Knowledge management system for applying educational innovative experiences

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ABSTRACT
This work describes obtaining indicators to meet two objectives: first, classifying and measuring the educational innovation degree in experiences and practices carried out at the University; and second, using them in order to manage new innovation experiences throughout a knowledge management system.

Categories and Subject Descriptors
D.1.2 **[User/Machine Systems]**, H.3.5 **[Online Information Services]**, H5.2 **[User Interfaces]**, H.5.4 **[Hypertext/Hypermedia]**, K.3.1 **[Computer Uses in Education]**

General Terms
Design, Human Factors.

Keywords
Indicators; Educational innovation; Knowledge management; Best practices in education.

1. INTRODUCTION
The presented research work reflects the main outcomes of the R&D&i project devoted to develop the Spanish Ministry of Education, Culture and Sport knowledge management system for best educational innovative practices and experiences managing [3].

The research is organized in two different areas that have led to the following innovations:

1. Indicators identification. These indicators must measure the innovation degree of a specific educational experience or practice taking into account aspects such as applicability, context and university teaching staff as target group.
2. Technological ecosystem. The set of tools for searching innovative experiences and practices using different criteria such as application context, teaching methodology, impact to achieve, and so on.

1.1 Indicators identification
To obtain the indicators it is mandatory taking into account that the target group of this knowledge system is the teachers themselves.

Therefore, theses indicators should be useful to identify the educational innovation applicable characteristics in their own work context.

Thus, the two keys that have guided obtaining educational innovation indicators are, on the one hand, they must be teacher-oriented and, on the other, that must be focused on the applicability of innovative experiences.

A good educational innovation practice must have characteristics of innovation, in a broad scope, and others ones related to the context where the innovation is applied. Most of the literature focuses on the general characteristics must meet an innovation practice, according to this the applied indicators in all the OECD countries (Organisation for Economic Co-operation and Development) are those that are included in the Oslo Manual [11]. These general indicators are used to measure innovation in a given region and even from one sector and a particular organization. Other relevant works have focused on the generic features of the innovation result, for example, expressed by Tomasevsky [13]: accessibility, adaptability, availability and acceptability.

Apart from considerations of innovation in general, a good educational innovation practice is associated with context where it is applied. In fact, it is the context itself that determines the indicators that must meet the experience to be considered as innovation or a new practice.

This is the followed principle in current important experiences with international impact, as an outstanding example UNESCO case for the measurement and management of good practice in adult literacy [15] may be cited.

Therefore, to obtain indicators must be based on, first, the investigation of models that allow defining the innovation characteristics and, second, in the context analysis to identify the good practice. This justifies, in the current research, we have conducted studies about generic models of innovation measurement together with the context analysis of the application, which is the teaching and learning in the University. Also, we have added another element: the innovation end-user, which, in the presented case, is the teaching staff of the universities.

1.2 Technological ecosystem for educational innovative experiences searching

Any knowledge management system must be able to evolve with their own knowledge and adapt itself to changes both in the structure and classification of the stored elements. Besides, it should facilitate an effective search system that allows finding the knowledge, or something more specific like useful information. The knowledge management system used in this work is CSORA [5], which searches either whether, in advance, the user knows what he/she wants to look for, or he/she simply has an idea, however vague, of what must be found.

The main contribution of this proposal is the inclusion of indicators of 1) educational innovation and 2) best practice as classification and search criteria of he educational experiences in the repository. It is, without doubt, a valuable support to assist in the evolution of both educational innovation and specific innovative experiences.

1.3 Paper structure

The rest of the paper is organized as follow: Section 2 is devoted to introduce the educational innovation context that is the context of this research work; Section 3 presents the proposal, including the research method that has been carried out; Section 4 describes the main results; and, finally, Section 5 closes the paper with some reflections and conclusions.

2. EDUCATIONAL INNOVATION CONTEXT

Most of the universities have institutional programmes of educational innovation with the aim to promote the application thereof in teaching. Countless innovative educational practices have arisen under those programs, which contain methodological and technological aspects. Existing data allow us to evaluate their success level, their applicability, the effort put into their development, the possibility of being exported and their degree of innovation.

