AC 2012-5093: INNOVATIVE LEARNING EXPERIENCES IN A TECHNICAL UNIVERSITY USING OPEN EDUCATIONAL RESOURCES

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Innovative learning experiences in a technical university using Open Educational Resources

Abstract

The growing Open Educational Resources (OER) is further increasing the wealth of up-to-date, relevant and well-presented course material available. However, just as important as having first class content, is that the learning activities designed for students using this content are likely to help students learn optimally. To help academics who are contemplating using Open Courseware material, guidelines are needed to help them reflect on how best to get their students to learn. The goal is to move away from a focus on teaching, that is, what the lecturer told the students, to a focus on activities that would help students learn. The task of university teachers is to create the conditions where students are most likely to learn. This paper presents the results of an educational innovation project that seeks to promote the design of learning experiences of students in Higher Education programs in a School of Engineering reusing such kind of resources. Each one of the learning experiences presented here are described in terms of the resources used, the repository where they were obtained and information and the type of repository, the teaching method used, evaluation forms, which competences and learning outcomes are expected to reach, among others. The students satisfactions of these experiences have been assessed. The lessons learned from each of these experiences are part of a set of guidelines published in a web site of the university. These practices can be imitated following the guidelines elaborated, and, to develop a community of teachers.

Keywords: Educational resources, Computer Science teaching, blended learning, teaching based on competencies, learning models, learning assessment, European Higher Education Area.

1   Introduction

Since 2009 Universidad Politécnica de Madrid (UPM) is involved in the transformation of its curricula. The process of adaptation to the European Higher Education Area (EHEA) has coincided with a deep economic crisis and social movements that pose a great challenge for its players. The most important commitment of the new educational model of the UPM [1] is the change process enabling the incorporation new curricula adapted to the changing needs of society, and facilitate the performance of best practices for more efficient use of resources.

In this context there are three aspects that the University considers essential in the learning process: (1) institutional commitment, (2) educational resources created by teachers and (3) active involvement of students in this process.

Keeping with this commitment, the UPM made various plans to achieve: (1) educational efficiency, high rate of educational success and active student participation, measured by the achievements of learning outcomes and (2) the stimulation of a education that enhances active teaching job well done, the quality of teaching resources to support teaching, and collaborative working through teaching teams.

Also provides the means to enable teaching teams called "educational innovation groups (GIE)" creating educational partnerships around new learning experiences. In this framework arises in 2007, the "Group for Innovation in Quality Management of University Centers (GICAC)" [2], to which authors belong.

This article presents the results of the research developed in an innovative educational project, from 2009 to 2011, which aims to promote the results of learning experiences with

new resources and methods of learning among students in higher education programs in schools of engineering, and the results of the assessment of its adequacy when they are reused in undergraduate and master levels.

Each one of the learning experiences presented here is described in terms of the resource used, the repository in which information is obtained and the type of repository, the teaching method used, evaluation forms, competencies and learning outcomes are expected to reach others.

The students satisfaction of these experiences have been assessed. The lessons learned from each of these experiences are part of a set of guidelines published in a university website. Subsequently, these practices can be applied following the guidelines developed, and therefore may be extended through a community of teachers.

2 Expected Results

The results of the research is presented in following sections: Section III explains the context in which the learning resources will be develop, each kind of resource, meaning subjects involved (all of them belong to the area of Information Systems Management), competencies and learning outcomes associated with each subjects.

Then, Section IV presents (1) the building process for educational resources and (2) the learning model proposed. A template is designed to describe the experience with each learning resource. Each template has been used in at least two subjects of degree and master respectively, and could be used in other subjects with similar goals. Each resource pursues the fulfillment of specific training objectives, e.g. acquisition of knowledge, capacity for synthesis, evaluation, etc. Proper management of these resources in the learning process facilitates the growth of the success rate of learning, and active participation of students. Though open resources can be used without a predefined order, and without the aid of a teacher, this section shows, as result, the learning model where the resources, provides a different value to achieve the learning outcomes and acquisition of skills.

Finally, Section VI introduces results of the application each resource and learning model with these, in two different subjects, at master and degree levels, from two faculties of UPM and the views expressed by students, in 2010-2011 and first semester of 2011-2012 for each resource showed by from section V. The learning model include a continual improve cycle. This section shows some recommendation for next project phases.

