INTED 2019

13th International Technology, Education and Development Conference

11-13 March, 2019
Valencia (Spain)

CONFERENCE PROCEEDINGS

Exploring New Frontiers in Education

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AVOIDING DESIGN FIXATION TO IMPROVE THE STUDENTS' CREATIVE CAPABILITIES

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Abstract

Undoubtedly, design is an important part of engineering degrees. In our universities, design pedagogy involves terms such as creativity, innovation and assessment. Educators involved in design engineering courses should emphasize these concepts among the students. Therefore, fostering creativity in engineering education is a fundamental task to improve the capabilities of the students to confront with new designs. Problem Based Learning (PBL) is a well-known methodology that meets the necessary requirements to achieve this goal. In this kind of activities, the instructor proposes a design challenge to the students in order to improve the features of a product that already exists in the market. The students have to analyse the product and study the different alternatives provided by different companies. Thus, it is common to conduct a search of these products to learn about the capabilities, advantages and drawbacks. However, it is clear that reviewing information about other products can affect the design creativity. Indeed, it has been demonstrated that people exposed to an example solution generate fewer ideas than those who were not. This effect is called *Design Fixation* because the person tries to find a solution close to the solution that they know. In other words, the creativity is constrained by the example or examples they have seen before. However, the study of examples is essential to know existing solutions and it could improve the generation of innovative ideas. This paper examines whether reviewing information about the product is negative because it can affect the design creativity. To this aim, students were divided into groups to carry out the design of a product proposed by the instructors. As part of the work, each group develops a portfolio containing the steps taken in the creativity process. This portfolio contains the number of sources consulted. The relationship between the number of sources and the quality of the solution achieved is presented and discussed in the paper. Based on this information actions to avoid *Design Fixation* are proposed.

Keywords: Design Fixation, creativity, idea generation, innovation.

1 INTRODUCTION

During the last decades applications in computers and Artificial Intelligence (AI) has become more and more important in engineering design. In fact, AI has replaced in many cases human work, especially in systematic, repetitive tasks and tedious work. Although the transformation of the world in this domain is clear, creativity is still a human work. In fact, the development of new products requires creative work performed by engineers and technicians. Creativity continues having great importance in design and is a crucial task in generating new, original and innovative products. The importance of creativity has made that universities include this kind of competence in their syllabus. This is done in response to the demand of professionals with skills on recognizing, understanding and applying creativity and critical thinking. However, currently there is no unanimity on how creativity should be implemented in education, and this problem is especially important in engineering studies [1].

Engineers are accustomed to use methods and process to achieve their objectives. Therefore, it would be no difficult for them to be adapted to the methods used in creativity. Indeed, engineering is a profession where scientific principles and methods are applied to obtain useful products and systems. Several methods have been described in the literature about how to implement creativity in the industry [2,3]. However, little has been done about their implementation in education [4]. As a result, learning about how to be more creative is today a challenge in our universities. One of the main issues is the implementation of ideation methods. Ideation methods are the methodologies that help to enhance the capabilities of people to be more creative [5-7]. The effectiveness of ideation methods is measured by using four concepts [1]. They are 1) Fluency, which is defined as the number of ideas generated in the creative process. 2) Flexibility, that is the capability of using different points of view in the generation of ideas, 3) Originality, referring to provide unusual or novel ideas and 4) Elaboration, which is the ability

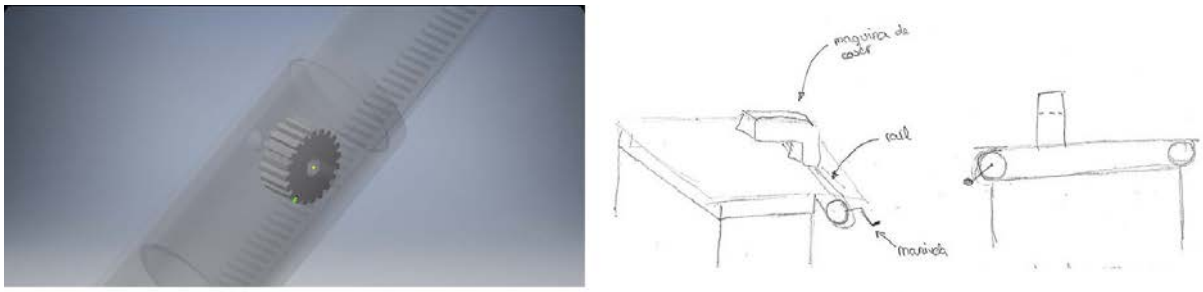

Figure 2. Example of two of the sketches presented by the teams.

4 CONCLUSIONS

This paper deals with the *Design Fixation* problem in engineering education. The paper shows an example where the main goal is to foster creativity in educational activities. However, *Design Fixation* can reduce the efficiency and effectiveness of the work carried out by students. In fact, when students know other solutions to their problem the capacity for generating new ideas could be reduced. In order to study the influence of such effect the experiment described in this paper divided the groups of students in two Sections. One of them worked without previous information and the other section worked with all information that they could collect.

In our study, the number of ideas generated by the students without information is greater than those generated with information. This fact is in accordance with those expected results in *Design Fixation*. Indeed, when the students know more solutions their generation of ideas is limited by the fear to copy those solutions. This trend is also shown in the originality of the ideas. In this case, Section 1 generates more original ideas because they are not conditioned by previous knowledge. Nevertheless, Section 2 tends to generate ideas related with the solutions they know.

