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PARTNERS IN EDUCATION – DEVELOPMENT OF GRADUATES COMPETENCIES

Agnieszka CZERWIŃSKA-LUBSZCZYK[1*], Michalene GREBSKI[2], Dominika JAGODA-SOBALAK[3]

[1] University of Technology and Humanities in Bielsko-Biała, Poland; aczerwinska@ath.bielsko.pl, ORCID: 0000-0001-8100-8802
[2] Colorado Mesa University, USA; mgrebski@coloradomesa.edu, ORCID: 0000-0002-3487-4473
[3] Opole University of Technology, Poland; d.jagoda@po.opole.pl, ORCID: 0000-0003-3085-6603
* Correspondence author

Purpose: The aim of this paper is to investigate the possibility of using the concept of "Partners in Education" as a solution for preparing the students to successfully enter the workforce**.**
Design/methodology/approach: Desk Research Method and survey are used. Paper is based on Partners in Education's documents (local non-profit organization) and results of empirical research.
Findings: The study includes the review of the results of empirical research carried out in Poland, which indicated the existence of competence gaps of graduates from technical universities. The study also indicated the need to constantly monitor the competence gaps and correct the education programs on this basis. One of the tools to improve the process of updating curricula may be the practice used in the USA.
Originality/value: The main goal of any system of education in any region is to prepare students to successfully enter the workforce. At the present time, the economy is changing rapidly. The educational and training needs are constantly changing. The authors pointed to a good practice used in the USA, as an example of a solution for preparing the students to successfully enter the workforce.

Keywords: Competence, engineer, university-business cooperation.

Category of the paper: Research paper.

1. Introduction

Rapid changes in the economy are challenge for enterprises (Michna and Kmieciak, 2020; Nürk, 2021; Kmieciak et. al., 2012). It requires changes in education. This is true at every level of education from vocational programs through engineering professionals (Sabirova et al., 2019). Training and retraining the workforce is a slow process requiring a few years. There is

a need for some kind of organization collecting information from industry related to the forecasted needs of the workforce. This process is beneficial for the local economy as well as local communities. Participating industries benefit by being able to hire a qualified workforce without a need to retrain. The educational institutions (career and technology centers, community colleges and universities) are benefiting by receiving guidelines related to curriculum development. By constantly updating the curriculum to comply with needs of industry, the educational institutions fulfill their goals better. This process allows educational institutions to maintain a high employment rate of graduates. This process decreases the unemployment rate in the region and contributes to economic prosperity.

The main focus of this research project is to evaluate the possibility of using the "Partners in Education" (PIE) concept as a solution to better prepare students to successfully meet the demand of the workforce. The article presents a fragment of international research on the competences of engineering graduates required by the industry. Competency gaps need to indicate directions of changes to be implemented in education. One of the tools to improve the process of updating curricula can be the practice used in the USA under umbrella of Partners in Education.

The reason for undertaking this research project is the good result in the USA in the field of university-business cooperation and innovation. The Global Competitiveness Report ranks the USA second in terms of cooperation between universities and industry (University-Industry collaboration in R&D under the 12th pillar: Innovation). The overall Global Innovation Index 2020 ranks the US in third place. For comparison, Poland is only in the 89th position regarding collaborations between universities and industry. (The Global Competitiveness Report). At the same time Poland is listed in 38th position in the Global Innovation Index 2020.

2. Theoretical background

Universities aims at development of competences and skills, corresponding to the characteristic of the future professional activities of graduates (Choe and Borrego, 2020; Dubovikova, 2019). In the traditional system of education, students mostly acquire theoretical skills and competences (Dubovikova, 2019). Presently we need interdisciplinary, competences and practice-oriented approach to the education (Fedoseeva et al., 2019; Ghonim and Eweda, 2019; Srgeeva et al., 2019). Ghonim and Eweda (2019) notice also the necessity of real-world projects, which should be included in curricula for engineers. Fedoseeva et al. (2019) is also emphasizing the importance of teamwork skills, which could be developed by participation in research projects, internships, sports and other university group activities.

Competences includes aspects of knowledge, abilities, skills and personality characteristics (Syahmaidi et al., 2019). Competencies of engineering graduates include: "theoretical knowledge, skills and ability, practical experience, method of training and method of implementation, activity, attitude and soft skills". Dubovikova (2019) divides engineering competences into: universal competences ("general scientific, social, personal, non-technical") and professional competences ("general professional and major-specific").