3 Context

Most engineering studies incorporate in their curricula courses on information systems. UPM has two computer faculties that teach, in their new degrees and masters in computer engineering, the core of study on information systems as well as all aspects of the processes and technologies involved in governance and management information systems. In addition, other schools, such as telecommunications, industrials, etc.., In which these issues are treated and, therefore, could benefit from the resources and methods of work submitted.

The curriculum for the Software Engineering degree, taught at the School of Computer Science, includes five subjects in the area of information systems management: (1) Project management and risk, (2) Management and governance of IT services, (3) Projects Portfolio Management and IT Services Outsourcing, (4) Models and Metrics for IT Control and Management, and (5) Computer audit.

In addition, the Faculty of Computing adds the teaching of the following subjects in the Computer Science degree: (1) Portfolio management, IT programs and projects, (2) IT Governance, (3) organization and processes, to the extent of Computer Engineering. In the

degree on Information Technology subjects such as (4) direction and management, and (5) Quality and Audit are taught.

UPM students could attend courses "Management and Government IT Services," "Portfolio Management, Program and Project" and "IT Governance and Management" [3][4][5]. All of them are included into a knowledge tree for Information System Area [6]. Table I shows the guidelines learning, outcomes learning and its linked skills, required for a future professional in this area, were analyzed by GICAC. Also, the research was complemented adding transversal skills, including systemic, personals, and instrumentals [7].

In order to get the skills, facilitating the active participation of students and thus improve the success rate, some open resources on this study area were analyzed.

With the same aim, some kinds of resources were proposed to be developed and later were shared and use by students and Information System community.

Table I: Learning Outcomes

	COMPETENCE	SKILL
Information Systems	I2	Ability to plan, design, deploy and manage projects, services and systems at all levels, leading its implementation and continuous improvement and assessing their economic and social impact.
	I3	Ability to understand the importance of negotiation, effective work habits, leadership and communication skills in all software development environments.
	I5	Knowledge management and maintenance systems, services and applications.
	I16	Knowledge and application of the principles, methodologies and life cycles of software engineering.
	I18	Knowledge of the rules and regulation of information at national, European and international levels
Direction and Management	CE2	Ability to solve integration problems in terms of strategies, standards and technologies.
	CE3	Ability to assess client needs and specify the requirements to meet these needs, reconciling conflicting objectives by finding acceptable compromises within the limitations imposed by cost, time, the existence of systems already developed and the organizations themselves
	CE16	Ability to make connections between desires and needs of the consumer or customer and what technology can offer
	CE17	Ability to decide whether to acquire, develop or apply technology across the broad range of categories of processes, products and services of a company or institution
	CE19	Ability to develop and implement a solution computing in an enterprise environment
Instrumentals	G1	Capacity for analysis and synthesis
	G2	Organization and planning capacity
	G3	Oral and written communication in the native language
	G5	Use of ICT
	G6	Resolución de problemas
Personal	G7	Teamwork
	G8	Recognition of diversity and multiculturalism
Systemic	G9	Critical Thinking
	G10	Autonomous learning, adapting to new situations and motivation for continuing professional development
	G11	Creativity
	G12	Team Leadership
	G13	Initiative and entrepreneurship
	G14	Motivation for quality
	G15	Respect for the environment

As we can see on Table II, each of them was named with a key code and classified according to: (1) keywords from knowledge tree included into the learning guideline, such as "IT Service Management", "IT Governance", "Project Management" [8], "IT Strategy"[9], "Design"[10], "Transition"[11], "Operation" [12], "CSI" [13], "ISO 20000" [14], "ISO 38500" [15], etc., (2) knowledge level required as "basic", "media", and "advanced", (3) type of learning method as "autonomous", "group", "self-assessment" or "reference", (4) kind of subjects and courses where it could be used such as "undergraduate", "graduate", "business training" or "self training" and (5) last column shows main skills which can be acquired using each kind of resources.

4   Educational resources and learning model

This section presents the building process for educational resources and the learning model proposed.

4.1   Building process for resources

After know the context of research, and before defining the educational resources that may be useful in acquiring knowledge and skills, we have develop a resource template. This permit us establish some of its main features and also will be useful to reuse it.

Our template is based on ISO / IEC 19788, [16]. This is a standard structured into modules. Each module represents a set of user requirements for the identification and specification of the field related to the educational resource, such as: technical, pedagogical, intellectual property rights, classification schemes, etc.. It is a flexible standard that allows us to define a educational resource, adding user extensions to suit specific needs of a particular educational community. The module V of this standard specifies the attributes that describe the pedagogical use of an educational resource in any educational system, cultural and linguistic background. This module has been used to define our resource template.

