TOWARDS AN E-LEARNING PLATFORM FOR TEACHING CREATIVITY IN ENGINEERING

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Abstract: Though the development of creativity is claimed to be an imperative objective of modern education, there are surprisingly few educational initiatives specifically aimed to foster creativity of students. Only a small fraction of the universities listed in Top500 Academic Ranking of World Universities offer regular courses on creativity. And despite the billions of Euros invested by the European Union in lifelong learning programes, we identified only two projects on this topic, which received financing before 2013. This paper is a brief presentation of the Leonardo da Vinci project TECRINO – “Teaching Creativity in Engineering”, scheduled to start in January, 2014. This project will attempt to make decisive steps ahead the state of the art in the field of education for creativity, by developing comprehensive and innovative courseware intended both for students and tutors, and making this educational content freely available in seven EU languages, by means of a dedicated e-learning platform.

Keywords: Creativity, Innovation, Education, e-Learning, TRIZ, Open Education

1. MAIN CHALLENGES OF THE EDUCATION FOR CREATIVITY

“We live in a knowledge economy, a knowledge society. Knowledge economies are stimulated and driven by creativity and ingenuity. Knowledge society schools have to create these qualities, otherwise their people and their nations will be left behind.” (Hargreaves, 2003)

In this society, the key resource for progress is no longer capital or labor – is innovation. (Drucker, 1993).

Under these circumstances, it seems that the school holds the burden of creating “knowledge workers” (Drucker, 1993), capable of systematic innovation. But, is the school capable to fulfill this task?

Not really, if we agree with Aljughaiman et. al. (2005), who conclude their study by stating that: “teachers feel ill-prepared to foster creativity when they do not know how to define creativity, recognize creativity, appreciate creative behaviors, or are overburdened with the demands of teaching content-driven curricula toward high stakes testing.”

However, the cited study of Aljughaiman et. al (2005) is only based on interviews with teachers in primary schools in the United States of America. Cachia et. al (2009) interviewed more than 7000 teachers from 27 European countries in a much more comprehensive study. They also conclude that “there
is a discrepancy between how teachers perceive creativity and the way they claim to foster creativity during their teaching”, and note that “in many countries, education policies and objectives mention the need for creative learning, but do not provide an encompassing working definition of creativity or instructive guidelines on how it should be promoted at school.”

This lack of a widely accepted definition of creativity is one of the major challenges of modern education. As a consequence, many teachers are still unsure whether creativity is an inborn gift, or a skill that can be taught.

Other challenges are (see Cachia et. al., 2009; Aljughaiman et. al., 2005):

- The lack of a clear model of the mental processes involved in creativity.
- A certain confusion of values: teachers frequently perceive some behaviors or personality traits specific to creative students (e.g. stubbornness, hyperactivity, argumentiveness, and independence) as “misbehaviors”.
- Teachers are not trained to foster creativity of students: though most of them claim they encourage students to be creative, they simply don’t know how to do this.
- The lack of quality educational content for teaching creativity. Teachers and students are equally in need of such materials.
- The lack of simple and easy to use instruments for the assessment of creativity.
- The lack of IT&C tools to support teaching for creativity.

Considering the above listed challenges, there are surprisingly few educational initiatives specifically aimed to foster creativity of students. Only a small fraction of the universities listed in Top500 Academic Ranking of World Universities offer regular courses on creativity. (Xu et. al., 2005). And despite the billions of Euros invested by the European Union in lifelong learning programs, we identified only two projects on this topic, which received financing before 2013, namely the TETRIS project (Teaching TRIZ at school, http://www.tetris-project.org/), and “Teaching Innovation” (www.teachinginnovation.eu).

In this context, we have initiated the project TECRINO – Teaching Creativity in Engineering, which received funding under the Leonardo da Vinci lifelong learning programme, starting with January 2014.

This paper is a brief presentation of how TECRINO will address the main challenges of the education for creativity.

Beyond this introduction, the paper is structured as follows:

- Section 2 contains a brief review of the state of the art in the field of the study of creativity for educational purposes;
- Section 3 presents the objectives and the expected results of the project TECRINO;
- Section 4 is reserved for conclusions.

