Building world class universities through innovative teaching governance

Ignacio De los Rios-Carmenado[1,*], Susana Sastre-Merino [2], Andres Diaz Lantada[3], Javier García Martín [4], Priscila Nole [1], Jorge E. Perez-Martinez[4]

[1]*GESPLAN. GIE Project, School of Agricultural, Food and Biosystems Engineering, Technical University of Madrid (UPM), Spain*
[2] *GIE Project, Institute of Educational Sciences, Technical University of Madrid (UPM), Spain*
[3]*GIE DIM, School of Industrial Design and Engineering, Technical University of Madrid (UPM), Spain*
[4] *GIE DMAE-DIA, School of Computer Systems Engineering, Technical University of Madrid (UPM), Spain*

Accepted Version - for the published version of this paper -see: Ignacio De los Ríos-Carmenado, Susana Sastre-Merino, Andrés Díaz Lantada, Javier García-Martín, Priscila Nole, Jorge E. Pérez-Martínez, Building world class universities through innovative teaching governance, *Studies in Educational Evaluation*, Volume 70, 2021, 101031, ISSN 0191-491X, https://doi.org/10.1016/j.stueduc.2021.101031.
(https://www.sciencedirect.com/science/article/pii/S0191491X21000572)

***Keywords**:* Educational innovation World-class universities Innovative teaching Higher Education Governance

ABSTRACT

There is a growing interest in educational innovation in universities at a global level, as a tool designed to create strategic changes in order to improve quality. This study evaluates the global improvement in universities as a result of educational innovation governance, as a pillar of the so-called world-class research universities and as a tool for continuous improvement in higher education. The methodology has been designed by different educational innovation groups from the Universidad Politécnica de Madrid, Universidad de Cádiz, and the International Project Management Association Spanish Board, and includes an analysis of 67 universities from 20 countries. The study is based on 32 universities in Spain, as well as 35 other international universities that carry out educational innovation activity. The results show that universities that have a more mature educational innovation governance in place, both in Spain as well as in other countries, are higher in the ranking of universities (Webometrics). These universities demonstrate a tendency to work on educational innovation projects, which are contributing to strategic changes that will permanently revitalise teaching, whilst also improving research and its links to society.

1. Introduction

1.1. World-class universities and change

In recent decades, there has been a lot of discussion about "*world-class universities*", i.e. leading universities with a global status and with the required characteristics that a university should have in order to belong to this select group (Salmi, 2009; Huisman, 2008; Cazorla et al., 2014; Cazorla & Stratta, 2017). According to several experts, these *world-class universities* are based on four key pillars: research; links with society, through the implementation of projects; high quality teaching with continuous improvement through educational innovation (EI); and a research and innovation management service, providing support for managing EI and research projects (Shils, 1997; Altbach & Salmi, 2011; Altbach, 2016; Cazorla & Stratta, 2017). High concentration of talent, abundant resources to offer a rich learning environment and to conduct advanced research, and favourable governance features that promote leadership, strategic vision, innovation, and flexibility and that support institutions to make decisions and manage resources without being encumbered by bureaucracy, have been also proposed as key features in "*world-class universities*" (Altbach & Salmi, 2011).

Three of the aforementioned pillars (research, teaching and links with society) are the three dimensions that gather all the indicators measured in the main international university rankings that have emerged since the first decade of the 21st century (Shanghai, The Times and Webometrics). Even though they give different weights to each dimension, they all have given research a prominent role, and hence, research universities are considered by these rankings as a benchmark for university quality (Lavalle & De Nicolás, 2017). The scientific community has a wide range of opinions around such quality model, with a debate in terms of what these universities contribute in the context of the country (Ordorika & Rodríguez, 2010; Altbach, 2003; Salmi, 2009). As Altbach (2003:7) stated, "for most countries, even large and relatively wealthy ones, only one or two world-class universities are possible or even desirable. Research universities are at the pinnacle of a differentiated academic system in a country—the rest of the system is just as important as its top".