So, the resource template developed has the follow items:

• Code: unique identity of the resource.
• Title: name of the resource.
• User language: language use.
• Author: person or body who is the creator of the resource.
• Contributor: agent responsible for making contributions to the educational resource description.
• Organization: organization or service that provides and shares pedagogical resource.
• Objectives: purposes that expect to be met
• Description: textual user comments about the educational resource.
• Audience: level of educational progress in a sequence. E.g., "master", "degree".
• Educational method: the process by which knowledge, skills and abilities are generated. e.g., "Collaborative learning", etc.
• User Role: the role of the user who runs the educational resource.
• Curriculum: structured plan that describes the educational program that is used in the educational resource.
• Theme of the curriculum: description of the subject, discipline, curriculum, and skills.
• Learning outcome: a description of what a student should know, understand or be able to do upon completion of the educational process.
• Indicators of resource: indicators showing the importance, quality and adequacy of the resource in the acquisition of different aspects of knowledge and skills:
a)   Acquisition of knowledge: increase the level of knowledge on the subject.
b)   Analysis of knowledge: development of analytical skills.
c)   Apply knowledge: increased ability to apply knowledge.
d)   Using selection criteria, classification and evaluation of information: ability to apply selection criteria, classification and evaluation of information.
e)   Structuring information and concept relationship: improved ability to structure information.
f)   Communication: improved ability to express one's ideas and relate to people involved in resource use
g)   Adequacy: resource adequacy of its approach to
h)   Tutorials: ability to facilitate self-help resource

Table II: Reusable resources at information system area

	Key Code	Type	Description	Keywords	Levels	Learning type	Used in	Competences
REUSABLE RESOURCES IN THE AREA OF INFORMATION SYSTEMS								
DEVELOPED	Q	Questionnaires	Questions with alternative response, with only one valid response, classified according to a catalog of keywords and levels of knowledge, (currently completing justification in the positive and negative responses)	IT Service Management, IT Governance, Project Management, IT Strategy, Design, Transition, Operation, CSI, safety, standard, ISO 20000, ISO 38500, ISO 27000, CMDB	Basic, Intermediate, Advanced	Autonomous learning and self-evaluation	Undergraduate, Graduate, Business training or Self training	I5, I16, I18, CE16, G1, G10,G14
	G	Glossary of terms and acronyms	Group definition of terms and acronyms	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 27000, CMDB	Basic, Intermediate, Advanced	Autonomous learning , group, and reference	Undergraduate, Graduate, Business training or Self training	I5, I16, I18, CE16, CE17 G1, G3, G5, G6,G7, G8,G9,G11,G12,G13,G14, G15
	CM	Conceptual Maps	Maps with the definitions and relationships between the main concepts of the topic in relation to information systems	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 27000, CMDB	Basic	Autonomous learning	Undergraduate, Graduate, Business training or Self training	I5, I16, I18, CE16, CE17 G1, G3, G5, G6,G7, G8,G9,G11,G12,G13,G14, G15
	S	Slides	Document explained and presented information about the various aspects involved in the management and governance of IT services, standards and frameworks, and so on.	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 27000, CMDB	Basic, Intermediate	Autonomous learning	Undergraduate, Graduate, Business training or Self training	I3, I5, I16, I18, CE2, CE3, CE16, CE17 G1, G2, G9, G10,
	A	Audios	Audio files that could lead to an iPod or similar and listen during a journey, usable by blind ...	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 27000, CMDB	Basic	Autonomous learning	Undergraduate, Graduate, Business training or Self training	I2,I3, I5, I16, I18, CE16, CE17 G1, G3, G5, G6,G7, G8,G9,G11,G12,G13,G14, G15
	QG	Quizzes and games	Fun activities: crosswords, soup of terms, words linked, puzzles, reursos developed with educational tools including free hot potatos, jclick,etc. A Trivial Game for virtual spaces like Open SIM or Second Life (reusing questions from the questionnaires)	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 27000	Basic	Autonomous learning , group	Undergraduate, Graduate, Business training or Self training	I2,I3, I5, I16, I18, CE16, CE17 G1, G3, G5, G6,G7, G8,G9,G11,G12,G13,G14, G15
	DV	Developed Video - Sketch	Videos developed, written and audio information, and presented in different formats, on aspects relating to the processes involved in the management and governance of IT services, standards and frameworks ITIL and COBIT, etc.	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 38500, ISO 27000	Basic, Intermediate	Autonomous learning	Undergraduate, Graduate, Business training or Self training	I2,I3, I5, I16, I18, CE16, CE17 G1, G3, G5, G6,G7, G8,G9,G11,G12,G13,G14, G15
	F	Forum	Design on a thematic forum included in the material studied, and aspects of monitoring and evaluation.	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 38500, ISO 27000	Basic, Intermediate	Autonomous learning , group	Undergraduate, Graduate, Business training or Self training	G3, G5, G7, G9, G12, G13
USED	UV	Used Video -Sketch	Youtube links in: Processes in IT Service Management, Project Management, Communication, Habiliaddes, Roles, etc.	IT Service Management, IT Governance, Strategy, Design, Transition, Operation, CSI, ISO 20000, ISO 38500, ISO 27000	Basic, Intermediate, Advanced	Autonomous learning	Undergraduate, Graduate, Business training or Self training	I2,I3, I5, I16, I18, CE16, CE17 G1, G3, G5, G6,G7, G8,G9,G11,G12,G13,G14, G15
	SN	Social Networks	Links to social networks whose main theme is the subject being studied: management and governance of IT services, project management, etc.	IT Service Management, IT Governance, IT Project Management, ISO 20000, ISO 38500, ISO 27000	Basic, Intermediate, Advanced	Autonomous learning , group	Undergraduate, Graduate, Business training or Self training	G3, G5, G7, G9, G12, G13