2. BRIEF REVIEW OF THE STATE OF THE ART IN THE STUDY OF CREATIVITY FROM A DIDACTIC PERSPECTIVE

2.1. In Search of a Definition and a Model of Creativity

It is not the scope of this paper to attempt to clarify all the aspects concerning the definition of creativity. As demonstrated in the comprehensive analysis of this topic offered by Parkhurst (1999), and Warr & O’Neill (2005), providing a definition of creativity is not an easy task.. We will only note here that the early definitions of creativity are “unidimensional”, considering only the individual, psychological aspects thereof. An example is the Webster definition (cited by Robinson, 2010), according to which the creativity is “the ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc.”

From this psychological perspective, “the personality factor most associated with creativity is openness to experience. The factor is split into several underlying facets: openness to fantasy (having a good imagination), aesthetics (being artistic), feelings (being emotional and excitable), actions (trying new things and having many interests), ideas (being curious, smart, and liking challenges), and values (being unconventional and liberal)” (Kaufmann et al, 2008).

Torrance (1966) provided a classic definition, which treats creativity as: “a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.” (see also figure 1).
More recent approaches notice that creativity has also a social dimension (see Fischer et al, 2005), and a complete definition should be multi-dimensional, illustrating various facets, and considering multiple levels of perspective (see figure 2).

Fig.1. Creative problem solving pathway, following the Torrance definition of creativity

![Creative problem solving pathway](image)

Fig.2. A multi-dimensional perspective on the definition of creativity

![Multi-dimensional perspective](image)

In what concerns the models of creativity, we have selected for this presentation the “Generate and Test Model of Creative Design” (Liu, 2000) for its potential applications in computational creativity systems. (see Saunders and Gero, 2006). As shown in figure 3, in this model the creative solutions are generated in an iterative process, wherein intermediary results are tested against the domain knowledge.

Fig.3. Liu’s personal generate-and-test model of creative design (apud Saunders and Gero, 2006)

2.2. Can Creativity Be Taught?

The lack of consensus of the researchers with respect to the question “what is creativity” is even more manifest when asking the teachers to choose a definition. Figure 1 reproduces the results reported by Cachia et al. (2009) regarding teacher’s opinions on the definition of creativity.

![Teacher’s opinions on the definition of creativity](image)

Nevertheless, despite the diversity of opinions concerning the definition of creativity, teachers seem to agree that creativity can be taught (see fig. 2), and that it is a fundamental skill to be developed in school (see fig. 3).

The idea that creativity can be taught is not new. Back in 1965, Bruner argued that children should be encouraged to “treat a task as a problem for which one invents an answer, rather than finding one out there in a book or on the blackboard” (Bruner 1965).

![Teacher’s opinions about the statement “Creativity can be taught”](image)

The cited work of Bruner (1965) and many others (see for example Diamond et al. 2007) are focused on pre-school children education. An extended study on this topic is provided by Scott et al (2004), who conclude: “Thus, creativity training appears beneficial for a variety of people, not just elementary school students or the unusually gifted. Taken as a whole, these observations lead to a relatively unambiguous conclusion. Creativity training works”.

The same work (Scott et al, 2004) also offers a precious hint on how exactly creativity training
Because creativity training is often rather short it seems unlikely that training is serving to develop expertise. Instead, what appears more likely is that training provides a set of heuristics, or strategies, for working with already available knowledge.

Other researchers identified a variety of other factors that directly affect creativity of students. Among these, we count:

- Moods and emotions (Newton, 2012; Van Kleef et al, 2010);
- Pattern recognition and “visual thinking” (Hong, 2013);
- Some neurologic conditions, like a certain imbalance between the activity of the cerebral hemispheres (Ghacibeh and Heilman, 2013);
- Organizational and institutional influences (Heinze et al, 2009);
- Teamwork (Hoegl & Parboteeah, 2007);
- Some cultural factors (Rudowicz, 2003);
- The ability to use certain heuristics, e.g. TRIZ (Altshuller, 1996; Altshuller, 1997);

And, last but not least, an essential factor that could dramatically impact the future of teaching for creativity is the use of ICT in education (Ala-Mutka et al, 2008; Loveless, 2002; Jahnke, 201; Roschelle et al, 2000; Thompson & Randall, 2001).

Davies et al (2012) formulate a couple of important conclusions:

- It is important to raise teacher’s awareness on the importance of a positive and flexible (less prescriptive) learning environment.
- Involve teachers in CPD (Continuous Professional Development) courses in order to elicit their preconceptions and misconceptions about creativity.

