Preface

A key question in higher education field is how to foster students’ creative problem solving skills. It is due to the growing challenges in working practice where requires people to manage many complex and uncertain problems. Creativity is also required in the process of problem solving in diverse contexts such as applying the new scientific knowledge and using the new communication technologies. This encourages higher education to implement new teaching methods and educational technologies that are directed towards not only producing highly knowledgeable individuals but also stressing creative problem solving skills. These new methods and technologies have been explored in different disciplines in higher education including Engineering, Science, Business, Art, and Medicine, etc. So organizational changes are undergoing in institutions in higher education towards developing the problem-oriented curriculum and the creativity-integrated pedagogies. This brings challenges those are from aspects such as curriculum design, teaching and learning process, education technology, and assessment, etc. This calls for a systematic research on building relations between creativity, creative problem solving skills, and higher education research in order to meet the current knowledge gaps.

This handbook aims to address and discuss the context of higher education, the significance, difficulties and strategies in developing students’ creative problem-solving skills. The editor collected 24 chapters that present both new theories and experiences from diverse perspectives and cultures and by different research methods. Accordingly, the handbook contributes to provide an international platform to bring together academics, researchers, lectures, decision makers, and practitioners to share knowledge discussed and rethink how to develop students’ creative problem solving skills in the future.

Chapter 1, “Fostering Creative Problem Solvers in Higher Education: A Response to Complexity of Societies,” tries to emphasize that the complexity of professional practice has been recognized as the root of challenges for higher education. To foster creative problem solvers is a key response of higher education in order to meet such challenges. This chapter aims to illustrate how to understand 1) complexity as the nature of professional practice, 2) creative problem solving as the core skill in professional practice, 3) creativity as interplay between persons and environment, 4) higher education as the context of fostering creative problem solvers, and 5) some innovative strategies such as Problem-Based Learning (PBL) and building learning environment by Information Communication Technology (ICT) as potential strategies of creativity development. Accordingly, this chapter contributes to bridge complexity of societies, creative problem solving skills, and higher education development in one theoretical framework.

Chapter 2, “Thinking Inside the Box: Educating Leaders to Manage Constraints”, highlights that despite the importance of constraints in creative efforts has been recognized, little research examines the role of constraints in the creative process, how leaders manage these constraints, and implications for educating leaders of creative efforts. The present chapter synthesizes the literature on constraints and
leadership of creative efforts to provide an initial framework of constraints and creativity. Furthermore, this chapter proposes an initial model of constraint management portraying the cognitive and practical processes leaders engage in when managing constraints. The complexity and dynamic nature of constraints, as highlighted by the model, emphasizes the need for educational efforts specifically addressing constraint management in creative endeavors. Therefore, this chapter provides practical suggestions for educating future leaders in constraint management.

Chapter 3, “Scientific Creativity in Psychology: A Cognitive-Conative Approach”, argues that the aspired outcome of the present research consists in the investigation of the cognitive and conative profile underlying scientific creativity in psychology. In this purpose, an innovative creativity test adapted to the considered population was developed, including both divergent and convergent thinking. Whereas the analysis focused on intelligence in the cognitive domain, it focused on personality in the conative domain. The sample of psychology students consisted of 121 participants. Results stayed in line with the established hypotheses. Intelligence played the major role for scientific creativity in psychology. Concerning personality, openness and negative agreeability additionally favored scientific creativity in psychology. In future research, the profile of scientific creativity could be set into comparison to the one of artistic creativity and everyday creativity.

Chapter 4, “A Creativity and Innovation Course for Engineers”, introduces the teaching methodologies and pedagogical styles adopted within the “Creativity and Innovation”, offered at the University of Bologna, Italy, in the academic year 2014/2015. This course is taught by the Marconi Institute for Creativity (MIC) to graduate students in Telecommunications Engineering, and its main goal was to give students both a theoretical foundation and a hands-on experience about meta-cognitive strategies for controlling the thinking process towards the generation of new ideas. The students were engaged in the selection of a focus area within the range promoted by the call, creating the playground for team-oriented sessions in which relevant information was collected, divergent modifiers were applied, ideas were generated, and finally business models were sketched and assessed, to then conclude the course with a final presentation in front of a jury of three experts. The students’ feedback was very positive in terms of opening their minds to an activity that has no single “correct” answer, but rather a multitude of possibilities to be explored. While the ideational part of the class followed a learning-by-doing approach, this was preceded by a specific theoretical part, striking an effective balance between theory and practice.