In the case of flexibility, there are not clear conclusions in this work. The results are similar in both Sections. Further investigation is necessary to obtain valuable information. Elaboration is also similar in both cases. However, this could be considered successful since it should not be influenced by the *Design Fixation*.

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REFERENCES

[1] Z. Liu, D.J. Schonwetter, “Teaching creativity in engineering,” vol. 20, no. 5, pp. 801-808, 2004.

[2] S.P. Besemer “Creative product analysis matrix: testing the model structure and a comparison among products. Three novel chairs,” Creativity Research Journal, vol. 11, no. 4, pp. 333-346, 1998.

[3] E.U. Haner, “Spaces for creativity and innovation in two established organizations,” Creativity and Innovation Management, vol. 14, pp. 288-298, 2005.

[4] N. Genco, K. Hölita-Otto, and C. C. Seepersad, “An experimental investigation of the innovation capabilities of undergraduate engineering students,” Journal of Engineering Education, vol. 1, pp. 60-81, 2012.

[5] A. F. Osborn, “Applied imagination: principles and procedures of creativity problem solving,” Charles Scribner’s Sons, New York, 1963.

[6] B. Rohrbach, “Creativity by rules – Method 635, a new technique for solving problems,” Absatzwirtschft, vol. 12, 53-73, 1969.

[7] P. Ngo, C. J. Turner, J. S. Linsey, “Identifying trends in analogy usage for innovation: a cross-sectional product study,” Journal of Mechanical Design, vol. 136, pp. 111109-1-13, 2014.

[8] S.M. Smith, The nature of insight, The MIT Press, 1995.

[9] D.G. Jansson, S.M. Smith, “Design fixation,” Design Studies, vol. 12, no. 1, pp. 3-11, 1991.

[10] A.T. Purcell, J.S. Gero, “Design and other types of fixation,” Design Studies, vol. 17, no. 4, pp.363-383, 1996.

[11] A. Hutchuel, P. LeMasson, B.Weil, “Teaching innovative design reasoning: how concept-knowledge theory can help overcome fixation effects,” Artificial Intelligence for Engineering Design, Analysis and Manufacturing, vol. 25, no. 1, pp. 77-92, 2009.

[12] R.J. Youmans, “The effects of physical prototyping and group work on the reduction of design fixation,” Design Studies, vol. 32, pp. 115-138, 2011.

[13] E.S. Abdelall, M.C. Frank, R.T. Stone, “Design for manufacturability based feedback to mitigate design fixation,” Journal of Mechanical Design, vol. 140, pp. 091701-1-9, 2018.

[14] R.J. Youmans, T. Arciszewski, “Design fixation: classifications and modern methods of prevention,” Artificial Inteligence for Engineers Design, Analysis and Manufacturing, vol. 28, no. 2, pp. 129-137, 2014.

[15] E.S.Abdelall, M.C. Frank, R.T. Stone, “A study of design fixation related to additive manufacturing,” Journal of Mechanical Design, vol. 140, pp. 041702-1-10, 2018.

[16] O. Atilola, M. Tomko, J.S. Linsey, “The effects of representation on idea generation and design fixation: a study comparing sketches and function trees,” Design Studies, vol. 42, pp. 110-136, 2016.

[17] C. Cardoso, P. Badke-Schaub, O. Eris, “Inflection moments in design discourse: How questions drive problem framing during idea generation,” Design Studies, vol. 46, pp. 59-78, 2016.

[18] H.H. Choi, M.J. Kim, “Using the digital context to overcomen design fixation: a strategy to expand students’ design thinking,” International Journal of Architectural Research, vol. 12, no. 1, pp. 228-240, 2018.

[19] N. Crilly, “Fixation and creativity in concept development: the attitudes and practices of expert designers,” Design Studies, vol. 38, pp. 54-31, 2015.

[20] N. Crilly, C. Cardoso, “Where next for research on fixation, inspiration and creativity in design?,” Design Studies, vol. 50, pp. 1-38, 2017.

[21] E.C.Y. Koh, M.P. De Lessio, “Fixation and distraction in creative design: the repercussions of reviewing patent documents to avoid infringement,” Research in Engineering Design, vol. 29, pp. 351-366, 2018.

[22] T. McCaffrey, “Innovation relies on the obscure: A key to overcome the classic problem of functional fixedness,” Psychological Science, vol. 23, no. 3, pp. 215-218, 2012.

[23] M.A. Neroni, L.A. Vasconcelos, N. Crilly, “Computer-based “mental set” task: an alternative approach to studying design fixation,” Journal of Mechanical Design, vol. 139, pp. 071102-1-10, 2017.

[24] C. So, J. Joo, “Does Persona Improve creativity?” The Design Journal, vol. 20, no. 4, pp. 459-475, 2017.

[25] I. Tseng, J. Moss, K. Kotovsky, “The role of timing and analogical similarity in the stimulation of idea generation in design,” Design Studies, vol. 29, pp. 203-221, 2008.

[26] L.A. Vasconcelos, N. Crilly, “Inspiration and fixation: questions, methods, findings, and challenges,” Design Studies, vol. 42, pp. 1-32, 2016.

[27] L.A. Vasconcelos, M.A. Neroni, C. Cardoso, N. Crilly, “Idea representation and elaboration in design inspiration and fixation experiences,” International Journal of Design Creativity and Innovation, vol. 6, no. 1, pp. 93-11, 2018.