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Additional Information

INNOVATION, CREATIVITY AND ENTREPRENEURSHIP LEARNING OUTCOMES IN HIGHER EDUCATION^[1].

L. Cuenca, P. Bonet, A. Boza, P. Fuentes, N. Lajara, J.A. Marin-Garcia, M. Peris-Ortiz,
L. Ruiz

Universitat Politècnica de València (SPAIN)

*llcuenca@omp.upv.es, pbonet@ice.upv.es, aboza@omp.upv.es, pfuentes@iqn.upv.es,
nalade@cegea.upv.es, jamarin@omp.upv.es, mperis@doe.upv.es, lruiz@omp.upv.es*

Abstract

A major trend in higher education is the current shift towards improving students' creativity and individual thinking. The aim of this shift is to bring students closer to the real world and the complex problems they will encounter outside formal education. Competencies describe what training participants should be able to do at the end of such training. This paper defines the learning outcomes associated with the innovation, creativity and entrepreneurship competency. This proposal draws on a review of the innovation and competencies literature and the expertise of selected staff. According to the literature review and the following analysis by the authors, the main indicators (key aspects) associated with the competency are as follows: seek opportunities, generate ideas, execute plans and add value. These indicators vary by educational level to reflect increasing complexity and difficulty in the learning outcomes at each stage of university education. This paper proposes learning outcomes and indicators associated with the competencies of innovation, creativity and entrepreneurship. It corresponds to the first essential step associated with the definition of a competency assessment.

1. Introduction

Many universities within the European Higher Education Area are redesigning their degree programmes to strike a balance between academic and professional skills in graduates' profiles. These new profiles require two sets of competencies: specific and transversal (or generic) competencies.

A competency is defined as 'the set of knowledge, skills and attitudes to be able to mobilize a person, in an integrated manner to respond effectively to the demands of a given context' [1]. Thus, in terms of education, a competency describes what training participants should be able to do at the end of their education at the university.

This complex know-how must be part of the design of new curricula based on specific and transversal competencies that students should develop:

- **Specific** competencies belong to a specific area of knowledge (in a bachelor's or master's degree), and they aim to foster a specific graduate profile.
- **Transversal** competencies (also called generic competencies or transferable competencies) are applicable to numerous personal, social, academic and professional contexts. Therefore, transversal competencies are a fundamental part of students' professional and educational profile in all academic disciplines. These competences cover cognitive and metacognitive skills and attitudinal and instrumental knowledge, thereby adding value to the knowledge society.

According to [2], incorporating these skills into university education curricula avoids a reductive simplification of university education opportunities. It is important to provide students with not only specific professional skills but also a well-rounded education.

1.1. Motivation and context

Specific competencies at the Universitat Politècnica de València (UPV) are taught, trained, acquired and certified through different subjects on the curricula. Transversal competencies, in contrast, are covered by different subjects but are not managed systematically across all disciplines. Moreover, transversal competencies are not assessed. Consequently, it is impossible to verify that the student has acquired the competency [3].

To respond to this challenge, the Universitat Politècnica de València launched the *Transversal UPV Competences* project. This Project is an initiative of the Vice-Rector for Research, Quality and Accreditation. The UPV 2020 strategic plan currently supports the project [4]. The project's main objective is to certify that graduate students in all UPV degrees bearing official titles acquire these competences. The reason is twofold:

- So that employers can assess students' education.
- So that international accreditations can recognize that students have acquired these skills.

Using regulations and guidelines (national and international) and extensive academic research, the UPV developed a list of 13 generic competencies [5] that any graduate should achieve during his or her studies, regardless of the subject. The UPV defined a working strategy to teach and assess each competency. The UPV created a work team for each competency. The task force consisted of teachers with experience in innovation projects related to the competency. A pedagogical consultant from the Institute of Education Science (Instituto de Ciencias de la Educación) coordinated each task force.

One of these work teams was responsible for the transversal competence *Innovation, creativity and entrepreneurship*. A key objective was to create an assessment tool to accredit this competency.

The objective of this paper is to define the learning outcomes and associated indicators for the competency *Innovation, creativity and entrepreneurship*. These learning outcomes and indicators have three levels: Level 1 for first and second year undergraduate students; Level 2 for third and fourth year undergraduate students; and Level 3 for master's (postgraduate) students.

The following sections of this paper present the research method, results and conclusions.

2. Method

A task force defined the transversal competencies and detailed the necessary tools to teach these competencies at the UPV. The process began with a meeting attended by UPV professors. All professors in attendance had strong backgrounds in innovation within higher education. The professors were involved in internal training workshops. Volunteer staff participated in the task forces. A multidisciplinary team of 13 staff managed the innovation, creativity and entrepreneurship task force. The team included lecturers from different faculties, staff from the IDEAS institute and a coordinator from the Institute of Education Science.