Chapter 5, “Teaching Creative Problem Solving in Engineering Education”, presents the principles of active learning and the contents of a creativity course entitled: Creativity and Problem Solving. The main purpose of this course was to create a space for discussing, reflecting and experimenting with creativity, creative processes and creative methods of relevance for university students working with problem-solving approaches. This course was developed at the Technical University of Denmark during the period 1998-2008 for engineering students of various specialities. It started with very few students and developed to a very popular course attracting many students from abroad. The selected themes, the methods and techniques, the structure of the course, the learning processes and the achieved results can be applied to a similar course for university students of other fields such as IT, Management Sciences, System Sciences, Computer Sciences, Design, Agriculture, Business, Art and Education, etc. Finally some reflections, recommendations, and conclusions are also presented.

Chapter 6, “Creativity Development through Inquiry-Based Learning in Biomedical Sciences”, suggests that the increasing complexity of biomedical research has led to new models for collaborative research at large scale. Big science projects require multidisciplinary teams and skills, such as creativity, to foster innovation. Higher education can play an important role in fostering creativity with active-
learning strategies, such as the Inquiry-Based Learning (IBL) approach. In this chapter, we explain how the Universitat Pompeu Fabra (UPF) in Barcelona, Spain, used IBL to bring medicine and human biology students together to find creative solutions to solve a challenging problem in biomedicine. In this interprofessional experience, students were taught creative techniques in a creativity workshop. The positive results, which were highlighted by external evaluators for their high quality, demonstrate the value of these collaborative projects in encouraging creativity. We propose that integrating the IBL pedagogical methodology with creative techniques and interprofessionalism is a valuable approach for fostering students’ creativity and generative and research skills.

Chapter 7, “Distributed Problem-Solving: How Artists’ Participatory Strategies Can Inspire Creativity in Higher Education”, aims to deconstruct some persistent myths about creativity: the myth of individualism and of the genius. By looking at literature that approaches creativity as a participatory and distributed phenomenon and by bringing empirical evidence from artists’ studios, the author presents a perspective that is relevant to higher education. The focus here is on how artists solve problems in distributed paths, and on the elements of creative collaboration. Creative problem solving will be looked at as an ongoing dialogue that artists engage with themselves, with others, with recipients and with materials, in asynchronous or synchronous relationships. The empirical background draws on qualitative narratives collected in 2011-2014 and based on interviews with recognized artists. The questions guiding the present chapter are: If creativity does not arise from talent but from exercise and hard work, what can educators at higher education learn from the ways creative groups solve problems? How can artists contribute to inspiring higher education?

Chapter 8, “Creative Life Experiences among Students in Medical Education”, focuses on creativity and creative life experience of medical students in a university in China, in order to find out strategies of improving the medical students’ creativity. The methods such as literature review, participation, intervention, and questionnaire survey are used jointly in this study. The students are divided into experimental group and control group. A two-month creative psychological intervention is carried out with the experimental group, and the results show that the level of creative life experience factors of the experimental group was significantly higher than that of control group after the intervention, which indicates that appropriate creative psychological intervention has certain effect on improving university students’ creative life experience.

Chapter 9, “International Center for Studies in Creativity: Curricular Overview and Impact of Instruction on the Creative Problem-Solving Attitudes of Graduate Students”, provides an overview of the programs offered by the International Center for Studies in Creativity (ICSC) at Buffalo State University of New York, where creativity is taught and studied extensively at the graduate and undergraduate level. Following the discussion on creativity as a 21st century skill and perennial need for creativity in the workforce, programs and courses are introduced along with the historical roots and philosophy of creativity at ICSC. The models of Creative Problem Solving and Thinking Skills Model, which represent the core of the curriculum, are described. The chapter also presents the results of the study regarding the impact of the graduate program on the creative problem solving attitudes of the graduate students based on qualitative and quantitative data.

