

APARATURA

BADAWCZA I DYDAKTYCZNA

Methodology of education by projects method in civil engineering fields of studies (degree course) at technical universities

JERZY OBOLEWICZ

BIALYSTOK UNIVERSITY OF TECHNOLOGY

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ABSTRACT

In present educational system of management personnel in construction industry in Poland, too much attention is paid to theoretical aspects, and not enough to practical aspects connected with teamwork. It causes a situation in which civil engineering graduates of technical universities, who have acquired wide knowledge, are not always able to use it while working in a team, during realization of construction and investment processes. Therefore the acquisition of interpersonal skills becomes necessary during educational process at university.

Metodyka kształcenia przez projekty na kierunkach budowlanych w uczelniach technicznych

Słowa kluczowe: uczelnia, kształcenie, budownictwo, kształcenie przez projekty

STRESZCZENIE

W obecnym systemie kształcenia kadr kierowniczych dla budownictwa w Polsce zbyt dużą wagę przywiązuje się teorii, a zbyt mało, poświęca się aspektom praktycznym związanym z pracą zespołową. Powoduje to, że absolwent uczelni technicznej po kierunku budowlanym posiada szeroką wiedzę, którą nie zawsze potrafi wykorzystać w pracy zespołowej podczas realizacji budowlanych procesów inwestycyjnych. Koniecznym staje się, zatem nabycie umiejętności interpersonalnych w procesie kształcenia na uczelni.

1. INTRODUCTION

Modern construction is characterized by great diversity and complexity of buildings. It consists of lots of organizational and technological processes proceeding in particular conditions comparing with similar processes occurring in other sectors of the economy. Each process is characterized by:

- individual character of building process,
- considerable size (dimensions) and large mass of buildings,
- considerable dispersal of realized structures on construction site,
- immobility of products,
- random character of time for completion of construction processes,
- dependence of atmospheric influences,
- long service life of building structures.

Foregoing features of building process realization indicate that organization, realization and management require special procedures whereas a construction and investment process require a new approach. According to Project Management Institute, project management is an approach using the application of knowledge, skills, instruments and techniques in order to satisfy the needs and expectations of participants and people associated with the project [1].

In construction each building project is an individual project, often referred to as construction project which:

- has specified purpose; It's achievement ends developing of the project,
- has defined time-frame,
- has assigned resources of: workers, machines, materials and money,
- consists of assigned, interrelated steps and/ or tasks [2, 3].

Managing of the investment process in the construction industry requires applying complex methods, which include technical, economical and social conditions. One of the methods that meets the requirements is project management method.

The term „Construction project”, which is a part of project documentation, should not be confused with other term „project” (investment project) used to describe investment project as a whole of developed investment.

As far as project management method is concerned, a project manager is fully responsible for the project and has full authority to make decisions.

His task is to transform funds, material means and information measures to achieve the objectives of a project. Project manager oversees the project team and every person seconded to it. This type of construction project management's structure in construction industry is used in case of high complexity of building process realization. Typical construction project is a combination of interrelated actions purpose of which is to meet the needs of investor or owner of a building facility [4]. Each Construction project requires lot of interdependent actions and includes a technical, economical, environmental study developing the conception of operations, construction project, preparing of organization and implementation of construction process including putting into operation. The exploitation of building facility defined as the possibility of usage of the facility in accordance with intended use through maintaining exploitation state of the building is a particular type of construction project. Members of the project team are required to have specialized knowledge, skills and competence necessary to work out and make decisions defining the techniques, time, costs, quality and location of construction project. This applies to particular aspects like:

- basic knowledge concerning: work, construction, building design, organization of investment projects,
- knowledge, abilities and competence in: technology and organization of works, management of construction works, management and organization of construction projects, construction economics, exploitation of building facilities,
- knowledge of related sciences.