Therefore, there exists a great deal of teaching experiences, most of them financed and promoted by the universities.

Universities also make efforts to promote the dissemination of best practices among its faculty, including, for example, dissemination events.

Taking into account the facts expressed above, we can deduce that there are a lot of innovative educational practices in calls with peer review and competitive regime and, when the universities publish them, teachers can know what was done by other colleagues, saving time and effort to apply them to heir own teaching or advancing in the educational innovation.

But nothing is further from reality; practices are usually repeated, even at the same university, and the faculty generally has not valid indicators of the educational innovation degree that performs. Furthermore, although innovative practices or experiences are disseminated, it is very difficult to find right information that allows applying them in other contexts or assessing their exportability and applicability. Usually, the results shown in educational innovation practices are derived from students' surveys that, most of the time, are positive.

Moreover, teachers continuously demand case studies that allow them to assess the incidence of educational innovation in teaching and learning processes, as well as methods that they can apply in their subjects, guides that indicate how to proceed in educational innovation and so on.

All in all, practical knowledge and experiences are needed to allow managing the efforts that all changing process involves. Indicators are also needed to measure the impact of educational innovation in the university quality improvement and to guide the way of innovative teachers. These needs are covering by our research proposal.

From an operational perspective, the ultimate goal is to develop a knowledge management system to classify, manage and identify best practices in educational innovation in the university context, such that it enables a search procedure that allows finding knowledge when knowledge is applied for.

This R&D&I project has also other more specific goals:

- Obtaining a categories model in which to place the indicators.
- Obtaining a set of educational innovation indicators in order to apply them a university context by faculty.
- Developing a dynamic, cooperative and sustainable technological ecosystem for innovative educational experiences management.

3. RESEARCH DESCRIPTION

This research project has been carried out following a typical research methodology in software engineering [1], complemented with several studies that are described in the following 3.2 and 3.3 subsections.

3.1 Categorizing indicators scheme

The purpose of the categories is to define a framework for regrouping and relate the different indicators, identifying both general aspects of innovation and the particular ones: educational innovation indicators and the university context indicators. To do this, we propose joining three different models:

1. Traditional innovation model, which classifies the indicators in: input, process and output.
2. Scientific quality measurement model, which only has output indicators.
3. Knowledge creation model, in which one the knowledge is created by the faculty or by the knowledge spirals.

The set of categories is called education innovation value chain because it may contain both general indicators of innovation and educational innovation specific ones. It responds to the process of creating an experience of educational innovation by teachers. The result of this is shown in Table 1.

Table 1. Set of categories of an educational innovation

Value chain
Motivation
Innovation characteristics
Development • *Processes* • *Resources* • *Method*
Results • *Context* • *Impact* • *Characteristics*
Dissemination /accreditation

3.2 Obtaining educational innovation indicators through studies

We conducted a field study to obtain information from five groups:

- Expert group: Focus group with 17 experts from 6 different countries.
- R&D&I group: Study of the traditional models of innovation [9-12; 14].
- Journal group: Analysis of 127 scientific journals indexed in first and second quartile of SCI-JCR.
- Keywords group: Analysis of the folksonomies expressed in the keywords section of 121 papers of scientific conferences.
- Educational innovation practices group: Analysis of 300 practices of educational innovation.

Table 2 shows the kind of the obtained indicators in each working-group.