Chapter 10, “Problem Solving at the Edge of Disciplines”, outlines a new perspective on disciplinary collaboration that draws inspiration from ecology that observes that the edges where ecosystems meet tend to have greater biodiversity than the ecosystems themselves. This thinking is applied to a typical University Faculty consisting of three Schools to show that the potential for collaboration across disciplinary boundaries is rich. The chapter proposes a new degree structure that embeds problem-solving
skills as core to the production of “pi-shaped” people, defined as those that have disciplinary depth in two areas and the ability to work outside of their core area of expertise. In this regard, problem solving is considered as an area where a student can achieve depth of knowledge. The degree is designed such that it produces an exchange of students across disciplinary boundaries and also structured so that it takes students on a journey through different models of disciplinary collaboration. The degree is seen as a key enabled of achieving so called “Mode 2” knowledge production.

Chapter 11, “Enhancing Students’ Critical Thinking through Portfolios: Portfolio Content and Process of Use”, discusses that portfolios can serve a crucial role in helping students’ develop their critical thinking in writing, thereby promoting write-to-learn philosophy in education. Still, not any portfolio’s content and approach can guarantee the achievement of this goal. Teachers’ concern in promoting students’ critical thinking needs to be reflected in their decision that is related to the evidences of students’ needs that helps to select their approaches of integrating and using them into class. Students’ reflection needs to underpin all stages of portfolio assessment through providing opportunities for their decision-making, initiation and creativity. Therefore, this chapter puts forward a student portfolio model along with its content and process of use. This learning tool was integrated within the course of Written Expression and used by 33 students at the Department of English at Abdelhamid Ibn Badis University during the academic year 2013-2014. Recommendations are also provided in order to make it a vehicle for critical thinking.

Chapter 12, “An Exploration on Darkness within Doctoral Education: Creative Learning Approaches of Doctoral Students”, describes doctoral education also takes place on informal and tacit levels, where doctoral students learn about the institutional regulations, the research field, academic craftsmanship, and research design by observing how their supervisors talk, act, and handle issues in the professional community. However, the formal-informal divide is not adequate if we want to understand the sprawling, mongrel, and diverse forms of student engagement, coping, and learning strategies within doctoral education today. By drawing on the empirical studies of cross-level institutional voices, as well as international studies into similar grey areas of student learning in doctoral education, this chapter argues that learning spaces of educational ‘darkness’ hold unrecognized potential for enhancing learning experiences, harnessing professional competences, and enriching the depth of research in the PhD life that implies significant contributions to future doctoral education development.

Chapter 13, “Integrating Creative Problem Solving Skills into Higher Education Classroom”, introduces that the Torrance Incubation Model (TIM) provides a simple and highly effective mechanism for integrating creativity into the teaching of any subject. The model provides guidelines for educators who wish to develop their students’ creative skills, but struggle to find the space in the curriculum in which to teach creativity as a subject. The TIM allows creativity to be woven into lesson plans by deliberately incorporating one, or more, of the core creativity skills identified by Torrance. This chapter explains the TIM, and provides examples of how it was used to redesign lessons in a higher education class, in order to teach both the subject, and at the same time develop the students’ creative capabilities.

Chapter 14, “Design Thinking for Creative Problem Solving in Higher Education: How Students become Dedicated Creative Problem Solvers”, regards design thinking as an educational approach to enhance creative problem-solving skills. It is a problem-based learning paradigm that builds on three pillars: A creative problem solving process, creative workspaces and collaboration in multi-perspective teams. This chapter discusses central elements of design thinking education and contrasts the approach to conventional education as well as other problem-based learning paradigms. In particular, design thinking classes harness a unique “look and feel” and “verve” to help students acquire and experience
creative mastery. Furthermore, the chapter overviews empirical studies on design thinking education. Four studies are described in more detail: Experiments on the three pillars of design thinking and one case study where a university class curriculum has been changed to a design thinking paradigm. Finally, the chapter provides resources for readers who want to learn more about design thinking education.

