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DESIGN BY ANALOGY IN ENGINEERING EDUCATION: A METHOD TO IMPROVE CREATIVE IDEAS

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Abstract

Design by analogy refers to the methodology used in creative studies for identifying new ideas, which are in the so-called distant domain of the exploration field. This method is a fundamental part of the ideation process, which try to find analogies as a source for new and innovative designs. Thus, this methodology is an alternative to other more common and well-known approaches, such as brainstorming, logical charts, etc. These traditional approaches to creativity make the designer to look inward for inspiration. This fact makes important the innate capabilities of the designer (or student). However, design by analogy makes the designer to look outside for the search of new and original ideas. The selection of the source is an important step in searching for creative ideas and this work presents the resulting methodology for the implementation. It is based on the so-called Word-tree method. Furthermore, design by analogy is not considered a standalone method. Indeed, this approach can be used together with brainstorming or other classical methods. The combination of different techniques improves the effectiveness of the method.

The main goal of this paper is to use this method in engineering education. Problem based learning (PBL) is the methodology used in class to propose design challenges to the students. The students have to find original ideas in a creative process controlled by the instructors. However, to be successful in this task, students must be trained with the basic principles of the method. Thus, the instructors have designed a procedure including different steps. Students have to work in class, at home and in groups. Consequently, students' teams generate ideas and they are recorded using a schematic tree of words. In this way, students identify more analogies than with other methods. The process includes both, convergent thinking and divergent thinking. At the end of the process, unexpected solutions are identified and compared with other solutions obtained with other methods.

Keywords: Analogy, problem based learning, innovation, idea generation, creative problem.

1 INTRODUCTION

In the last decades, education curricula in engineering degrees have tried to make room for fostering creativity and innovation [1,2,3]. Strong emphasis has been placed on these issues related with the improvement of the students' skills, to makes the graduates more competitive in the labour market. These works have been focused on research for defining creativity in engineering and searched for the main characteristics that this field must fulfil. The concept creativity can be applied at least to five elements taking part in an engineering problem: idea, product, process, person and the environment where the process take place. Idea and product could be considered similar concepts because in engineering the creative ideas lead to creative products. Process refers to the ideation methodology, the cognitive process that leads to new designs. When the term creativity refers to a person, we means not only the innate features of that person, but also the experience and learning to be more creative. Environmental factors are very important part of creativity that sometimes is forgotten by engineers. Indeed, the room used for discussions and generation of ideas should meet some conditions to foster creativity with success [4]. In this paper, we focused on the process to generate creative ideas and products. The methodologies used to this aim are called ideation methods. Many ideation methods can be found in the literature [4,5]. Starting from the well-known Brainstorming (and its many variations) to the more sophisticated approaches, such as SCAMPER technique (Substitute, Combine, Adapt, Modify, Put, Eliminate and Reverse), or TRIZ method which help to find contradiction in new designs [6,7].

Due to the great variety of ideation techniques, educators may be uncertain when selecting a method to be used in their classes. In many cases only Brainstorming is selected because is a simple method, successful and well documented in the literature [8,9,10]. However, other ideation methods exists and are simple, successful and allow exploring new solutions. Furthermore, many studies [11,12] have reported that they increase confidence in users and lead to the generation of valuable ideas.

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