DEVELOPMENT OF COMPETENCES NECESSARY FOR ENGINEERS IN THE PROCESS OF STUDIES

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Abstract. Today in any professional sector in Latvia there is a great demand for highly qualified and competent specialists not only in their professional field, but also having other competences that are necessary to be successful in this field. In order to train the future engineers for being able to integrate in the labour market after graduation from the university, the task for the teachers is imposed to improve the study process in a way that it helps the students develop the necessary competences accordingly. The article describes the research in the competences that are necessary for engineers, including theoretical descriptions and empirical materials obtained in interviews, discussions and enquiries among the employers of the graduates from the Faculty of Engineering and the graduates themselves who are working in the sphere of engineering.

Key words: competences, engineers, study process.

Introduction

Employers are the consumers of the final product of education; they evaluate its quality and conformity with the requirements of their needs. At present there are no direct ways to get feedback from the employers except contacting them and getting to know their opinion. The authors of the article have tried to find out what competences besides the specific professional ones are most important in the opinion of the employers that should be additionally trained while the future specialists are still at the university, for them to be able to integrate in today's labour market in Latvia as well in other countries of the world and to be ready for life-long learning.

Materials and methods

In the present research the opinion of the employers was obtained through enquiries, interviews and discussions. The definitions given in the article are selected through analysis and synthesis of scientific publications on the theme of the investigation. Personal reflection of the authors has made it possible to draw conclusions.

There are very many investigations carried out all over the world on competences, due to this also many different definitions of this term can be found in the scientific literature. For instance, in the dictionary of foreign words compiled by J. Balodunciks and K. Pokrotniece the terms "competence" and "competent" are described as:

1. German *Kompetenz*, Latin *competentia* - coincidence, conformity and wide knowledge, understanding in a definite sphere, subject and set of questions;
2. Latin *competens* means appropriate, being able, proficient, having wide knowledge, understanding in a definite sphere and set of questions [1].

The competence has become a social and pedagogical problem and an object of pedagogical research due to the changes that are going on in the society today all over the world. The competence is crucial in any sphere of work and life and it determines the degree of competitiveness in the labour market as well as in the quality of life of a person. For the present research out of many different definitions of competences the definition given by the Latvian educator B. Briede: "Competence can be defined as the ability to acquire and use knowledge and skills in action with a sense of responsibility, which should be assessed through performance according to the appropriate criteria (as standards of profession involving occupational requirements)" and the definition given by the Latvian educators I. Maslo and I. Tilla: "Considering competence as the ideal of upbringing it can be defined as an individual combination of abilities and experience based in the possibilities of getting experience" were considered to be the most acceptable [2, 3].

Usually the competence is referred to knowledge and skills but there are also many other aspects of competences that play an important role in the professional life of a specialist. So, the task was set to determine the most important competences of the future engineers for them to be able to find a job

after graduation and make a carrier afterwards in their professional field as well as to be ready for learning life-long.

The first experiment was carried out from 2003 to 2006 within the frame of an international scientific Leonardo da Vinci project "CLIL.AXIS" in which five countries participated – Latvia, Finland, Great Britain, Poland and Spain. CLIL means content and language integrated learning. The results obtained in the mentioned project were used to determine the changes in the situation of the requirements about the competences of the engineers five years ago and today.

The next experiment was started in 2008 with an interview among the employers and graduates who are working in the field of engineering. They were asked to mention the competences that are most necessary to be a competent and successful specialist, and to rank them according to the importance. The employers were not given any versions of the answers; the engineers were given a list of competences among which to choose to their mind the most important ones. The list included the following competences:

- specific professional (theoretical and practical),
- practical application of knowledge,
- team work,
- communication (these skills include also team work, ability to communicate in Latvian and foreign languages, to apply them in professional everyday situations),
- native language and foreign language,
- cross-cultural communication,
- planning,
- organizational,
- adaptation in new situations,
- independence in acquisition of new skills,
- collection and processing of information,
- computer skills,
- independence in decision making etc.

Eighty employers and engineers who are working in Riga, Jelgava, Talsi, Tukums and Liepaja were interviewed. After processing of the obtained results the following conclusions can be drawn: professional knowledge ranks first, it is followed by communication skills and quite surprisingly the foreign language skills were mentioned in the third place. It is obvious that professional knowledge is needed to do the required work qualitatively. The respondents explained the necessity for communication skills – as the graduates have higher education they occupy the managing positions. So, their work is in close relation with people around, not only their colleagues but also their clients. Besides, they have to communicate also with people from foreign countries as work in the sphere of engineering requires co-operation not only among people in Latvia, but also with foreigners. Foreign countries can be consumers as well as suppliers or consultants. Team work was mentioned as the fourth most important competence in the work in the sphere of engineering.

An interesting opinion was expressed by some of the employers about the foreign language competences. Although they are working in a Latvian company and dealing only with Latvian clients, they would still prefer to have employees being competent at least in one foreign language, preferably English. In general, the most often mentioned foreign languages were English and Russian, followed by Swedish and German, and in some cases French, Spanish and Italian were mentioned. The last mentioned languages were not referred to as compulsory. The reason for the necessity to know foreign languages was explained by the fact that the relations with different foreign languages are developing very fast all the time and in the future they may have the need for employers having the mentioned competences.