2. EDUCATION BY PROJECTS

The etymology of the term „education” comes from derivation of word „shape”. It can be said that „education” is giving a shape to knowledge acquired by student in independent and creative way. According to educationalists, education is a specific process of:

- *merging* by collecting, encompassing and combining,
- *organizing*, systemizing and hierarchization, that is creating of compacted and logically built scheme, hierarchic built structure by denying what is needless,
- *organizing and forming* of what is really important and necessary,

- *utilizing* information for enriching intellectual, moral, esthetic or physical student's experience. In the literature the term „education” and „teaching” is frequently interpreted alternatively. However education is more completed process than teaching. During the teaching and learning one can acquire valuable, extensive and varied knowledge and abilities. This may include encyclopedic information, not creating a harmonious whole, but isolated and superficial. Education based on teaching process is its further continuation on higher level [5, 6].

According to Z. Rusin, student's education on faculty of civil engineering does not end at university. Graduate of university with the title of civil engineer should get the appropriate entitlements to be able to perform his work independently. The procedure of granting building license is regulated by the Construction Law and specific regulations, whereas the Polish Chamber of Civil Engineers issues proper documents after passing the exams.

According to a number of practitioner¹, an engineer who passed through such education path is not fully prepared to perform independent functions in construction industry. There are numerous postulates to improve this situation. One of them is introduction of postgraduate education and another is change in actual education system. In implementing changes in the processes of education in Polish higher education, the use of experience of other countries seems to be the best way to implement changes in the processes of education in Polish higher education. Z. Rusin [7] described the education system of civil engineer in USA (ASCE – American Society of Civil Engineering) and a Danish system (PBL – Project Based Learning) and compared them with the standards of education in Poland. American system differs significantly from the Danish and is also criticized in various aspects. In both cases, the important factor is economic one, containing financial outlays on education in these countries.

¹ Dr. Eng. J. Obolewicz worked over 15 years in construction industry doing various management jobs from construction site manager to building enterprise director. Currently he's teaching and doing research and is member of: management board of „Oddział Podlaskiego PZITB”, leaders of „Rady do spraw Bezpieczeństwa i Higieny Pracy przy Okręgowym Inspektorze pracy w Białymstoku” and member of many regional commissions evaluating construction work.

For instance, the Danish government is financing programs of civil engineers education (Danish Universities network – VIA University College Denmark) notwithstanding the nationality of the student. In Poland the financial outlays on education are very low comparing to other countries. It remains to adapt the Polish standards of education to EU standards whenever it's possible. Polish education standards are generally comply with UE requirements. In the opinion of the practitioners they are not perfect, conformed to market requirements and require continuous revisions. It is common occurrence of modern building industry. The environment of it is constantly changing and these changes are enforcing the necessity of changes in the areas of education. What seems insufficient in Polish education system of engineers is the range of the knowledge, interpersonal and social skills combined with current construction practice, in which more commonly are applied quality methods in management, where quality is defined as compliance with requirements. These in turn play decisive role in project management. At technical university civil engineering student who takes part in education process of particular thematic blocks divided into lectures, exercises, laboratories or projects, traditionally acquires:

- *knowledge* defined as a resource of related facts, principles, theories and experiences assimilated by the learner
- *skills* – understood as the ability to use knowledge and skills to perform tasks and solve problems;
- *personal and social competence* treated as the ability to perform tasks in autonomous and responsible way; willingness to learn through entire life; proficiency of communication; ability of cooperation with others as both a member and leader of a team.

The student takes part in workplace learning in building companies. Very often the blocks of each courses are not connected with each other with any primary objective. Usually the practices do not correlate with the theory conveyed at university.

Upon entry to the EU, in Poland appeared new attitude to education at higher education level. It was initiated with European Qualifications Framework (EQF) and European perspective on overall progression of human. National Qualifications Framework for Polish higher education is a description of interrelations between qualifica-

tions, integrating various national qualifications subsystems, in which are determined educations outcomes and qualifications for individual areas of education, such as:

- first degree qualifications – the effect of education at the undergraduate level, completed by obtaining engineer or bachelor title or equivalent courses and educational profile completed by obtaining relevant diploma,
- second degree qualifications – the effect of education at second-cycle studies, completed by obtaining a master’s degree, Master of Engineering or equivalent courses and educational profile completed by obtaining relevant diploma,
- third degree qualifications – acquired, in the way of a doctoral degree of the academic doctor in a field of science in specified scientific discipline, certified by a diploma.