- Resources reused: other resources which they relate and whose use can facilitate the improvement of knowledge acquisition.
- Assessment: description of the activity of evaluation used to ensure an outcome of education. Resources achievements in information systems area can be three types: (1) achievement to acquire knowledge of concepts and relationships between them, (2) procedural accomplishments or skills that students must achieve to perform a professional job, and (3) attitude achievement is represented by the way in which a student carries out its tasks, how are its feeling , and how these are transmitted. All of them are referenced in this item of the template.
- Improvements: improvements proposed for the resource.

The template have been applied, by GICAC, to develop educative resources of Information System. Also, it was shared and applied by some collectivities in their own resources developing. So, Table II and template presented in Table III were the inputs to develop the next resources:

- Questionnaires: there have been over 300 questions, all of them classified, that allowed us to develop specific questionnaires concerning the knowledge tree of management information systems.
- Glossary of terms and acronyms: the glossary has been built around 150 entries. It is shared and integrated into the learning platform MOODLE and is the result of a collaborative effort between different groups. Also represent the basis for the realization of conceptual maps.

- Conceptual maps: we have produced a total of eleven conceptual maps, each about a different theme related to the management of information systems. For each map we have prepared a list of key concepts to develop and relate to.
- Slides: 15 files classified: (1) IT Service Strategy, (2) IT Service Transition, (3) IT Service Design, (4) IT Service Operation, (5) Continuous IT Service Improvement, (6) Provision of Service (7) Support Service, (8) Process Control, (9) Management Program and Project Portfolio, (10) Introduction to IT Service Management, (11) Corporate Governance, (12) IT Governance, (13) ISO 20000 processes, (14) The Government IT the ISO 38500 and (15) Security Management IT Service
- Video / Audio: we have developed a total of 20 audio and video files with information on the management of information systems and is also classified according to the keywords of the knowledge tree whose skeleton is shown [6].
- Quizzes and games: we have developed ten entertainment resources: crosswords, word searches, liaison of concepts, and so on. And with them the students can relax in their study time while learning the meaning of different concepts.
- Forum: this type of communication resource is performed through nine forums. The students are the most active part of the resource.
- Standards: a special kind of questionnaires, which we have included to study different standards as ISO 20000, ISO 38500 and ISO 27000. Templates with 140 questions relating to compliance with them have been developed.

Moreover, we use some resources elaborated by another team, as:

- Video / Audio: 10 references with information on the management of information systems
- Social networks: this type of communication resource is performed through 10 links to social networks whose main theme is the subject being studied: management and governance of IT services, project management, etc.