Regarding teaching, it has been, is and will be one of the main pillars of the university concept. It is essential for learning and transferring knowledge. High quality teaching contributes to the strengthening and prestige of the institution (Lavalle & De Nicolás, 2017). In this context, educational innovation emerges as a strategic governance pillar for

research universities (Zomer & Benneworth, 2011; Blass & Hayward, 2014), aimed at improving the university's quality (Altbach, 2008; Dede, 2013).

The signing of the Bologna Declaration in 1999, together with other changes that were taking place in the existing management models worldwide, and the dispute between university autonomy and financing (Flórez-Parra et al., 2014) provoked university teaching revolution, with EI becoming a key topic for dealing with these changes at an institutional level (Bartkus, 2001; Gunasekara, 2006), more closely integrating research with teaching (Sonka, 2004; Buddlemeyer, 2010; Huisman, 2008). Several international universities started to redesign their governance models, following the path of globally renowned universities (Cazorla & Stratta, 2017; Altbach & Salmi, 2011; Altbach, 2016).

During the 1980s and 1990s, Australian and overseas universities moved away from the self-governance model of university governance to a model more closely aligned with business corporations, oriented towards the efficiency and effectiveness of institutions (Harman and Treadgold, 2007). In North America, the governance bodies established as a strategy the search for alternative sources of financing to public income, through patents, paid by companies. These measures have put increasing pressure on universities to produce research that is valuable to the industry and to establish closer links with the business community (Muscio et al, 2013). In continental Europe, the strategy of university governance mechanisms has aimed at transferring the results from the university to society, both in research and in continuous learning (Flórez-Parra et al., 2014). Recently, greater attention has been paid to university–industry collaboration projects such as research contracts and consulting activity, characterised by a higher degree of relational linkages, capable of generating strong learning by inter- action effects (Perkmann and Walsh, 2009; Geuna and Muscio, 2009). In Asia, the governance strategy has been aimed at professionalizing the management of universities and orienting the training of students towards developing the necessary skills for their professional activity both in companies and in government (Flórez-Parra et al., 2014).

There are different trends within all this process of change that universities are immersed in. An important number of them are critical of top-down change strategies in academic contexts (Lane et al., 2020; Saroyan & Trigwell, 2015; Henderson et al., 2015). The later claims that: "*Two commonly used change strategies [in STEM-institutions] are clearly not effective: developing and testing 'best practice' curricular materials and then making these materials available to other faculty and 'top-down' policy-making meant to influence instructional practices.*"

Nonetheless, there are studies that approach strategic change based on Shepards's model of planned change, who proposes four steps: 1) identify the objective; 2) plan the change process; 3) take action; 4) evaluate; and then repeat. Following this model, Storberg identifies three key factors in higher education (Storberg & Torraco, 2004). First, *institutional leadership,* asserting that "it is clear that the leadership and governance structure of higher education will substantially shape any change process that begins with identifying and building consensus on objectives". Second, *diverse stakeholders and continuents*. And finally, *institutional culture,* claiming that "change strategies seemed to be successful if they were culturally coherent or aligned with the institution's culture". In this case, culture is defined as "the deeply embedded patterns of organizational behavior and the shared values, assumptions, beliefs, or ideologies that members have about their organization or its work" (Peterson & Spencer, 1991).

Kezar and Eckel deepen this concept of institutional culture (Kezar & Eckel, 2002). Specifically, their study analyses its effect on strategies for change in higher education and highlights five strategies for change: *senior administrative*, which concerns with "the way senior administrators can facilitate change through resources, structures, and so on"; *visible actions* to facilitate people to see the results of their work; *staff development* seen as "a set of programmatic efforts to build new capacities within faculty and staff"; *robust design* and *collaborative leadership*.