Law of Higher Education [8] distinguishes two different educational profiles: practical and theoretical. Practical profile includes modules of acquiring by the student practical skills and social competences accomplished on the assumption that more than a half of the study programs includes practical lessons forming these skills and competences, including abilities acquired during courses conducted by persons with professional experience gained outside the university. Theoretical profile includes modules of courses related with conducted scientific research at university and is accomplished on the assumption that more than a half of studies program includes courses intended to acquire in-depth knowledge by a student. In both cases „teaching outcomes” should be distinguished from „learning outcomes”. In practice, these terms are often used interchangeably. However the essence and objective of properly understood educational process is to make – as a result of the use of appropriate didactic methods – student learn and to be taught [9]. Implementation of the Framework of Qualifications for Polish higher education resulted from realization of objectives of the Bologna Declaration and resolutions of the Conference in Bergen, which was attended by higher education ministers from 46 countries. Today Qualifications Framework should be considered in the category of tool increasing quality of education. At technical universities, where the traditional system of education is still realized on civil engineering degrees, relations between student and subjects of education are the only one which appear to exist

[10]. These relations can be shown as a structure of „student – subjects of education” (Fig. 1).

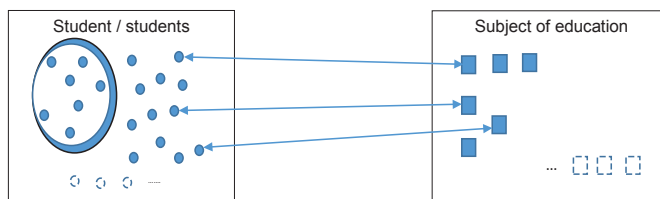


Figure 1 Traditional structure: student – subjects of education

Source: own work based on position [9]

In education by project method, apart from former structure elements such as „student” and „subjects of education”, there are new elements like the „team” and „project”.

Introducing new elements of this structure creates opportunity for students to acquire practical skills connected with teamwork as well as learn to solve specific problems defined in the project. Interaction in educating students by projects method presented in Figure 2.

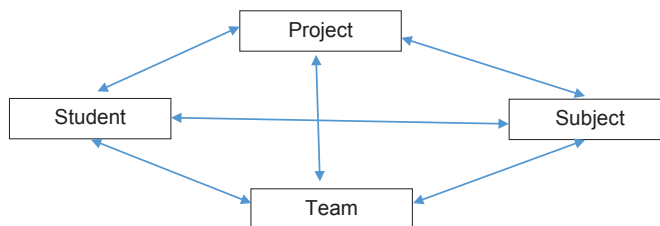


Figure 2 Interaction in educating students by projects method

Source: own work based on position [9]

Basic assumption of education by projects method is that the students are divided into and each team makes one complex project during semester. Implementation of these projects requires knowledge obtained during courses of individual subjects and skills of team working in project team. Students make distribution of roles to complete the project in scheduled time. They also learn methods of project management which are useful and needed in building companies. Using the author’s work experience in an international environment in terms of engineering education, like German experiences in terms of obtaining skills and professional competences [11], and Danish experiences in terms of innovation methods of engineering education [12], it can be stated that in order to educate by projects in civil engineering courses at universities in Poland, education should comply with such requirements as:

- work in teams consisting of students and academic teachers,

- teachers leading specific subjects establish among themselves the scope and importance in final evaluation being guided by the rules of assigning bigger value to principal subjects,
- group of student consists of 25-30 people and project group of 5-6 people,
- attention over project is hold by project supervisors and their assistants,
- group classes are conducted in large blocks at the beginning of the semester and are combination of lectures, exercise classes and laboratories,
- activities carried out in project groups are realized in the second part of the semester,
- project consultations are held once a week with the participation of students, project supervisors and their assistants,
- students from individual project group prepare work schedules, watch deadlines from time schedule and report the progress to the project supervisor,
- at the end of the semester each project team take an exam in each subject and practical knowledge to „define“ completed project,
- final work and report should be done from completed project,
- every student of project group is evaluated individually.