Table 2. Educational innovation indicators obtained in the different performed studies

Value Chain	**Expert Group**	**R&D&I Group**	**Journal Group**	**Keywords Group**	**Educational innovation practices group**
Motivation		New knowledge creation			
Educational Innovation characteristics	Kind of work	Kind of R&D&i	Innovation for scientific publica-tions		
	Kind of funding	Innovation orientation			
	Thematic				
Development Processes	Teaching methodo-logies	Scientific methodo-logy	Scientific methodo-logy	Teaching methodo-logies	Teaching methodologies
	Compe-tences			Thematic	Thematic

Value Chain	Expert Group	R&D&I Group	Journal Group	Keywords Group	Educational innovation practices group
Development Resources	Emerging techno-logy	Human and technolo-gical resources		Emerging techno-logy	Emerging technology
Development Method		Scientific methods	Scientific methods	Techni-ques	Techniques
				Compe-tences	Competences
Results Context	Subject		Value of the generated knowledge		
	Degree				
	University				
Results Impact		External impact			
Results Characteristics		Innovation characteris-tics			
Dissemination /accreditation	Conferen-ce Journal				

3.3 Research for obtaining indicators of good educational innovation practices based on the context and target group

The research was conducted in three phases; the first two used empirical methods, while the third used a descriptive one. The first and second phases were conducted in a two-days seminar (September 10-11, 2012) and the third through a questionnaire. The first and second phases were called 2.p activity as it was aimed at both the speaker (micro-conferences) and the attendances (cooperative work) [4].

Phase 1. Indicators from the organizational point of view in educational innovation related contexts.

A six-expert group suggested innovation-related indicators both in the education area (university, non-university and training in workplace) and in a generic way (technological innovation, quality indicators in scientific journals and scientific conferences).

Experts presented their conclusions through half-hour conferences and a curator organized and related the knowledge provided by them.

Phase 2. Indicators from faculty point of view

In this second stage 54 teachers from different universities were met. They were organized in four parallel working-groups. Each group also counts with two experts/researches from the project staff, one with the moderator role and other with the aim to boost the group's discussions.

The work session began with the intervention of a speaker introducing various aspects related to the educational innovation value chain (motivation, characteristics of the innovation, development and result). Each group had the task of identifying characteristics or indicators for each of the value chain categories. The working sessions were organized so that each group has 25 minutes for discussion of each category and, once consumed, the group representative set out the conclusions to all attendees.

One curator made an organization work of all the group expositions representing the knowledge into a conceptual map (http://www.mindomo.com/es/view.htm?m=6896bd5017504f158f6847a9ea028039).

Phase 3. Questionnaire about educational innovation. Measurement of the indicators

From the conceptual map obtained at the seminar, a twenty-question questionnaire was developed. The first eight questions were devoted to identify the participant's profile and experience, the other twelve ones were about the educational innovation measuring.

This questionnaire was sent to 600 university teachers with experience in educational innovation, which participated as speakers in at least one of the following conferences:

- CINAIC 2011 (http://www.cinaic.com/).
- CITEC 2012 / CIE 2012 (http://www.uned.es/infoedu/CIE-2012/).
- XXCUIEET (http://www.eiic.ulpgc.es/xxcuieet/).
- *VI Jornadas de Innovación Docente* (http://www.unizar.es/innovacion/jornadas12/).

426 people answered the questionnaire, 228 completely answered the questionnaire and 198 left any questions unanswered. The analysis presented in Table 3 and Table 4 is derived from the 228 full responses collected.

Table 3 presents the question 1 (Q1) answers distribution. This question wondered to the surveyed that selected all the option related to his/her previous experiences with educational innovation.

Table 3. Surveyed type linkage with educational innovation

Relationship with educational innovation (Q1)	Response rate
Application in your subjects	90.50
Research and studies	60.18
Funded educational innovation projects	75.57
Educational innovation trainer	31,.22
Innovation management responsibilities	10.86

Respondent's years of experience mean was over 9 years (9.4). The 50.68% of the participants were female and 49.32% male.

Some of the most valued indicators by the respondents are summarized in Table 4.