This study is developed within Kezar & Eckel framework of change in higher education, as it addresses academic change from the perspective of educational innovation management. Such management is mainly supported by the development of educational projects, since projects are considered a fundamental pillar of the institutional culture of engineering education, although project work is not an exclusive practice of engineering and extends to other areas of research and academic knowledge (Pemsel and Müller, 2012; Poell and Van der Krogt, 2003; Cerezo et al., 2019). The first three strategies from Kezar & Eckel mentioned above are directly related to the items included in our study (see the first three sections of the questionnaire: Actions for Supporting educational innovation; Strategies, structures and processes; Educational Innovation Projects). The authors acknowledge that this perspective may have a bias, but it is essential to take it into account in order to get a complete picture of change in higher education. The views of teachers and students will be integrated into future work.

1.2. Teaching and research

The globally renowned universities have demonstrated that establishing links between teaching and research improves the quality and attractiveness of educational programmes (Elton, 2001; Zamorski, 2002; Healey, 2000; Jenkins et al 2003; Marsh and Hattie, 2002; Healey, 2005). "Teaching and research are becoming ever more intimately related. In a 'knowledge society' all students—certainly all graduates—have to be researchers. Not only are they engaged in the production of knowledge; they must also be educated to cope with the risks and uncertainties generated by the advance of science." (Scott 2002, p. 13).

These universities have moved away from the traditional model of "teaching vs. research" (Healey, 2005; Cummings, 2009), and they consider research and teaching to be an essential characteristic of the university, as both are forms of learning. Under the concept of "research-based learning" (Blackmore and Fraser, 2007) learning strategies have been developed with the aim of connecting research with teaching. Based on this idea of seeking a relationship between teaching and research, different terms and methodological focuses have emerged (*research-enhanced teaching; research-informed learning; research-based education; research-based learning; teaching-research, inquiry-based learning*), indicating that this relationship should be an essential characteristic of the university and its teachers (Scott 2002; Brew, 2003; Fernández Pello, 2017). Therefore, the faculty's drive for creativity has been considered a key aspect for strengthening a university (Cazorla et al, 2019).

1.3. The context of educational innovation

Using these experiences from *world-class universities*, many universities have started a new culture of "working on EI-based projects (EIP)" (Kooli et al, 2019), creating educational innovation teams and groups, therefore driving consistent collaboration between teachers (Buddlemeyer, 2010). An educational innovation project is an operation with time and resource constraints that aims to improve or change the field of education, defined in accordance with quality requirements and standards. This project-based approach to EI has led to a "change in mentality" (De Ferrari, 2006; Sonka, 2004) amongst the more "traditional" teachers, who transfer knowledge, towards a profile of teachers who are researchers and innovators, capable of creating knowledge (Cazorla et al, 2014), and driving research activity based on EI. Within this change process, the importance of facilitating new interdisciplinary cooperation relationships between teachers has been emphasised (Chinnowsky et al, 2006; Colomer et al, 2018; Cropley, 2015), as well as the permanent review of teaching duties in order to achieve excellence and EI (Shulman, 2016).

As time has gone by, the work done by EI groups has started to overlap and connect more of the research groups, becoming an original strategy in the governance of many universities who seek continuous improvement (Kooli, 2019; Salmi, 2009; Gunasekara, 2004; Sharma et al., 2006) and who want to become agents for development (Ischinger & Puukka, 2010; Chatterton & Goddard, 2000; Widen, 2019; Cazorla et al, 2017).

A key dimension of EI has been its ability to create change and methodologies for developing skills (knowledge, values and behaviours) to guarantee a higher education system that is able to meet society's needs (Aydar and Kalimullin, 2016; Kooli, 2019) as well as "global citizenship education" (UNESCO, 2016). The abilities and skills that society requires of its future professionals have become fundamental factors that should be considered in the design of new educational strategies. These competences have currently been established as the foundations in the professional world and therefore become a key factor for the majority of educational models, not only in the higher education area, but also increasingly in primary and secondary education. The European Higher Education Area (EHEA) has represented a significant change in university teaching, which has traditionally been based on the transfer of knowledge, towards teaching systems focused on students' active learning and the development of their personal and professional skills. In this respect, cross-functional skills are emphasised, including teamwork, communication, leadership, creativity, ability to solve problems, getting on with people socially, amongst others (CEC, 2003).