Chapter 15, “Students’ Learning Experiences in Project-Based Learning (PtBL): With Pain Comes Gain”, examines the perceptions of nineteen graduate students’ regarding the incorporation of project-based learning (PtBL) in a Student Affairs class. This chapter demonstrates that not all students in the class were prepared to assume the responsibility of PtBL learning and yearned for a “traditional” classroom environment where instructors provide structure and step-by-step instructions. However, through hard work and the support from the instructor, the students were successful in completing outstanding PtBL workshops. While students reported increased levels of stress and anxiety while creating their workshop, students also reported having high levels of pride and validation once they successfully conducted it. Students reported being taken outside of their comfort zones and reported high levels of personal growth once they successfully completed their workshops. The PtBL research supports the assertion, “with pain comes gain”.

Chapter 16, “Advocating Problem-Based Learning and Creative Problem Solving Skills in Global Education”, advocates the development of Problem-Based Learning (PBL) and creative problem-solving skills in global education, thus describes the theoretical and practical overviews of PBL and creative problem-solving skills, the significance of PBL in global education, and the significance of creative problem-solving skills in global education. The application of PBL and creative problem-solving skills are critical in the educational institutions that seeks to serve the educational administrators and students, increase educational performance, sustain competitiveness, and fulfill expected accomplishment in global education. Therefore, it is required for educational institutions to utilize PBL and creative problem-solving skills and develop a strategic plan about PBL and creative problem-solving skills towards satisfying the requirements of the educational administrators and students.

Chapter 17, “Instructional Design Technology in Higher Education System: Role and Impact on Developing Creative Learning Environments”, focus on how it is possible to facilitate better instructional experiences for the stakeholders in higher education. The chapter addresses the emergence of Instructional Design Technology (Chao, Saj & Hamilton, 2010). Its role and importance in higher educational institutions is analyzed with current practices in the field. The impact that this field had made in the evolution of instructional frameworks across the different layers of tertiary educational system is studied especially with regard to improving the teaching and learning experiences of educators and students respectively. The importance that institutions pay to instructional design is reviewed by a case study. Any technology needs to adapt to the requirements of the age. The role of adaptive Learning technologies’ is studied with emphasis on the success that these systems have enjoyed in improving instructional design. Universities are going to have business intelligent systems while going for instruction designing and deciding learning strategies.

Chapter 18, “Developing Creative Problem Solvers and Professional Identity by Information Technology Communication (ICT) in Higher Education”, regards creative problem solving as a professional identity skill that can be fostered by creative learning environments supported by Information and Communication Technology (ICT). A systematic literature review will be provided in order to build relationships between creative problem solving, creative learning environments, ICT, and professional identity in the context of higher education. The literature review will focus on the following research questions: How do ICTs support a creative learning environment in fostering creative problem solving
skills? How do ICTs relate to or affect the characteristics of professional identity in the context of higher education? And how do ICTs relate to or affect the formation of professional identity in the context of higher education? These three questions will help allow to organize the structure of this chapter that drive the authors to propose a change of perspective in the study of professional identity and ICT, from the theoretical standpoint of actor-network theory.

Chapter 19, “Reaching ‘Creating’ in Bloom’s Taxonomy: The Merging of Heutagogy and Technology in Online Learning”, emphasizes that Creativity of thought and critical thinking are two concepts that faculty struggle with teaching in higher education, particularly in the distance learning environment. Bloom’s taxonomy has been used to define taxonomic levels in learning since the 1950’s; “create” is one of its highest taxonomic levels. It can be difficult to create relevant, authentic assessments that require students to display both synthesis of meaning, as well creative synthesis of concepts learned to reach this “create” level in an effective manner. Transformative learning and especially heutagogy or “self-determined learning” can be used as theoretical curriculum models or frameworks to help students learn and solve problems. These two theories are particularly effective when leveraged with technology. Today’s instructional technologies allow students to more readily create and explore new concepts on their own to generate a more fulfilling education process with meaningful relevant practice and assessment.