Competences should reflect the needs of the job market. Balve and Ebert (2019) focused on a wide range of graduate competences, required by the industry. They divided them into four groups: professional competences (e.g., knowledge of engineering methods and knowledge of IT), methodical competences (e.g., analytical skills and problem-solving ability), social competences (ex. communication ability and oral expressiveness), self-competences (e.g., adopt to changing circumstances and decision-making ability). The feedback from industry confirmed that industry values soft skills as much or even more than hard skills.

University-industry cooperation brings benefits for both parties. For universities, it is an opportunity to verify the theoretical assumptions in real conditions. This is also an opportunity for students to develop practical skills and for faculty to receive guidelines related to curriculum development (Czerwińska et al., 2020). For entrepreneurs it is an opportunity to attract apprentices and trainees as well as qualified employees. University-industry cooperation is the synergy of modern knowledge and experience (Jagoda-Sobalak et al., 2018).

University-industry cooperation is "a model of inter-institutional agreements between organizations of fundamentally different nature, which may have different goals and adopt very different formats" (Tatum et al., 2018). University-industry cooperation includes formal and informal relationships and interactions between the parties involved (Raesfeld & Fuentes, 2018).

University-industry cooperation covers many cooperation areas. During the literature review, it become apparent that the different authors focus on one area or number of different areas of Industry – University cooperation. D'Este and Patel (2007) focused on conducting joint research, staff exchange, joint patents and publications and opening spin-offs. Informal relations are important also: participation in conferences and meetings (Kuna-Maszałek, 2013). Gill et al. (2007) focus on relationships that are based on relationships between people. For example, delegating university employees to industry or inviting industrial specialists to the university (Kuna-Maszałek, 2013). Fajfer, Koliński, Kolińska (2013) analyzed a number of areas of cooperation. Industry-University relationships in the field of training and joint projects were the most common type of cooperation. Based on research results from Mexico, Raesfeld and Fuentes (2018) highlighted the importance of student internships. Other popular and effective forms of cooperation are faculty exchange and research and development cooperation. However, the authors emphasize "the sporadic nature of these activities and the lack of continuity in their initiatives". Epure (2017) focused on the education process (innovation in

teaching) and the graduates' integration into the labor market. Liu, Li and McLean (2017) focused on the many aspects of educating students.

3. Results of survey

The research described in this article was conducted in 2020 (Czerwińska-Lubszczyk et al., 2020). The criteria for selecting enterprises were based on the following:

- Compatibility criterion – companies hiring engineering graduates.
- Diversity criterion – enterprises represent various industries.
- Willingness of the company to participate.

The research was conducted at various enterprises located around two technical universities in Poland. The survey questionnaire was addressed to owners, entrepreneurs or managers. The authors used the snowball sampling method. University employees having a working relationship with industry helped in the selection of enterprises for collecting research data. The data was collected from eighty-six companies hiring engineering graduates. The surveyed companies represented very small, small, medium and large companies.

The study included:

- Identification of skills and competences relevant and important to industry. The individual areas of knowledge/skills were assessed on a scale from 1 to 5, where 1 meant an unimportant area and 5 meant a very important area.
- Assessment of the level of preparation of engineering graduates in specific areas of knowledge/skills and competencies. A scale from 1 to 5 was also used, where 1 meant unprepared and 5 meant very well prepared.

The results are shown in Table 1. The assessment numbers in Table 1 represent mean values.

Table 1.
Graduates' competences: value to industry and level of preparation of engineering graduates

Item	Value to industry	Level of preparation of graduates
Knowledge of science, mathematics and engineering principles	4.65	4.20
Engineering design and analysis	4.80	4.12
Humanities (literature, writing, speech, etc.)	4.10	4.13
Design of processes, systems or devices	4.55	4.44
Arts	3.35	3.07
Teamwork	4.52	3.85
Formulation of problems and methodologies	4.40	3.83
Engineering Ethics	4.15	4.08
Communications	4.61	4.52
Social and behavioral sciences	4.45	4.02
Global and societal contexts	4.42	4.63
Lifelong learning	4.53	4.02
Computers and related technologies (tools)	4.95	4.74

Cont. table 1

Broad general subject knowledge	4.30	4.61
Professional work-related skills	4.60	4.16
Articulating yourself using writing skills	4.45	4.04
Articulating yourself orally	4.74	4.05
Thinking critically and analytically	4.43	4.12
Using quantitative analysis to solve problems	4.54	3.64
Using computers and IT	4.91	4.74
Works well with others	4.84	3.55
Solving real-world problems	4.55	3.52
Developing personal ethics and values	4.46	3.03
Contributing back to society and community	4.04	3.93
Has practical skills necessary to obtain employment	4.77	3.52
Can define the problem	4.37	3.3
Is a problem solver	4.65	3.43
Understands global concerns	4.48	4.27
Understands environmental concerns	4.04	3.94
Understands scientific principles	4.05	4.04
Understands scientific methods	4.05	3.78
Applies scientific principles	4.16	3.87
Applies scientific methods	4.01	3.56