For the development of these competencies, a number of areas of study with regards to EI have emerged over time, which are helping to reconfigure teaching for the 21st century. The objective of introducing methodologies based on active and experiential learning is for people to create new knowledge from their own existing knowledge base and experiences (Gijselaers, 1996) by participating and interacting with others. In this context, methodologies such as project-based learning, challenge or problem-based learning, or game-based learning have been extended. This involves integrative approaches, and position students as the protagonists in competency-based learning (Larmer, 2014).

In many other situations, EI has led to a better strategic vision for building the EHEA and moving towards an educational model in which the university tries to become a transformation engine for society (Razak, 2007), contributing to a knowledge-based economy that responds to the challenges of globalisation (Blass and Hayward, 2014; Altbach and

Salmi, 2011, 2016). These models have also aimed to respond to the new professional profiles that are emerging as a result of the fast technological, economic, social, cultural and political changes. As a result, new structures, strategies and resources have been created at an institutional level, that promote EI, incorporating research and EI, resulting in more innovative teachers who provide new knowledge, whilst connecting their students with society and businesses (Lester et al., 2005; Desay, 2013; Gunasekara, 2006; De los Ríos, 2017).

In this context, project-based governance is understood as a form of government that fulfils two characteristics: it achieves the strategic objectives of the organization through projects and programs and it maintains a continuous development of organizational competences (IPMA, 2016).

1.4. Objectives of this study

Several studies have analysed the relationships between research and teaching in higher education (Johnston, 1996; Rowland, 1996; Neumann, 1994; Jenkins et al, 1998; Neumann et al 2002; Robertson and Bond, 2001). However, few have focused on EI governance, and its global effects in relation to improving a university.

This study focuses on the governance dimension of EI, with the purpose of evaluating and extracting a set of best practices for improving universities, towards achieving excellence. It is clear that change within universities should be promoted by the more relevant key players of the teaching-learning process (students and professors) and, consequently, should ideally be driven in a bottom-up approach. Nevertheless, authors believe that it is also relevant to focus on the governance of EI and to obtain the views of university managers, for different reasons. First of all, in most cases, university managers are also involved in day-to-day educational activities and their views as managers is complemented with their experiences as educators. Secondly, most "world-class universities", as present study also puts forward, tend to plan very dynamic and flexible strategies for the promotion of EI, which combine some general top-down views and strategies, but clearly rely on the gathering and fostering of all kinds of bottom-up proposals, from single-course level to innovation within varied programmes, up to reinventing the university procedures. This mixed and quite common top-down / bottom-up approach is also exemplified by very relevant research programmes, like European Commission's recent "Horizon 2020" and new "Horizon Europe", in which strategic and very focused directions are funded together with more open topics oriented to fostering bottom-up innovation. Even for the more focused or specific actions, as happens also in universities when defining their EI strategies, these actions are planned not only by the governing bodies, but also counting with input from researchers and society, in the case of R&D, and from professors, students and social councils, in the case of EI.

This study therefore aims to answer the following two questions:

(1) what are the key aspects of educational innovation governance in the universities?

(2) what effects are usually generated by this educational innovation governance by projects?

These research questions and related exploratory analysis can help to identify the different dimensions that the universities should consider when it comes to EI as a strategy for improvement and developing the associated policies.

2. Methodology

The results of this research study are based on a methodology that incorporates different tools and sources of information:

Firstly, numerous secondary sources (scientific literature) on the concept of EI were identified and reviewed. Furthermore, the outputs of recent international conferences (Argentina, Peru, Boston) were also considered as relevant complementary information, in terms of improving universities using EI strategies, as they have shown the path taken by some globally prominent universities with regards to EI (Cazorla & Stratta, 2017).

Secondly, the research methodology includes empirical evidence obtained directly from the management and those responsible for EI governance at Spanish universities as well as international universities.

This study is part of an innovative teaching initiative (implemented trough the EI project-based governance) that has had different phases, which started around 2006 and from the prominence of the Educational Innovation Groups and Research Groups of Universities associated with the IPMA competences model, providing professional contact with the external agents.