The employers consider motivation to be very important for performing work successfully. Motivation can be considered as a component of competence. Surely, motivation plays a very significant role in any work. It is necessary to have motivation to learn while at the university as well as being a specialist at work after graduation. Here it should be mentioned that motivation should be stimulated by the employers in different ways to make their employees be highly motivated. The same

can be said about the teachers at the university – it is possible to use many different methods in the process of studies to make the students motivated for learning.

We would like to mention CBI – competence based instruction that is an effective teaching method which is largely used, for instance, in the Netherlands. The authors of the article had an opportunity to visit the CAH Dronten University of Applied Sciences in this country and get acquainted with how this method is applied practically teaching students in international groups. The teacher acts as an adviser and consultant; the students are learning through doing. They are given instructions and the main operations are shown or explained, but the assignments are performed independently. Of course, the students can ask for help if there are some unclear situations or they cannot do the work by themselves. Applying this method in the process of studies it is possible to consider the individual peculiarities of the students and to train them in being autonomous. Teaching students through application of the mentioned method assessment is very important; it should be very fair-dealing, tactful and objective. The students should be able also to self-assess their performance. Only in co-operation of teachers and students the competence based instruction can be used successfully in training students in the process of studies at the university.

The employers mentioned also such components of competences as experience, attitude and values. They are as important as other competences because they determine the way how people do their job, with what responsibility, feelings etc.

It is interesting to mention that in the previous research that was carried out within the frame of the international scientific Leonardo da Vinci project CLIL.AXIS in which the authors of the article were involved for three years the obtained results were quite similar. The core CLIL (Content and language integrated learning) competence that was mentioned by the respondents – students, who were enquired within the frame of the mentioned project, was language/communication based as it is needed for successful co-operation in the professional environment. The language/communication based competence ranks first within the CLIL core competences. It is defined as:

1. Sufficient target language and pragmatic skill for the CLIL type followed so as to be a comprehensive input producer;
2. Sufficient knowledge of the learner's majority language;
3. Fluency in an additional language, which may be the CLIL target language, or some other (of particular relevance to target language native speaker teachers as regards personal additional language learning experience) [4].

Results and discussion

The results of the interviews show that the employers are more or less satisfied with the professional skills of young specialists but often they lack other competences that are also important according to the opinion of the employers. Among the competences and their components that were mentioned above in the text intellectual capacity was also mentioned. Intellectual capacity, including problem solving, is an integral part of the general activity of giftedness [5]. It involves the identification of the problem, the setting up of different hypotheses, the testing of those hypotheses through researching new material and through comparing the new material to previously acquired knowledge and through planning experiments to facilitate the testing of those hypotheses [6].

Analysing the publications related to the competences necessary for engineers in their professional life it is possible to come across many other skills that are mentioned in this respect. As, for instance, in one of the latest publications – the teaching aid “Global Positioning Technologies in Agriculture” the authors A. Vilde, Ā. Ruciņš and D. Viesturs who are closely connected with education at the Latvia University of Agriculture have pointed out that the first and main prerequisite for the development of Precision Agriculture in Latvia is training of high level agricultural specialists, and uniformity of science and practice. They say that the documentation, programs and technical equipment of GPS (Global Positioning Technologies) have been developed in the United States of America; therefore, the original names and symbols are given in the English language. The authors in the teaching aid have used them in definite cases in English giving also their Latvian equivalents considering that it is useful as it will help understanding and promote better acquisition of the teaching

context, especially for those students who are learning the English language at the university [7]. This is another example proving the necessity for foreign language competences.

Foreign language learning is a desirable way to help students in the development not only of their professional competences but also in the development of their personalities as it includes broadening of the world outlook and the improvement of almost all competences that are necessary for the future specialists that were mentioned by the employers. Besides, language is a part of cognition and it is linked with the thinking processes, memory and logic. The command of not only the native language but also of a foreign language or even several foreign languages has an important impact on a person's cognitive functioning.

Rapidly changing industrial and economic situation in Europe and in the world requires effective approaches to training engineers, including further and continuous education. Globalisation, computerization, mobility etc. require keeping up in learning, work and all other aspects of life.

The content of education alone cannot ensure sufficient professional background, intellectual development and abilities of the future specialists to adjust to the requirements of the changing labour market situation. A new task arises for the teaching staff of higher schools – to ensure appropriate learning environment for the students to train their skills in being able to adapt to new conditions, take independent decisions and become responsible for their own learning and results, be creative and flexible, evaluate professional situations and act accordingly. If the future specialists can reach a definite level in these competences it will ensure competitiveness in the labour market. This work requires devotion of the teachers and being able to make their investment in training highly qualified and competitive specialists for Latvia. It means not only supplying students with theoretical and practical knowledge in different subjects, but also development of high – qualified specialists as personalities is a very important task for the teaching staff of the university.