4.2   Learning model with open resources

Learning resources have value if they meet their goals. Otherwise, all efforts and resources invested are lost. Therefore, not enough to build learning resources, it is also necessary to establish a learning model that ensures these objectives are met.
This paragraph presents a learning model with open resources, shared and followed by two computing faculties at UPM.
The initial objective of the OCW was to provide a free, simple and consistent teaching material for educators, students and self-learners around the world, and nonprofit [17].
Nowadays the volume of resources is enormous and can be of varied types. The resources can lose its value and a learning model can increase this value for a community.
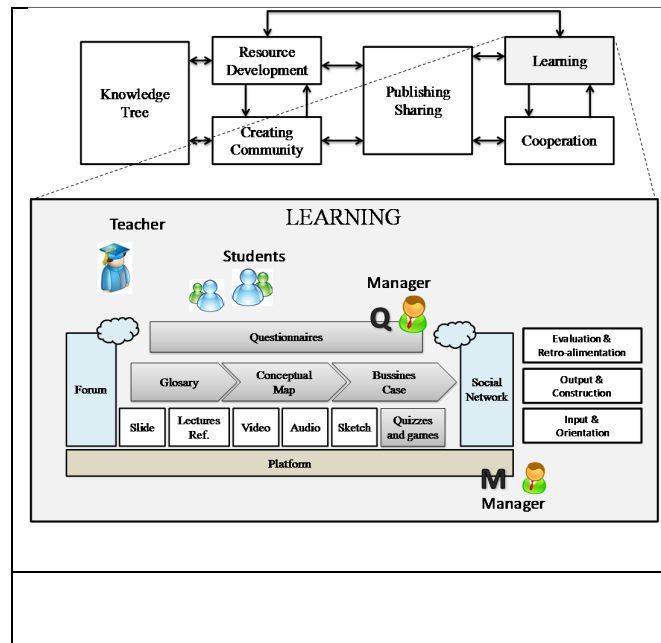So, Fig. 1 shows the learning model defined in next terms:

Fig. 1. Learning Model

- Actors. We define three types (1) Student: the learner a subject, (2) Teacher or person who guides the student learning process and (3) learning Manager who coordinates the processes and activities that involve resources , students and teachers, ensuring quality and continuous improvement.
- Processes. The proposed model is process-oriented. It consists of six processes: (1) Building Tree Knowledge, is described in [6], (2) Resource Development, describe in paragraph A of this section, (3) Creating Community, such as GICAC team and the students of the chosen subjects, (4) Publishing and Sharing, through MOODLE and others opened platform, forum and social networks (5) Cooperating actors through using and providing resources, where the collaboration among actors is the most important key and (6) Learning process conducted through various activities into three sequential levels:

a) Orientation & Input: The level of participation e interaction is low. The lectures, information and referral resources, proposed by teachers, assume great importance. The tutorials, through forums and similar resources are helpful for an initial orientation. The complementary use of different kinds of resources such as slides, lectures, references, videos, audios, etc.es important to acquire this level of meaningful learning. The collaboration is present only in the commitment of participation established by the students.
b) Construction & Output: Meaningful learning, held at the previous level, is the basis for this second level. It is important to reach this second level with an acquired knowledge of the subject from multiple perspectives.
c) At this level becomes important individual work to strengthen the knowledge acquired in the former. Thus, the key is to work situation, developed through the collaborative and cooperative work, group discussions, glossary building and / or concept maps, conducting business cases, projects or case studies, preparation of sketch that contextualize realities and monitoring of all this work by the teacher.

d) Evaluation and Retro alimentation: In the final stage, participation is lower. The mode of interaction is more collaborative than cooperative, but a higher degree of learning, is reached. Work with the teacher is stressed, as well as the extent of feedback from evaluations.

Participation and collaborative learning are the keys of the model: participation is present in all activities carried out by the student. It is extremely importance to determine the value of labor from each of these activities. The interaction takes the form of the extent of collaboration and cooperation generated by the communication process.

Motivation is the engine that drives teachers and students to participate actively adding value to the resources used and developed. It covers the following aspects: (1) the teacher motivation influences the student. When a teacher has clear their education guides facilitates the learning process of student, (2) students must be motivated. The learning resources should enable student to interact, communicate, present ideas, answer questions and feel part of the process, (3) the quality and presentation of content, ease of use, readings and references, and organization of the resources, are keys for both teacher and the student, (4) technology platform acts as a meeting place where the learning process occurs. Learning manager is responsible for its operation.

