000 crowns, that of one third of them is 20 000 crowns or less and that of another one third of them is more than 30 000 crowns. The gross wage of the graduates who work in the field of education or science is 10 000 crowns or less. With respect to the capacity of enterprises, the highest salaries are paid to the graduates who work in enterprises with more than 1000 employees; the gross wage of 81% of them is more than 20 000 crowns. In other enterprises about 54-65% of them get this wage. With respect to the property of firms, the highest salaries are paid to the employees of foreign companies and managers. The salary of 80% of the managers is more than 20 000 and that of one half of them is more than 30 000 crowns. The salary of employees of more than one half of them is more than 20 000 crowns and that of one fifth of them is more than 30 000 crowns (1100 EURO).

The opinions of the graduates of the CTU of the possibility to apply knowledge acquired during their study

In the course of monitoring the possibility of the graduates to assert themselves on the labour market and their further education it is important to find their opinions of the system of the education at a faculty. Its evaluation is one of the most important feedback factors for drawing the curricula.

If the graduates point out problems concerning the application of their knowledge, they at the same time point out the necessity of changes both in the content and form of teaching or individual educational programmes. On the contrary, their satisfaction witnesses the good content of an educational programme or individual subjects. Within the researches the graduates evaluate according to their experience how they are prepared for work after graduation from a faculty. It is clear that study at a university can not prepare graduates fully for all kinds of work. Nevertheless, it is important as a feedback. The researches monitor whether the graduates are satisfied and how they apply their knowledge acquired at a faculty in their everyday activity. They monitor their opinions of teaching, i.e. both theoretical and practical or supplementary subjects such as languages or humanities; in addition, the researches find out which knowledge is appreciated, which gaps in it should be filled and which knowledge and skills are important for the graduates to assert themselves on the labour market.

With respect to the comparison of the results of researches, I lay stress on those, which show the practical contribution of individual parts of a teaching programme. It can be said that in spite of the fact that the monitored groups of the graduates (from the period between 1985-2003) differ with regard to practice and experience, their evaluation of teaching is remarkably similar. They are satisfied above all with their theoretical knowledge. Most of the graduates appreciate acquired ability of "technical thought" (80%) and more than three quarters of them appreciate their theoretical preparedness. In addition, they appreciate ability to orientate themselves in their line (70%), ability to analyse and work systematically (51%), special knowledge in the line (52%) and ability to work on PC and apply software programmes (35%; nevertheless, there are evident differences among the graduates with respect to the year of graduation). On the contrary, the graduates find insufficiencies in their ability of self-presentation (22%), practical knowledge (19%), ability to communicate with people (13%), ability to manage and organise (12%) and the knowledge of foreign languages (11%). With respect to the evaluation of knowledge acquired at school, the opinions of the graduates from the period between 1985-2003 and those from the period between 1993-2001 do not differ.

Table 2. The evaluation of acquired knowledge with respect to the preparedness of the graduates for work after graduation from the CTU (1993-2000), expressed in percents. The evaluation is as follows: 1+2, the best, 4+5 the worst.

Knowledge and Ability	1+2	3	4+5
1. technical thought	80	16	3
2. theoretical knowledge	77	20	3
3. orientation in the line	70	26	4
4. special knowledge in the line	52	36	12
5. ability to analyse and work systematically	51	31	18
6. general knowledge of facts, social sciences	36	35	29
7. work on PC	35	23	42
8. self-presentation ability	22	30	48
9. practical knowledge and skills in the line	19	38	43
10. relation between theory and practice	17	43	40
11. communication with people	13	30	57
12. knowledge in the field of management and organisation	12	27	61
13. education in the field of social sciences	12	30	58
14. foreign languages knowledge	11	25	64

The graduates appreciate above all technical thought, the general knowledge of facts and knowledge in their field. One fifth of the graduates think that they have to improve their knowledge of foreign languages, work on PC (especially those who graduated in 1990s and before), economy, and communication with people and the solution of interpersonal problems, law and legislation. That

is why they find insufficiencies in knowledge that they acquired in a faculty in the field of management and communication with people as well as the knowledge of the contemporary society that is so important for their ability to assert themselves. During the evaluation of teaching process it is important to monitor which its forms are appreciated by the graduates more than the others. The results of long-term researches show the importance of workshops and seminars because they enable a pedagogue to discuss a subject individually and examine it. With respect to practice and preparedness for a future profession, the students appreciate above all those forms of teaching in which they are allowed to participate – for example dissertations, study projects and workshops.

