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PROJECT-BASED LEARNING FOR ENGINEER'S CREATIVITY FOSTERING

Abstract. Engineering schools all over the world are facing a number of key issues these days. Fostering student's creativity is one of the most pressing as creativity is among highly desirable skills of nowadays. Since project-based learning is rightly considered to be one of the leading methods in engineering education it was applied for the current research. Projects are not an innovative approach at Ukrainian high school. Though, the fact that it had lost its efficiency became a reason for searching after new ways. Application of Engineering Design Process revealed a whole number of improvements. High level of student's motivation and engagement as well as an independent cognitive activity and tangible creative results, which could be included in student's portfolios, comprised the strong sides. The weakness of the method is the lack of knowledge and confidence among engineering teachers who have difficulties both with proper application and evaluation practices. So the further study might be devoted to the development of the easily transferable project-based models as well as mechanisms of funding and supporting such activities at Ukrainian engineering schools.

Keywords: engineering education; engineer's creative potential; project-based learning.

1. INTRODUCTION

The world tendency in engineering education (actually it is true for the education in a whole) is towards the training creative and independent experts able to manage and effectively solve the problems facing society. Another vital feature of today's education is a huge amount of accessible information which is constantly increasing. Such conditions require engineering teachers to search for more effective ways as well as rebuild the old ones to provide competitive educational services.

The problem statement. It has been observed that project-based learning (PjBL) is an effective mechanism for students to develop their engineering skills. There is enough evidence in favour of PjBL in [1] - [4].

Analysis of recent studies and publications. For the purpose of the current research the definition by Prince and Felder [3] has been applied. The authors emphasize that the core element of the project-based learning method is an assignment which carries out one or more tasks [2], [3]. The main activity is creating of a final product in a form of 'a design, a model, a device or a computer simulation'. The relationships between PjBL and other inductive instructional methods such as problem-based learning or enquiry-led learning have been explained in [4]. The methods provide a starting point for student's activity: a problem, a question or questions, or a scenario which are realized in a project with its obligatory final product. The whole process of the project work is targeted at encouraging of student's creative potential through their curiosity, cognitive activity, divergent thinking and inventing.

Projects are widely used at Ukrainian high school and not an innovative approach. Though, significant industrial, economical changes as well as changes in society require new more effective ways to provide successful application of engineering PjBL.

The article's goal. The current research was aimed to analyse and predict how a project work, which was organised according to the Engineering Design Process concept, could increase the efficiency of PjBL method and influence on development of the engineering student's creative potential.

2. THE RESULTS AND DISCUSSION

It was observed that PjBL is currently a diverse experience both in the disciplines which employ the method and the ways it has been used in the classroom. In spite of the diversity in approaches and ways, different experiences show that PjBL is acceptable at all stages of engineering education as individual and group projects. The themes used in PjBL practice are also broad. R. Graham presents some effective and potentially transferable approaches to PjBL in her report [2]: entrepreneurship and product design, video production and showcasing, robot competitions, energy-efficient high-speed vehicles etc. There are a lot of positive reviews of PjBL applied in the curricula worldwide. Although, faculties have lots of questions and unsolved problems with the specific of PjBL for different disciplines and courses as well as with the assessment and evaluation (particularly for group projects).

As a definite problem or a question is the core of the method it is reasonable to teach the students to identify and analyse the problem which is going to be solved. That is why the Engineering Design Process which engineers utilize to find design solutions have been studied in the aspect of PjBL. The Engineering Design Process includes the following stages: *defining the problem, researching, creating different options, modeling, solution or design producing, testing and improving.* Every step requires its own special tools and methods. Learning existing tools and methods or searching for new ones fosters student's creativity and expertise providing necessary engineering skills.

The approach encourages students to start the design process after identifying a need and / or benefits of the solution. So the first skill is problem definition. It requires the engineering student to learn how to cooperate and communicate with the customer asking as many questions as possible to reveal customer's specific 'needs' and 'wants' which then make up requirements and criteria for the solution. Further researching teaches students to analyse existing solutions as well as realise the problem in details to make sure that the goals are understood correctly. Inventing possible solutions is highly creative process. Its main purpose is teaching the engineers to generate ideas. At this stage students learn and practice brainstorming techniques: SCAMPER, SWOT Analysis, Mind Map, Random Stimulus [4], etc. Then special tools for making an informed decision are introduced in the classroom. Modeling is usually made by means of mathematical or computational models. If it is possible the solution (design) is produced, tested and improved to meet the design requirements and criteria. Actually, the Engineering Design Process supplies students with necessary experience and tools leading their activity from the problem to the final product, improving their motivation, engaging into the creative process and giving the right feeling that the designing is flexible, non-linear and iterative.

3. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

To sum up, it is necessary to highlight that the Engineering Design Process applied as a basic outline in the PjBL could provide to a set of specific engineering skills necessary for

innovative nonconventional solutions. After practicing PjBL organised by means of the Engineering Design Process, students could obtain skills of problem definition, brainstorming and informed decision making, modeling and realising the solution. So the further study could confirm the efficiency of the project-based learning models. The supporting mechanisms (including funding) also need to be investigated to provide a foothold for the PjBL relaunching at Ukrainian universities.

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