Measuring learning was crucial. A qualitative approach was used to develop the structure, content and pedagogy for a rubric to measure learning outcomes. The team drew on the results from literature reviews conducted in research projects and on the members' teaching innovation activities:

- Project for educational improvement (PIME/2013/A/016/B) RECICRE – Rubric for evaluating competence of innovation and Tempus IDEA: Inter Disciplinary Education Agenda
- FINCODA EU project
- Transversal UPV competences

In addition, the competence model and rubrics proposed by [6] served as a reference for discussions.

The team met for three hours once a month for four months:

- Meeting 1 (April). Definition and description of the complex competency (definitions from the literature and indicators).
- Meeting 2 (May). Definition of three proficiency levels through the formulation of learning outcomes.
- Meeting 3 (June). Definition of indicators for each learning outcome.
- Meeting 4 (July). Creation of a clear, understandable, innovative layout for the results of the task force.

A set of online tools (email, wiki documents, polls in google drive and shared documents for collaborative editing) enabled communication and progress during pre- and post-meeting periods.

3. Findings

3.1. Semantic analysis

The proposal was based on a review of the innovation literature. The main indicators associated with innovation are as follows: seek opportunities, generate ideas, execute and add value [6, 7, 8, 9, 10, 11, 12, 13, 14]. These indicators should vary according to the three education levels mentioned previously. As the levels increase, so should the complexity and difficulty of the indicators. Tables 1 and 2 summarize the results of the semantic analysis.

Table 1. Key definitions of innovation

Source	Schematic definition of innovation
Bapat [7]	Creativity, Entrepreneurship, Forecasting, Integration and Change Management
Morales [8]	Opportunity x Creativity x Execution = Added Value
Club of Excellence in Management (Club de la Excelencia en la Gestión) [15]	Environment X (Creativity X Risk Taking)
FINCODA [16]	Creativity X Entrepreneurship

Table 2. Innovation analogies

Bapat [7]	Morales [8]	Club of Excellence in Management (Club Excelencia en la Gestión) [15]	FINCODA [16]
Creativity	Creativity	Creativity	Creativity

Entrepreneurship	Execution	Risk Taking	Critical Thinking
Forecast	Opportunity	Environment	Impact
Integration	Execution	Risk Taking	Networking
Change Management	Added Value	Risk Taking	Leadership Teamwork

3.2. Visual thinking

Visual thinking is a process of overturning and manipulating ideas using drawings, diagrams or mind maps. Visual thinking uses interconnections to improve understanding, identify problems, find solutions, simulate processes and discover new ideas. Rudolf Arnheim coined the term in 1969 in book *Visual Thinking* [17].

Visual thinking aids the understanding of goals, projects and tasks, and it enables the discovery of how to make and how elements relate to one another [18]. It has numerous uses: problem solving, studying concepts, exploring concepts and systems, and innovation, among others.

Many companies use visual thinking to drive their creativity and innovation. Exponents of visual thinking include Apple, Google and Ebay. Some organizations and professionals offer services based on visual thinking. Examples include Dan Roam and Xplane.

We followed the four steps described below:

1. Collect and select elements relevant to what we will explore;
2. Identify the relationships between the elements and guidelines;
3. Handle the elements to discover new patterns;
4. Show. When a pattern is found and understood, it must be shown to others for feedback.

Visual thinking is closely related to innovation, and its goal is to improve systems or ideas. Those who work in innovation are constantly working with fuzzy goals and hypotheses, so visual thinking is an ideal way to explore new areas, communicate ideas, make hypotheses and, as a result, make better decisions

In this paper, the application of visual thinking allowed us to visually define levels and key areas (Figure 1).

The creativity, innovation and entrepreneurship competency is defined as a process with the following activities: environment analysis (*seek opportunities*), proposal of creative ideas (*generate ideas*), deployment or procedure of execution (*execute*) and, finally, risk and reward evaluation (*add value*).

Three domain levels were defined (different colours in Figure 1). Each domain level shows the learning outcome that students should have attained by the end of second year of their bachelor's degree (Level 1), the fourth year of their bachelor's degree (Level 2) and the end of their master's degree (Level 3).