2.1. Instruments

2.1. Instrument and sample

A web-based questionnaire was implemented for this study. Data obtained through online instruments are considered better, or at least as good, as representations of the general population compared to data collected through traditional pencil and paper samples (Gosling et al., 2004).

The literature that supports the questionnaire design is organized around the following frameworks: Kezar & Eckel framework of change in higher education (Kezar & Eckel, 2002); world class Universities´ trends for improving through innovation (Cazorla & Stratta, 2017; Altbach & Salmi, 2011; Altbach, 2016) and the organisations' project management competences (International Project Management Association, IPMA OCB model) (IPMA, 2015, 2016; Pemsel and Müller, 2012; Van der Krogt, 2003; Wagner, 2012; Maylor et al., 2006). The first two frameworks have been explained in deep in section 1.1. From a holistic point of view, the IPMA OCB model offers competence development guidelines for assessment and improving project success, training and certifying practitioners. It is a project management framework that has been shown to be potentially useful for university governance, as it incorporates principles of sustained success for any project, also applicable to educational innovation projects (Bodea et al 2010; Otero et al, 2014; De los Ríos et al, 2010, 2015; Wagner, 2012; Cerezo et al, 2019). We also considered the psychometric models (Leigh, 2007; Fouad, 2009; Donovan and Ponce, 2009).

The questionnaire includes the findings in previous EI-projects and has its background on the EHEA, the European Research Area and the international project management governance standards in the university (teaching and research) context, to promote project management competences (De los Ríos et al, 2010, 2015, Cerezo et al, 2019). The researchers held a series of meetings with Educational Innovation Groups and other staff from IPMA to engage them in the design and implementation stage.

The following six variables were included in the questionnaire:

M Support: actions for supporting innovative teaching governance (specific webs, awards, Training measures, Conferences for sharing experiences, Advisory Committees, support services for the faculty).

M Strategy: The establishment of a governance system for educational innovation as a basic element to provide strategic guidance to the university (strategies, structures and processes related to EI).

M Projects: Maturity of EIPs work, to successfully carry out any type of change, innovation and improvement through projects. This variable includes items like planning and scheduling of EIPs, tools and systems, indicators, criteria to measure the quality of the results and benefits of the EIPs, monitoring and control of EIPs, and lessons learned and results of the EIPs.

M Effect: This variable aims to assess perceptions from the agents of the effects of projects in improving the quality through a series of specific dimensions that help the governance towards building world class universities.

The questionnaire was sent to key people (managers and directors) involved in EI and its governance in national and international universities. In each of the thematic clusters, questions were evaluated in order to ensure their relevance (Table 1). Ultimately, 35 items were established within six overall variables. Furthermore, an initial cluster was included with questions to identify and determine how long the specific EI services and units had been in place.

Thematic Cluster	***Items***	**Variable**
Actions for supporting educational innovation	1. Educational innovation groups or teams	M Support
	2. Educational innovation portal	
	3. Educational innovation awards	
	4. Training measures related to educational innovation	
	5. Conferences for sharing educational innovation experiences	
	6. Educational innovation Advisory Committees	
	7. Educational innovation support services for the faculty	
Strategies, structures and processes	8. Existence of Strategic Plans related to EI	M Strategy
	9. Existence of Structure, Services or Units specifically related to EI with staff (administration and services) to support EI project management	
	10. Existence of specific calls for improving EI projects and EI training activity	