Chapter 20, “Applying Blooms Digital Taxonomy to Address Creativity and Second Order Digital Divide in Internet Skills”, suggests that Internet technologies play a significant role to enhance creativity of the students in learning environments. Internet literacy is vital to effectively use the Internet tools to enhance creative learning environments. In the developing countries Internet literacy is still an unfulfilled dream for students coming from underprivileged backgrounds thus bringing a digital divide in skills. The chapter draws upon an empirical study done in India on how an intervention comprised of Internet training designed on Bloom’s Digital Taxonomy and action research workshops based on the learning domains of the digital taxonomy was an effective approach for empowering women students through learning to use the Internet. The chapter puts forward the argument that an intervention for learning to use the Internet can be effective where focus is on the reflective and conceptual skills in using the Internet than focusing too much on the content that is dynamic.

Chapter 21, “Creative Problem Framing in Higher Education”, re-examines conventional views of problems in the context of creativity those indicating can be “solved” creatively, and argue that such views are misleading notions, as problem-finding and problem-framing are more appropriate and relevant issues to be focused in the study, practice, and teaching of creativity. The chapter continues Section 2 with a review of key ideas from the literature. In Section 3, the formulation and reformulation of problems is analyzed by considering a collection of real cases where the authors have been directly involved. These cases illustrate a wide diversity of types of reformulation processes. A specific case is described at length, inspecting in detail the issues related to reframing creative problems. The chapter ends with a discussion of the pedagogical issues needed to support the development of Creative Problem Framing (CPF) in Higher Education.

Chapter 22, “On Relationships between Creative Learning, Creative Teaching, and Roles of Creative Teachers”, discusses the relationships between creative teaching, creative learning and the role played by creative teachers in the contexts of students’ creativity development. Firstly, this chapter analyzed the characteristics of creative teaching and creative learning. The history of the research on creative teaching and learning since the first half of 20th century was briefly introduced. Secondly, the authors discussed the nature of creative teaching, the features of creative teachers compared to non-creative teachers, the environment for the development of creative teachers and the measures that should be taken to promote
the growth of creative teachers. Accordingly, this chapter contributes to development of creativity in higher education both theoretically and practically in the future.

Chapter 23, “New Paradigm of Creativity: From Newtonian Mechanics to Quantum Mechanics and Higher Education Development”, provides an alternative perspective on creativity in order to accelerate a paradigm shift in creativity in higher education. The perspective would enable every single person to extract the full potential and to contribute to society. Due to the idea of science: reproducibility, the main goal of research has been finding an ultimate solution that would be applicable to every single person. This idea comes from Newtonian mechanics; or, in other words, cause and result relation, that a specific factor causes a specific outcome. The problem of this idea is that Newtonian mechanics is designed for such objects as an apple and a car. Obviously, human thought, the main source of creativity, is not an object. This fact suggests the necessity of alternative approach. The author proposes a different perspective to change a paradigm of creativity in higher education.

Chapter 24, “Going towards Adaption, Integration, and Co-Creation: A Conclusion of Developing Creative Problem Solving Skills in Higher Education”, serves as a conclusion chapter. It highlights that as a response to growing challenges brought by complexity in professional practice, the collection of chapters in this volume guides an intellectual journey through the various theoretical perspectives, research methods and pedagogical models with a focus of developing creative problem solving skills in higher education. Based on an overview of topics in this volume, this chapter aims to draw a conclusion of research directions in future exploration from present presentations. It could be an extended journey with an intention to help audience to locate the ideas presented in this volume within a framework constructed by three main themes of adaption, integration and co-creation. This lays a stepping-stone in paving the way of pedagogical development and research prospects.

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