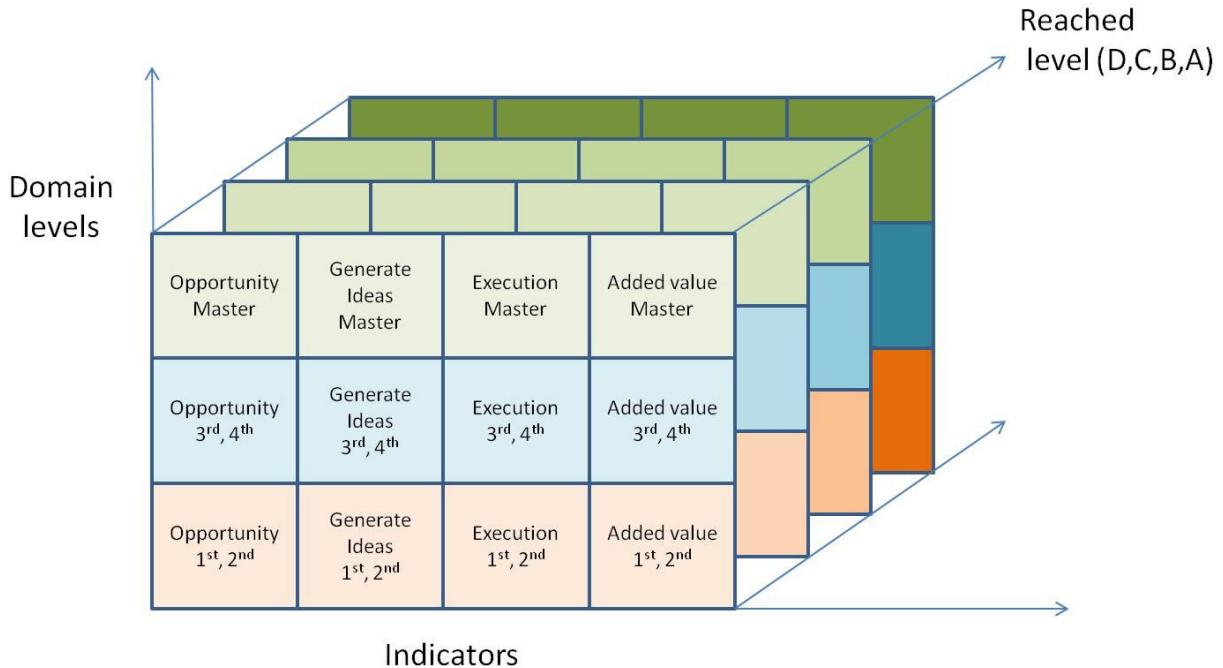


Figure 1: 3-D representation (designed by Llanos Cuenca)

Level D is the lowest level and Level A is the highest level. Each domain appears in a different colour in Figure 1.

Learning outcomes are related to indicators. These indicators help the user of the rubric to pay attention to the main aspects to analyse and detect progress (level attained). It This set of indicators corresponds to the activities identified in the innovation, creativity and entrepreneurship competency.

Level 1: First and second year of bachelor's degree

Learning outcome: question reality, identify needs for improvement and ideas that can generate value.

Indicators:

Seek opportunities: Students question reality.

Generate Ideas: Students contribute ideas.

Execute: Students formally express ideas.

Add value: Students identify results.

Level 2: Third and fourth year of bachelor's degree

Learning outcome: contribute to generating original ideas and plans, providing added value through strategies and creative techniques.

Indicators:

Seek opportunities: Students identify opportunities or detect possible scope for improvement.

Generate Ideas: Students contribute original ideas and procedures.

Execute: Students use creative strategies and techniques to formally express ideas and solutions.

Add value: Students control results.

Level 3: Master's degree

Learning outcome: propose an action plan, including a comprehensive analysis of the innovation value.

Indicators:

Seek opportunities: Students incorporate knowledge from other disciplines.

Generate ideas: Students adopt creative approaches in content and execution.

Execute: Students propose an action plan.

Add value: Students analyse the innovation value.

Once the learning outcomes and indicators associated with the innovation, creativity and entrepreneurship competency were identified, the next step was to define the rubric for student assessment.

Conclusion:

This paper proposes a rubric-based assessment method for the innovation, creativity and entrepreneurship competency in bachelor's and master's degrees. The key factors associated with this competency are as follows: seek opportunities, generate ideas, execute and add value. The paper proposes learning outcomes and indicators associated with this competency. The rubric to link class work with student assessment is being developed. The aim of the project described in this paper was to establish procedures for systematically teaching transversal competencies. The project also aimed to define the necessary assessment tools to ensure students were able to attain competencies during their university education and apply these competencies in their professional lives.