To achieve any remarkable results it would be advisable to reorganize the process of studies in a way that the employers are involved more or less in the development of the study programs or at least the teachers who are responsible for these programs should consult the employers and graduates working in their specialties. The students should have more possibilities for practical training that could be ensured through dynamic co-operation with higher schools and employers.

The authors of the article had an opportunity to visit Baranovichi State University in Belarus and get acquainted with the experience of training engineers there. The students at the mentioned higher school have a wonderful possibility to have practical training right in the process of studies as next to the building of the Faculty of Engineering there is a plant where students can have their practical sessions just after the theoretical course is delivered. So the acquired theoretical knowledge is at once strengthened through practical training. It is a well known fact that it is crucial that knowledge and skills have to be applied in action, in the present case, it means that the students can train the skills in their professional work.

Another way how to improve the process of studies is co-operative teaching and learning. The role of the teacher in co-operative learning as a partner in the interaction is not limited only to the teaching contents, but extends to a “background coordinator” who stimulates the student motivation, the student – teacher, and student – student interacting. The teacher stimulates students to make statements, to confront and defend their views and ideas. The teacher directs class discussions: creates situations in which each student will feel free to enquire and research; structures the students’ thinking (by turning their spontaneous sayings into precise statements, confronting them with their own sayings, leading them by adding sub-questions, and stimulating them to generalize, to extract what is essential etc.), invites them to check again, and make comments on what has been stated. To ensure an effective group functioning the teacher should help his/her students to master such skills as: active listening to their peers, respect for speech rights of others, accepting one’s own share of responsibility in the scheme of group work, sharing one’s own views and ideas with others [8].

Judging by this statement we can conclude that almost all the necessary competences for engineers can be trained through cooperative learning. Also critical, analytical and productive reasoning is acquired through discussions and exchange of ideas. Teachers should stimulate students’ active participation and indirect acquisition of knowledge; teachers create situations in which students can analyse, compare with what they already know, determine and observe relations and links between

notions, draw conclusions and accumulate new knowledge in these processes. It helps the students to raise their level of understanding how to apply the theoretical knowledge that has been delivered by the teachers in practical situations.

Accessing content information through different foreign languages can provide added value to the subject matter itself and it helps broaden horizons through providing opportunities for critical thinking. For instance, a module can be used which examines the same topic in a contrastive way using materials from different language perspectives [9]. Application of this approach leads to interdisciplinary co-operation that can be considered to be quite a new approach to language teaching, that is, integration of language and non-language learning. The curriculum should be influenced by specific needs: teaching English for special purposes (in the given case – engineering) as well as individual approach to students using individual styles and strategies. Although the main focus will be on the development of professional competences, language skills can be developed alongside. It prepares the students not only for their professional competitiveness but also for life-long further education. The specialists will be able to learn after graduation from the university not only in their target language at home but also abroad. When using a foreign language as a tool for studying other subjects, remarkable achievements can be made [9].

As the results of the enquiry among the employers show, the opinion is expressed that the present system of education cannot satisfy the growing requirements of the labour market. This opinion was substantiated by the statements that young specialists have low practical skills and the theoretical knowledge is not adequate to the practice. The authors of the article consider that an advisable way how to eliminate this drawback is collaboration with the employers. The importance and relevance of collaboration between university and industry in engineering education and industrial training in an era of advancing technology and modern production processes was stressed already in 1996 in the booklet "3rd East-West Congress on Engineering Education under the Theme: Re–Vitalising Academia/Industry Links" [10].

Summarising and considering the opinions expressed by the employers and analysing the scientific publications it is clear that the process of studies at the university should be improved taking into account the suggestions of the employers in developing the curricula for training engineers.

Further research is necessary in the ways and methods how to achieve the improvements that could ensure more qualitative results in training high-quality engineers that could be competitive in Latvian as well as in foreign labour markets.

Conclusions

1. Our world is undergoing different rapid changes under the conditions of globalization, modernization and abundant flow of information that determine new requirements for specialists to be competitive in the labour market. Adequate and developed level of competences ensures successful integration in this market. The most necessary competences for engineers besides the specific professional ones that are mentioned by the employers are communication, foreign language competences and skills to work in a team.
2. In order to improve the process of studies at the university and ensure training of high-quality engineers it is advisable to include the employers in the development of the study plans and curricula taking into consideration their suggestions and proposals.
3. It is also necessary to link theoretical knowledge the students acquire at the university with practical experience that the students can get while in internship or work placements in companies and enterprises the field of which is related to the specialty the future engineers are studying.
4. Foreign language teachers are open to use different new approaches and styles in foreign language teaching like content and language integrated learning and co-operative teaching/learning collaborating with the teachers of special courses to make the process of studies not only more efficient but also interesting and enjoyable for the students and to motivate the students for learning both – the foreign language and their special subjects.
5. The foreign language competences are developed in the foreign language sessions through the development of the four practical skills: speaking, listening, reading and writing, so learning of foreign languages has a great potential to develop also students as personalities and to improve

many other competences that are necessary for young specialists in their professional life, making a carrier and learning life-long.

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