	11. Existence of guidelines relating to EI	
	12. Governance strategies for strengthening culture and recognition of EI achievements	
	13. Specific actions and resources for improving the faculty's EI training	
	14. Existence of a relationship between quality services and EI services	
Educational innovation projects	15. The reach and implementation environment of EIPs are aligned to the university's vision and mission	M Projects
	16. There is planning and scheduling of EIPs including opening and closure processes	
	17. Processes and systems (indicators, criteria, tools) are available to measure the quality of the results and benefits of the EIPs, as well as monitoring and control	
	18. Processes and systems are available to manage human resources	
	19. Budgetary planning is in place for EIP financial resources and infrastructure	
	20. Scientific publications are created by the EIPs and results are shared	
	21. There is an institutional database or portal where lessons learned and results of the EIPs can be shared	
Effect on improving teachers	22. The university has a quality department	M Effect Teachers
	23. Improvement in the quality of teaching activities	
	24. Improvement in the faculty's motivation	
	25. Improvement in collaboration amongst the faculty	
	26. Improvement in teaching creativity	
Effect on improving students	27. Improvement in the quality of the students' academic activity	M Effect Students
	28. Improvement in students' motivation	
	29. Improvement in collaboration between students and teachers	
	30. Improvement in students' creativity	
Effect on improving universities	31. Improvement in the quality and quantity of web content and creation of open-access resources	
	32. Improvement in research through educational innovation	M Effect Universities
	33. Improvement in social commitment and links with other national and international universities	
	34. Improvement in the university's branding and increased online presence: Managing and increasing connections	
	35. Improvement in sharing results through journals or other channels, or in the institution's own publication	

Table 1. Questionnaire on educational innovation governance in universities, and its effects

In order to evaluate the items, a Likert scale was used (Likert, 1932), which is commonly used in social sciences for measuring perceptions and quantitative aspects (Barbero, 1993). Each item is structured with five different responses (Ávila, 2006) – completely agree (5), agree (4), neither agree nor disagree (3), disagree (2) and completely disagree (1). A higher score is given when the respondents have a more favourable perception.

To contrast and verify some data from the questionnaire, periodic working meetings of the project advisory board were celebrated, including debates between the team of authors and the Educational Innovation Service at Universidad Politécnica de Madrid and other international universities, mainly aimed at organizing the research, analysing the key results and summarizing a set of proposed good practices.

Furthermore, the integrated analysis has also considered the position of each university in the rankings using the Webometric ranking (Aguillo et al, 2008), as this is the only one that ranks and evaluates all of the universities across the world. The universities' position in the national rankings (*N Ranking)* and Webometric international rankings (*M Ranking)* were included as variables. Other variables considered were geographic area and age of EI services.

The questionnaire was implemented over a four-month period, with the support of the Universidad Politécnica de Madrid's EI Service.

2.2 The sample's reach

As far as national sample is concerned, this study has been promoted by the Universidad Politécnica de Madrid to analyze those Spanish universities that offer engineering degrees, in addition to degrees in other areas of knowledge. Therefore, the 57 Spanish universities that meet this characteristic were selected. Nevertheless, due to the variety of degrees covered by these institutions, the results obtained can be considered general, not specific for engineering.

The target of this first study has been the analysis of the EI management, starting from the information obtained from the own institution. Then, the questionnaire was sent to directors and managers who are directly or indirectly involved in the governance of EI groups and projects in universities. After a validation process, 27 valid responses were included in the statistical analysis. This sample is uniformly distributed across the Spanish territory. Moreover, there are 23 public institutions and 4 private ones, which can be considered representative of the Spanish university map.

Regarding the international sample, the questionnaire was sent to those universities that somehow already had collaboration with the Universidad Politécnica de Madrid. Valid responses of the questionnaire were obtained from 35 universities, which were divided into four groups for the analysis, based on their location: 13 in Latin America, 8 in the USA and Canada, 12 in Europe, and 2 in Asia. In this way, except from Asia, we obtained a balanced sample from different geographic areas.

In summary, the total reach of the questionnaire was 62 universities worldwide.

2.3 Statistical analysis of the consistency

Once the variables had been filtered, the tool included 35 items. Cronbach's alpha has been used to measure the questionnaire's reliability (Cronbach, 1951; Fernández et al, 1999; Yang et al, 2011). The coefficient was calculated for each of the individual items in each cluster of questions (Table 1), except for the first cluster "Actions for supporting EI", as the response is YES/NO. In the case of the responses from national universities, for clusters 2 (items 8 to 14), 3 (items 15 to 21), 4 (items 22 to 26), 5 (items 27 to 30) and 6 (items 31 to 35), the α values obtained are 0.709, 0.608, 0.782, 0.863 and 0.765, respectively. If the values are higher than 0.7, we consider that the scale used is acceptable. Having examined the second cluster of questions, the Cronbach's alpha was recalculated eliminating question 16, obtaining an α value of 0.709 (Abad et. al, 2011; Pardo et al, 2009). In terms of the overall data set including national and international universities, the α values for all the clusters of questions were higher than 0.8.