The main objective of evaluation process is to identify strong and weak points and thus improve. The evaluation includes some aspects as people review, resources and processes. In this phase of the innovation project every learning resources has been reviewed.

The resource template, Table III, include a guide to evaluate each resource. Each resource has a specific set of questions designed to reveal the adequacy of the resource to the learning proposed in its template. Next section permit us know the result of the application resources into the learning model.

5   Resource assessment

Finally, we have applied each resource in at least two subjects at both curricula. The adequacy of resources to learning outcomes and learning model has been evaluated by students. The evaluation process was developed through: (1) a specify quality survey for each resource, with 10 questions relative to its compliance to global context of the subject and (2) another survey for each resource with the questions directed toward obtain its suitability to each learning outcome.

The questions were designed to determine the quality level of experience with the resources, its content and format, time, interest, technical quality, impact on the improve the level of knowledge, suitable of assessment procedure used, important of using several kind of complementary resources and language are treated in each survey.

Table III: reusable resources in the area of information system

Resource Type	COMPETENCE																						
	G1	G2	G3	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	CE2	CE3	CE16	CE17	CE19	I3	I5	I16	I18
Questionary	20	0	0	0	0	0	0	0	62	0	0	0	64	0	0	0	57	0	0	0	2	56	70
Glosary	69	0	79	41	6	79	16	84	0	18	18	32	71	0	0	0	37	37	0	0	79	86	85
Conceptual Map	68	0	78	41	6	79	16	84	0	17	19	32	71	0	0	0	37	37	0	0	78	82	83
Slide	82	66	0	0	0	0	0	82	83	0	0	0	0	0	82	79	81	67	0	82	84	85	85
Audio	73	0	69	56	6	59	48	51	0	26	16	30	60	0	0	0	56	40	0	39	50	47	40
Quiz & Games	31	0	43	28	11	58	6	15	0	97	11	9	13	0	0	0	11	6	0	9	8	13	9
Video-Sketch	71	0	69	56	6	57	48	64	0	83	16	29	60	0	0	0	56	38	0	39	46	47	33
Forum	0	0	84	84	0	78	0	74	0	0	82	76	0	0	0	0	0	0	0	0	0	0	0
Social Network	0	0	42	42	0	68	0	70	0	0	67	65	0	10	0	0	0	0	0	0	0	0	0

Each one of ten questions was responded with a score from 0 to 4:
- 0- Not agree at all
- 1- Slightly agree
- 2- Agree
- 3- Some agree
- 4- Totally agree

The responses obtained were treated according to the degree of adequacy obtaining values between [0,100]. 0 as it was not applied or not influenced at all and 100 when the incidence rate was total. Table III presents the relevance of each type of resource to acquisition of each competence.

Analyzing the value that students give to different resources we can see:
- Questionnaires have best values to motivation for quality and autonomous learning, but they didn't impact to the skill focused to, the knowledge management and maintenance systems, services and applications. One of the most valued aspects was useful to know and establish the concepts included in different certifications.
- Glossary and Conceptual Maps had similar results both. Students have noted its importance to learn the most important concepts and their relationships. Furthermore, they note the importance to share this knowledge among team works.
- Slides have a high impact to acquire of competences where they are implicated. But we want note that although they are very well valuated, the students hasn't an active behavior working with this resources.
- Audios and Videos resources worked by students had a low evaluating. However, they enhanced the creativity developed, the collaboration in the teamwork, and analyzing and synthesizing active engagement. By other hand, the reused audios and videos were evaluated positively as real view in an enterprise.
- Games and Quizzes. These resources were not too well valuated. The students think that the time for those activities was too much and gave them bit benefit. However, they think they can be useful to ensure the learnt concept, and to self-evaluation.
- Forum and Social Network. Most students think forum resources facilities the purchase of skills. The communication is a key aspect in this kind of resource. These resources give them the opportunity to play several roles in IT service management.