From the results of the conducted research, the authors (Czerwińska-Lubszczyk et al., 2020) concluded that companies expect graduates to have a wide range of skills and expertise from the application of modern technologies to soft skills. The highest mean values correspond to the following: Computers and related technologies (4.95), Using computers and information technology (4.91), Works well with others (4.84), Engineering design and analysis (4.80).

As a result of the comparison of "value to industry" and "level of preparation of graduates", competency gaps were identified. The biggest competency gaps identified by the research project are as follows: Development of personal ethics and values (1.43), Works well with others (1.29); Has practical skills necessary to obtain employment (1.25), Is a problem solver (1.22).

The presented research results indicated the existence of significant competency gaps of engineering graduates (gaps between graduates' preparation and industry expectations). Addressing the competency gaps requires constant monitoring of the Engineering curriculum so that the Engineering curricula corresponds to the current needs of the industry. One of the tools to improve the process for updating curricula can be the practice used in the USA: Partners in Education.

4. Partners in Education

Partners in Education (PIE) is a local non-profit organization, incorporated in 2000 under the name (Partners in Education…). It consists of "business and education partners who are focused on ensuring that all students leave school with the academic, technical and employability skills necessary to be successful in the 21st century".

The members of PIE are volunteers representing industry as well as educational institutions. Examples of educational partners include: Keystone Job Corp Center, Luzerne County Community College, Pennsylvania State University Hazleton, Hazleton Area School District, Weatherly Area School District, Crestwood School District.

There is a Student Advisory Committee comprised of representatives from local school districts (Hazleton Area, Weatherly Area, and Crestwood High Schools). All students have an opportunity to participate in various business projects as well as meaningful career related activities.

The mission of PIE includes "providing the students with an understanding of the career opportunities available in Northeastern Pennsylvania and enabling students to remain in the area and fulfill their career goals".

Funding needed to sponsor some of the projects are normally secured from grants and industry donations. Projects and activities sponsored by PIE include the following topics and goals (Partners in Education…):

- Promote career awareness among students and help to improve the skills necessary to enter the job market.
- Develop career and technical education, which addresses local job skill needs.
- Familiarize students with career options emphasizing the job respectability.
- Broaden and foster cooperation between the community and the educational institutions.
- Promote projects that involve parents in the education of their children.
- Provide decision making opportunities and leadership experience which increase confidence and self-esteem of students.
- Help students develop pride in themselves, their school, and their community.

For example, Greater Hazleton Partners in Education is hosting its annual Girl Power in STEM (Science, Technology, Engineering, Mathematics) and Spring Symposium. The symposium is a seminar that brings together professional women in the science, technology, engineering and math fields to motivate local high school girls to pursue careers in those related field. The goal is "to bring the women and girls together and create an atmosphere for sharing information. This is a great opportunity for young women who may be interested in science, technology, engineering or math to be able to connect with women who are already paving a path in those fields" (Partners in Education…).

According to an Executive Summary done by the US Department of Commerce, Economics and Statistics Administration, "the Office of the Chief Economist (OCE) noted that America's STEM workforce is crucial for generating new ideas and providing critical thinking necessary in the modern economy. However, women continue to be underrepresented in STEM jobs and among STEM degree holders ". During "Girl Power in STEM", the professional women "share their experiences and expertise through brief presentations and interactive panel discussions. Attendees will also have the chance to have one-on-one conversations with local businesswomen and representatives from several educational institutions" (Partners in Education…).

5. Discussion and conclusions

The main goal of any system of education in any region is to prepare students to successfully enter the workforce. At the present time, the economy is changing rapidly. The educational and training needs are constantly changing. The main goal of this research project is to investigate the possibility of using PIE model to better prepare students to successfully enter the job market.

PIE consists of business and education partners. The main goals are ensuring that all students have "academic, technical and employability skills necessary to be successful in the 21st century". The members of PIE are volunteers representing industry as well as educational institutions. Funding to sponsor projects or activities is secured from grants and industry donations.

The paper refers to the results of empirical research carried out in Poland, which indicate the existence of competence gaps of engineering graduates. There is a need for constant monitoring and correcting of engineering education to comply with expectation of industry. One of the methods to improve the process of updating curricula may be the model of PIE in the USA.

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