Reaching the final effect is held under the supervision of the teacher conducting classes in three




main stages: preparation, implementation and evaluation in which proceed the development of knowledge, skills and personal and social competences. Characteristic of stages and activities in the various stages of the project, splitting into fundamental areas of knowledge, skills and personal and social competences development, are shown in Table 1.

3. CONCLUSION

The Conception of „learning by projects“ in civil engineering fields of studies at technical universities – used successfully at foreign universities – could become an alternative to the traditional way of teaching. It is especially important in construction industry, where developed building facilities are more complex and complicated and require collective management through entire investment process. Introduction of learning by project method in civil engineering fields of studies at universities allows to educate future staff for construction industry not only in the area of theoretical knowledge, but also practical in area of teamwork and project management. The cooperation between universities and enterprises in education area creates such opportunities.

Table 1 Stages and activities in education by project process

Lp.	Stages of process	Activities in particular stages
1	Preparation of a project	Selection of a project topic
		Organization of the project
		Collect materials (collecting materials)
		Processing of a detailed development plan
2	Implementation of a project	Execution of all operations step by step according to prepared schedule
3	Evaluation of the project defined as the way of assessing obtained values in the project	Evaluation planning: analysis of needs and preliminary definition of the scope of the evaluation and formulation of conception of the research
		Collection and analysis of data: conduction the research and analysis of collected data
		Reporting: present presentation of the results of the evaluation in report, discussion and their consultation.
		The use of evaluation results: making decisions to improve evaluated project based on the information in the report of evaluation

Legenda:  – Development of knowledge;  – Development of skills;  – Development of personal and social competences.

LITERATURE

- [1] Mingus N., Zarządzanie projektami, Gliwice, Wydawnictwo Helion, 2002, 21.
- [2] Strzelecka E., Glinkowska B., Maciejewska M., Wiażel-Sasin B., Zarządzanie przedsięwzięciami budowlanymi. Podstawy, procedury, przykłady; Łódź, Wydawnictwo Politechniki Łódzkiej, 2014, 9.
- [3] Stockes E., Akram S., Zarządzanie przedsięwzięciem budowlanym, Warszawa, Wydawnictwo Poltext, 2010, 15.
- [4] Kasprowicz T., Proces analizy koncepcyjnej, projektowania, organizacji i realizacji przedsięwzięć budowlanych. Czasopismo Techniczne/Technical Transactions, Kraków, Wydawnictwo Politechniki Krakowskiej, 2010, 177-189.
- [5] Zaczyński W., Proces kształcenia, w: Encyklopedia Pedagogiczna, Warszawa, wyd. Pomykało, 1993, 626.
- [6] Bereziński F., Podstawy dydaktyki, Kraków, wyd. Oficyna Wydawnicza Impuls, 2007, 243-309.
- [7] Ustawa z dnia 11 lipca 2014 r. o zmianie ustawy – Prawo o szkolnictwie wyższym oraz niektórych innych ustaw.
- [8] Projekt MNiSzW „Krajowe ramy kwalifikacji w szkolnictwie wyższym jako narzędzie poprawy jakości kształcenia”, Priorytet IV PO KL, Działanie 4.1. Poddziałanie 4.1.3., Warszawa, wyd. Oficyna Drukarska J. Chmielewski, 2010.
- [9] Spałek S., Nauczanie przez projekty, jako metoda kształcenia menedżerów XXI wieku zgodnie z zapotrzebowaniem przedsiębiorstw. Zarządzanie i Edukacja nr 79/2011, 6.
- [10] Europejska ścieżka kształcenia nr PL/05/Exd/174344, DEULA Berlin – Brandenburg; dyplom uczestnictwa Europass-Mobilność nr PL/2006/170/11/DE/10.
- [11] Europejska ścieżka kształcenia, dyplom uczestnictwa Europass nr EM/00026/2, VIA University College Horsens Denmark.