The evaluation of individual faculties with respect to knowledge acquired at a faculty shows the satisfaction of graduates on one hand and the level of study on the other and serves as a feedback indicator for every university. One half (maybe even two thirds) of the graduates state that they are satisfied with knowledge acquired during their study. More than one third of them are satisfied partly and only a small part of them are not satisfied at all. As for the potential changes at the CTU, the graduates suggest the improvement of practical knowledge, the knowledge of foreign languages and the attitude of some pedagogues to students. The orientation of teaching relates to a certain degree to the students' abilities and skills. Some of them can be developed within the framework of the pedagogical process itself. The development of students' abilities can help their preparedness for work. The graduates of individual faculties express their opinions of contemporary demands on the labour market, required abilities and social competencies.

The graduates of individual faculties consider following abilities most important (this example shows differences between the opinions of students who graduated in 1985-1994 and those of students who graduated in 1994-2003):

1. The ability to solve problems	80/91%
2. The ability to learn and acquire new knowledge	79/75%
3. The ability to communicate with people	67/75%
4. The ability for teamwork	53/44%
5. The ability to assert themselves	38/40%
6. The ability to risk	35/48%
7. The ability to adapt themselves to the requirements of a firm	33/26%

The graduates of individual faculties who graduated in 1985-2003 agree on their opinions of important social competencies. In their opinion ability to solve problems, communicate with people and learn is important for practice. One half of the graduates stress the necessity of the ability of teamwork. The graduates who have been working for longer time stress ability to risk. It is possible to deduce from the above information that in practice it is more important for them to be able to solve problems and communicate with people than to adapt themselves to the situation of an enterprise. It is good that these opinions are not advocated only by the graduates who hold high posts. The information witness that the graduates agree on principle regardless a faculty from which they graduated and a year in which they did so. The differences result from the variety of positions which they hold after finishing studies.

The further education of the graduates of the CTU

With regard to the further education of students, their interest in such a study is monitored. It relates above all to the courses of life-long education or the study of ones about to take a doctor's degree. Life-long education after graduation from a university is nowadays necessary. The graduates thus complete their knowledge, improve qualification or undergo re-qualification. Interest in the improvement of qualification, life-long education and broadening the professional horizon helps the creation of the profile of a graduate and develops his ability to assert himself on the labour market. Three quarters of the graduates (in case of those with longer practice even 82%) have improved their qualification after graduation. More than one half of them have improved it through educational

courses in their enterprises. One tenth of the graduates did so out of the CTU and another one tenth even in another line than they studied at it. Almost one tenth of the graduates go on their studies as ones about to take a doctor's degree. 1% of the graduates study an additional line and about 5% of them study simultaneously at another university. 4% attend re-qualification courses. One quarter of the graduates did not improve their qualification at all. Recent trends in the field of the development of education reflect the interest of the graduates in further education proved by researches. In general, the relation of the graduates to education is positive, but their interest in life-long education is differentiated. One half of the graduates are interested in post-gradual study (one fifth of them state "surely yes", one third "probably yes" and two fifths "maybe yes"). Nowadays only one tenth of the graduates are not in it at all. On the other hand it is necessary to admit that real interest of the graduates in life-long education is less than the researches proclaim.

The scale of the topics of life-long education at the CTU according to the interest of the graduates in them:

1. Professional and applied disciplines	54%
2. Communication with people, enterprise sociology, personnel management	41%
3. Economy and management	37%
4. Law and legislation	29%
5. Environmental problems	14%
6. Theory – mathematics, physics	11%

Within the framework of life-long education most of the graduates are interested in professional and applied disciplines (one half of the respondents), communication with people, enterprise sociology, personnel management (two fifths of the respondents almost one third of the respondents), economy and management (one third of the respondents), the improvement of knowledge in the field of law (almost one third of the respondents), and environmental problems (more than one tenth of the respondents). The minority of them are interested in the improvement of knowledge in theoretical disciplines such as mathematics and physics (about 11%).