If we study the table from the point of view of competences, there are some interest aspects. General competences which were showed in Table I as instrumentals, personal and systemic:

- Capacity for analysis and synthesis (G1). The most important resources to develop the skills associated to this competence were the slides and also videos, glossaries and conceptual maps.
- Organization and planning capacity (G2). The students evaluated only the slides as good resource to achieve this competence.
- Oral and written communication in the native language (G3). All of resources where they had to write and make some speech were evaluated positively for this competence.
- Using ICT (G5). The platform and different ICT resources, which have been used through different subjects, have been assessed positively to achieve this competency.
- Solving Problems (G6). No resources studied in this paper have been included in order to obtain this competence. We have to note that the students makes another type of activities as roll play they face real situations in which they have to resolve different kinds of problems.
- Team works (G7). All resources excepting questionnaires and slides have collaborated in order to obtain this competence.
- Recognition of diversity and multiculturalism (G8). Some students consider very interesting some of videos and audios as they may show some different multiculturalism aspects.
- Critical Thinking (G9). This competence in once of most important of the student education. All of resources are involved in its achievement. Slides, conceptual maps and glossaries are considered most important resources for this competence.
- Autonomous learning (G10). Only the questionnaires and slides are considered by students as resources to learning autonomous. The activities developed with other of the resources were developed at team.
- Creativity (G11). Games, quiz, sketches and videos developed by students were the resources which have involved creativity competence, showing graphically different real situations at organizations.
- Team Leadership (G12) and Initiative and entrepreneurship (G13). In opposite to autonomous learning, all resources except slides and questionnaires were considered to get skills for these competences. The communication involved in forum and social network have the greatest incidence. We note that in addition to learning resources presented, students played a game of roll that allowed them to develop this kind of competences
- Motivation for quality (G14). Conceptual maps and definitions into glossaries were the most important aspects to be considered by students in relation to this competence. Also the quality aspects in videos and audios to reflex all information system management concepts involved into their tasks.
- Respect for the environment (G15) was treated very lightly in some forum, so the impact was very insignificantly.

From direction and management competences showed in Table I we can see:
- Ability to solve integration problems in terms of strategies, standards and technologies (CE2). The students feel that only the slides help them to acquire this competence. Business cases and roll game complement this competence.
- Ability to assess client needs and specify the requirements to meet these needs, reconciling conflicting objectives by finding acceptable compromises within the limitations imposed by cost, time, the existence of systems already developed and the organizations themselves (CE3). Same as CE2, the feeling of students is they achieve this competence through working over the slides. Also they have been helped by Business cases and several discussed situations during the lecture sessions

• Ability to make connections between desires and needs of the consumer or customer and what technology can offer (CE16). Slides, questionnaires, videos and audios were the resources better evaluated to know the relation between consumer and customer.

• Ability to decide whether to acquire, develop or apply technology across the broad range of categories of processes, products and services of a company or institution (CE17). As in other competences, business cases and different debates were important too but forum and social network haven't been applied.

• Ability to develop and implement a solution computing in an enterprise environment (CE19). These competences have been elaborated through Business Cases and Roll play. So, the feeling of students is that the resources which we are evaluating in this paper take advanced from them, but they are not directly implicated in the acquisition of this competence.

Finally from information system competences of Table I:

• Ability to understand the importance of negotiation, effective work habits, leadership and communication skills in all software development environments (I3). Students indicate that the slides and the elaboration of videos and audios have helped them for this competence.

• Knowledge management and maintenance systems, services and applications (I5). The slides, glossaries and conceptual maps were involved in getting this competence. We note that forum and social network haven't been value in relation to this competence by students.

• Knowledge and application of the principles, methodologies and life cycles of software engineering. (I16). As I5 competence, students feel that the slides, glossaries and conceptual maps are the most important resources used to obtain the skills of this competence. They haven't felt value for forum and social network.

• Knowledge of the rules and regulation of information at national, European and international levels (I18). Students note in this competence the importance of questionnaires added to the slides and glossaries resources. The training with this kind of resource has helped them to achieve different levels of certification.

6   Conclusions

The project has allowed us to obtain a reusable template for educational resources that can be applied by any subject and it has allowed to GICAC, develop a set of standardized resources that have been used by students in both faculties. Also, some of these open resources have been used in some course for unemployed.

The evaluation of each resource in relation to each competence allows us to improve the objectives and direction of each one. It's a necessity to apply all of resources, which have been chosen, in a complementary way, showing to students each one of resource template.

A simple learning model has been defined in order to give value to the learning resources. This model, linked to the resources, has allow us evaluate the processes involved. The communication and collaboration has been a key for the success of the project.

This new model of learning requires the active participation of students and the involvement of the teacher as a guide.

Similarly, the quality of platform and resources and the best practices of learning manager are a key to the reliability of resources and model.

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