Ala-Mutka et al (2008) extend the responsibility from teachers to policymakers, researchers, and other practitioners, who “should engage in developing a common vision of future learning for innovation, as a tool to guide their joint effort”.

2.4. Can Creativity Be Assessed?

A comprehensive analysis of all the aspects and instruments related to the problem of assessment of creativity is available in Treffinger et al (2002).

This work identifies the following types of creativity assessment instruments:

- Assessment of creativity based on behavior or performance data (e.g. portfolios, evidence of awards in contests or competitions, ratings issued by judges or critics);
- Assessment of creativity based on self-report data (e.g. biography or interest inventories);
- Assessment of creativity based on rating scales (ratings issued by external sources teacher, parent, peer, or community member);
- Assessment of creativity based on tests (specific tests designed to evaluate the student’s ability to produce many, varied, original, or elaborated responses. A typical example is the Torrance test of creative thinking TTCT – see Torrance, 1968, and Torrance, 1974)

From these instruments, only the rating scales and creativity tests can be easily integrated into an e-learning platform for teaching creativity.

Simple tests like those presented in Carter (2008) may be the most convenient way to
assess the progress of students while learning creativity (see also figure 7), but the effectiveness of these tests is yet to be determined (see Kim, 2006).

![Diagram](image.png)

Fig. 7. Simple test items for the assessment of creativity (apud Carter, 2008)

3. AN OVERVIEW OF A LEONARDO DA VINCI PROJECT DEDICATED TO TEACHING CREATIVITY

Despite the promising results reported in the existing projects related to teaching creativity, the mass education in VET schools and Universities seems very slow in adopting systematic courses of innovation. Some of the causes of this situation have been outlined in the previous section of this presentation (e.g. the persistent belief that creativity is a “gift” reserved to very few people, the lack of quality didactic content, and the lack of easy to use assessment tools for creativity applicable in the education environment).

In this context, the project 538710-LLP-1-2013-1-CY-LEONARDO-LMP – “Teaching Creativity in Engineering” – (Acronym TECRINO), proposed by a consortium comprising 8 research and VET entities from 6 EU countries has been accepted for financing, and will start the activities in January, 2014.

3.1. The Consortium that Initiated the Project

The project is coordinated by RTD TALOS from Cyprus, a SME specialized in management of EU projects.

The research activities and the development of the educational content will be assigned to the University partners (University of Zagreb, Croatia, and University “Dunarea de Jos” of Galati, Romania).

The Quality Assurance Plan will be the responsibility of Syntea S.A., from Poland, which will also handle the issue of Vocational Competence Certificates according to the European Qualification Framework.

The problems related to the actual implementation of the e-learning platform will be the responsibility of Fondo Formación Euskadi, and Inercia Digital from Spain.

Two other partners BICRO from Croatia, and Epralima from Portugal will handle the aspects related to the dissemination of the results and to the intellectual property issues (e.g. producing educational content related to writing patent applications).

Each and all partners also assume the translation of the didactic materials in their own language, so that at the end of the project all the educational content will be freely available in seven EU languages (English, Greek, Croatian, Spanish, Romanian, Polish, and Portuguese).

3.2. The Objectives of The Tecrino Project

Being well aware of the challenges and difficulties involved in the development of new educational content for teaching creativity, the promoters of this project formulated the following objectives for the project:

- Create comprehensive educational content, dedicated to teaching creativity, and make it freely available in seven European languages;
- Approach the problem of the education for creativity from both the perspective of teachers and students, with a special emphasis on the education of trainers;
- Adopt a multi-dimensional approach on the explanation of the mental processes, and social communication mechanisms that foster creativity;
- Create an open access elearning platform for delivering the educational content;
- Adapt existing tools for the assessment of creativity to an elearning environment;
- Include in the courseware a section dedicated to the management of the results of innovation, and legal information about intellectual property.

4. CONCLUSION

This paper reviewed the vast literature related to creativity from the pragmatic perspective of a team of experts in education and ICT enhanced learning, with the objective to identify the difficulties and the possible solutions for developing an open access elearning platform for teaching creativity.

Unlike the vast majority of other projects dedicated to lifelong education, the TECRINO project attempts not just to develop new skills and competences in the audience, but to produce a major change in the way we think about teaching creativity.
It has been said that the encounter with a Teacher is an opportunity to learn something, while the encounter with a Master is an opportunity to change yourself. From this metaphoric perspective, TECRINO is a Master project.

5. REFERENCES


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