The graduates of the CTU - both employees and businessmen - apply their knowledge according to the demands of the labour market. The fact that technical knowledge prevails (84%) proves that they work either in the lines that they studied or in similar ones. Another important field is communication with people (79%). More than one half of the graduates links up better possibility to assert themselves with the application of economic and commercial knowledge and mastering foreign languages.

The graduates state that they most often apply following fields of knowledge (according to the year of graduation) completely (1985-93/1994-03):

1. Technical knowledge	84%	(78/91)
2. Communication with people	79%	(79/75/)
3. Economic and commercial knowledge	56%	(62/57)
4. Mastering foreign languages	49%	(43/64)
5. Law knowledge	35%	(38/37)
6. Ecological knowledge	18%	(20/16)

These results "prove" that the graduates adapt themselves to the existing conditions of market economy, economic development and international co-operation. With respect to social competencies, a graduate of the CTU who wants to assert himself on the labour market has to be able to solve problems, communicate with people, learn and participate in teamwork. The differences result partly from the variety of jobs offered after graduation.

Conclusion and Discussion

Most of the graduates work in the line that they studied and do not think of leaving it. They are either employees of various enterprises or businessmen. Their experience with unemployment relates mostly to a period of transfer from one job to another. They have various posts, but most of them are organisers, managers or designers. Regardless the line they more or less participate in the management of enterprises. In dependence on the year of graduation 29-55% of them hold management positions, especially positions of site managers, department managers and general managers. More and more of them are head designers (about 15% of the respondents). The wage of “younger” graduates is 10-30 000 crowns, while that of 40% of “older” ones is more than 30 000 crowns. It can be said that the graduates of the CTU assert themselves on the labour market successfully. On the basis of the results of researches focused on the graduates of the CTU I suggest its management to think over the importance of individual factors that would enable the graduates to assert themselves better on the labour market in the Czech Republic and are linked up with their social competencies. These factors are independent and responsible activity, teaching focused on teamwork, acquiring knowledge and skills in the field of social relations at work, communication with people, the management of working groups, connection between theory and practice in the educational process, life-long education and its advertisement in enterprises.

The further education of the graduates is concentrated on the system of life-long education. Further to the results of sociological researches and long-term experience this education should focus on three basic points. It must be said, that there is necessity to anticipate long-term conception. The supply of the courses of life-long education meets with the absence of demand of enterprises for the systematic education of employees and even long-term educational courses, offering the broad spectrum of management and communication skills. (More than one half of respondents have attended educational courses in enterprises). It is recommended to focus on:

1. The graduates who want to improve their knowledge after graduation, but do not want to take a doctor's degree. It is useful to create for this target group a) the system of specialised professional education lasting 2 semesters; it would be a basis of life-long education at a university; b) the management and communication courses, because most of the graduates hold management positions (these courses should not replace the educational courses in enterprises);
2. The graduates who are interested in short-term courses focused on the improvement of qualification. It is useful to create for this target group the system of 2-3-day courses focused on professional issues, management and design teamwork;
3. The ones about to take a doctor's degree, i.e. those who go on study at a faculty. Many of them have problems during it and further education could make their study efficient and facilitate their graduation. “The Programme of the Development of Ones about to Take a Doctor's Degree” is focused on following issues: a) the problems of these graduates relating to the pedagogical part of their study; the minimum of them study pedagogy and that is why it would be appropriate to add it to their teaching programme; b) the problems of writing the dissertation; c) the problems of the presentation of results, i.e. adding the ways of presentation and rhetoric to their teaching programme; d) the problems of communication within the team with respect to grants (in other words the problems of communication and social skills).

The management of the CTU supports teaching subjects in the field of social sciences that are either compulsory, “compulsorily optional” or optional. Regardless this fact it would be useful to integrate theoretical and practical subjects with the above skills and thus make all students of individual faculties familiar with them. On the basis of my personal experience I know how comprehensive this process is. Nevertheless I consider it important both for practical purposes and as a feedback of the graduates of the CTU.

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