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- Project for educational improvement (PIME/2013/A/016/B) RECICRE - Rubric for evaluating competence of innovation and Tempus IDEA Inter Disciplinary Education Agenda http://tempus-idea.org.il/idea_wp/

References

- [1] Perrenoud, P. (2004). Diez nuevas competencias para enseñar. Barcelona: Graó.
- [2] Yáñiz , C & Villardón, L. (2006). Planificar desde competencias para promover el aprendizaje. Bilbao: Universidad de Deusto Cuadernos del ICE 12
- [3] Incorporación de las competencias transversales en los currícula de los egresados UPV En: <http://www.upv.es/entidades/ICE/info/U0700547.pdf>
- [4] Plan estratégico UPV 2015- 2020 <http://www.upv.es/contenidos/PLAN2020/info/U0685838.pdf>
- [5] Proyecto de competencias transversales de la Universitat Politècnica de València. <http://competencias.webs.upv.es/wp/>
- [6] Villa, A., & Poblete, M. (2007). Aprendizaje basado en competencias. Una propuesta para la evaluación de las competencias genéricas. Bilbao: Universidad de Deusto.
- [7] Bapat et al., (2014) Technical Report. [Consulta: julio de 2015]
- [8] Morales, M. & Leon, A: (2013) Adiós a los mitos de la innovación. Innovare. <http://www.quieroinnovar.com/wp-content/uploads/2013/06/Capitulo1AdiosALosMitosDeLaInnovacion.pdf>
- [9] Marin-Garcia, J.A., Perez-Peñalver, M.J. & Vatts, F. (2013). "How to assess innovation competence in services: The case of university students". Dirección y Organización(50), 48-62.
- [10] Marin-Garcia, J.A., Ramirez, L., Andreu, M.A. (2015). "Comparación de los métodos de escalas y frecuencia de comportamiento para valorar la competencia de innovación. El punto de vista de alumnos y profesor en el caso de una asignatura de máster". Congreso In-Red 2015-Universitat Politècnica de València. <<http://ocs.editorial.upv.es/index.php/INRED/INRED2015>>
- [11] Cuenca, L., Alarcón, F., Boza, A., Fernández-Diego M., Ruiz, L., Gordo, ML., Poler, R., Alemany, M.M.E. (2015). "Rubric to assess the competence of innovation, creativity and entrepreneurship in bachelor degree." Book of abstracts of the ICIEOM-CIO- IIIE. Engineering Systems and Network: The way for industrial engineering and operations management. International Conference 2015 ISBN: 978-972-789-453-6
- [12] Cuenca, L., Alarcón, F., Boza, A., Fernández-Diego M., Ruiz, L., Gordo, ML., Poler, R., Alemany, M.M.E. (2015). "Rúbrica para la Evaluación de la Competencia Innovación, Creatividad y Emprendimiento en máster". Congreso In-Red 2015-Universitat Politècnica de València. ISBN: 978-84-9048-396-1. Disponible en <<http://ocs.editorial.upv.es/index.php/INRED/INRED2015>>
- [13] Cuenca, L., Fernández-Diego, M., Gordo, M., Ruiz, L., Alemany, M.M.E., & Ortiz, A. (2015). Measuring competencies in higher education. The case of innovation competence. In P.O. Marta & J.M.M Lindahl (Eds.), Sustainable Learning in Higher Education, Innovation, Technology, and Knowledge Management (pp. 131-142). London: Springer.

- [14] Boza A., Cuenca L., Fernández-Diego M., Ruiz L., Gordo M.L., Alarcón F. , Alemany M.M.E., Poler R. (2014) Innovation, creativity and entrepreneurship competence in higher education. Learning objectives and measurement. ICERI2014 Proceedings Pages: 405-411
- [15] CLUB EXCELENCIA EN GESTIÓN [Consulta: junio de 2015] <http://www.clubexcelencia.org/>
- [16] FINCODA EU PROJECT [Consulta: mayo de 2015] <http://bit.ly/FINCODA-EUsite01>.
- [17] Rudolf Arnheim (1969). Visual Thinking University of California Press
- [18] Ruiz, L., Gordo, M.L., Fernández-Diego, M., Boza, A., Cuenca, L., Alarcón, A., Alemany, M.M.E. (2015):" Implementación de actividades de aprendizaje y evaluación para el desarrollo de competencias genéricas: un caso práctico de aplicación de técnicas de Pensamiento de Diseño, y evaluación mediante rúbricas, de las competencias de Creatividad, Innovación y Emprendimiento". Congreso In-Red 2015 - Universitat Politècnica de València. ISBN: 978-84-9048-396-1. Disponible en <<http://ocs.editorial.upv.es/index.php/INRED/INRED2015>>