Table 4. Most valued indicators

Question	Options and rates
Q2. Educational innovation characteristics	– Effective in learning outcomes (85.07%) – Sustainable and transferable (78.28%) – Intentional, planned and purposeful improvement change (75.57%) – Using methodologies that involve an increased activity by students (67.42%)
Q3. Motivation	– Official recognition (57.47%) – Capturing student's interest (45.25%) – Responsibility and challenge (33.94%) – Cooperation (29.86%) – Being updated (27.45%)
Q4. Facilitators	– No institutional technology resources (46.15%) – Support for student (46.15%) – Experience (41.18%) – Support for the faculty (38.46%) – Institutional technology resources (37.56%)
Q4.1. Where have you found useful information	– Conference, workshops and seminar papers (78.025) – Journal papers (68.13%)
Q5. Barriers	– Lack of indicators (56.56%) – Development effort (54.30%) – Weak institutional recognition (52.49%)
Q6. Educational innovation success	– Active participation of the students (88.24%) – Student's motivation (87.33%) – Academic performance improvement (81.90%)
Q7. Aspects to improve educational innovation	– Technical and human (85.97%) – Faculty training (78.28%) – More institutional recognition (78.28%) – Promotion of the educational innovation culture (76.92%)

Question	Options and rates
	– Ease of access to other teachers' experiences (67.42%)

4. RESULTS

The main results of this research projects are the following ones:

1. A set of educational innovation indicators.
2. The technological ecosystem for educational innovation good practices searching.

The indicators allow measuring the educational innovation result from the point of view of both institution and faculty as it is shown in Table 5.

Table 5. Result indicators to measure the quality of an innovative education practice

University oriented indicators	Faculty oriented indicator
Kind of R&D&i • Basic • Applied • Experimental development Funding source (competitive call) • University • Regional project • National project • International project Kind of practice • Experience • Study • Research • Development • Innovation Participant human resources	Impact on the methodology • Existing methodology improvement • New methodology • Methodology identification Impact on the learning • Active participation of the students • Effort reduction • Resource adaptability to students' necessities • Student's motivation improvement • Learning outcomes improvement Technology used (not necessarily emergent) Learning technique used

Other elements have also been obtained that, in the opinion of the respondents, are helpful for dynamizing of educational innovation. The main indicators, whose inclusion would facilitate the innovation, the sources of experience attraction, or eliminating barriers that hinder the innovators, are included in Table 6.

The searcher for best practices is a system that uses some of the indicators obtained in this research project as search criteria and partly as classification criteria. Currently the searcher is a prototype with 130 innovative educational experiences. The main searcher screen may be seen in Figure 1.

Table 6. Indicators that influence educational innovation promotion

Question	Main indicators obtaining in the survey
Resources that facilitate educational innovation	• Support for the students • Open/free technological resources (non-institutional) • Other teachers' experiences
Sources for obtaining experiences	• Conferences, workshops and seminars • Paper journals
Educational innovation barriers	• Lack of indicators • Faculty effort • Shortage of available supporting resources • Weak institutional recognition (external to the university)

Figure 1. Searcher main screen

5. CONCLUSIONS

Educational innovation is one of the pillars of the teaching dimension or mission in the XXI Century University. Web 2.0 philosophy [2] and an institutional commitment to open knowledge [8] in the most of the universities [7] must improve the innovative teaching practices, as well as an active exchange of knowledge to avoid the effect of reinventing the wheel over and over again [6]. This work goes in this direction proposing both a methodological instrument based on indicators to classify innovative education experiences and practices and a technological ecosystem for sharing and finding out them.

The sustainability of the work is guaranteed because of we work with several conferences that provide good educational innovation practices and experiences that are classified and measured taking into account the defined set of indicators. The work finished in 2012 with the contribution of good practices from 4 conferences, also in 2013 other 3 new conferences have been added. Authors of this work will start offering the knowledge management system to educational innovation scientific conferences from 2014.

The transferability of the experience occurs internally and externally.

Internally, the system is able to adapt itself to any are of knowledge, university, degree or specific subject, whether exist or not similar experiences.

The external transferability is based on the use of the results of this work in other contexts. As a first successful case, the outcomes of this research work are already being implemented both at he Polytechnic University of Madrid and the University of Zaragoza for classifying and measuring educational innovation practices produced in these universities.

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