To confirm if the samples of the different variables match the normal population, the Kolmogorov-Smirnov and Shapiro-Wilk tests were carried out (Massey, 1951; Shapiro et al, 1965). Based on these results, parametric and nonparametric tests were then used. The Student's t-test was specifically used for the samples with a normal distribution and the Wilcoxon test was used for those that did not meet this requirement.

Different comparisons were carried out for the statistical analysis of the 6 dimensions in the questionnaire. Firstly, an individual comparison between the group of Spanish universities and the universities from other countries (Latin America, USA and Canada, Europe) was carried out. Additionally, the results from the questionnaire were compared, dividing the universities into two groups based on how long their EI services had been established. Finally, the universities were divided into those that have high positions in the rankings and those that are towards the bottom, comparing the results from both groups. SPSS V.15 software was used to analyse the data.

3. Results and discussion

Following the inclusion of the different sources used, the results are presented based on the research questions that were posed.

3.1. Educational innovation governance dimensions

The governance of EI has been analysed using three dimensions: a) institutional support measures, b) EI strategies, structures and processes, and c) EI projects. The universities were organised in the following groups: SP= Spanish (27), LA = Latin American (13), NA = USA and Canada (8), EU = Europe (12). Although the group of Asian universities (A) also appears, the sample is very small (2). An individual comparison was carried out between the group of Spanish universities and the rest of the groups.

3.1.1. Actions for supporting educational innovation

Table 2 shows the results of section 1 of the questionnaire, taking into account the total number of universities surveyed. The answers are Yes / No and the results are shown in percentages.

Both in the parametric and nonparametric tests, statistically significant differences are only obtained between the group of Spanish and Latin American universities, with a confidence interval of 99% for the *Support Measures* variable (figure

1). The effect size has also been calculated using the Cohen's d Formula (Cohen, 1992), obtaining a value of 1.365, which is very significant.
By examining the existence and age of the services or departments specifically dedicated to EI in Spanish universities, it can be observed that 56% were established more than 10 years ago, and 22% have had them for between 5 and 10 years. It can be observed that those that have been in place for more than 10 years have a higher mean (4.48) than those that have been in place for less than 10 years (3.69), although the difference is not statistically significant.

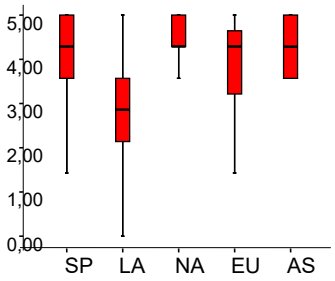

Figure 1. Mean and range of the EI support measures by geographic area.

Response	Item	YES	NO	NA
Educational innovation groups or teams	1	90.91	7.58	
Educational innovation portal	2	59.09	39.39	
Educational innovation awards	3	60.61	37.88	
Training measures related to educational innovation	4	86.36	12.12	
Conferences for sharing educational innovation experiences	5	86.36	12.12	
Educational innovation Advisory Committees	6	59.09	34.85	4.55
Educational innovation support services for the faculty	7	87.88	9.09	1.52

Table 2. Evaluation of Actions for supporting educational innovation (%)

3.1.2. Strategies, structures and processes for supporting educational innovation

Similarly, with regards to the EI strategies, structures and processes, statistically significant differences have only been obtained between the group of Spanish and Latin American universities, with a confidence interval of 99% for the *M Strategy* variable (figure 2) and an effect size of 1.357. It is worth highlighting that 78% of the universities have information on their websites about the management teams responsible for EI and 53% of them indicate that they have staff who are exclusively dedicated to the administration and management of EI. This data confirms the strategic vision that many universities have so that they can imitate the world-class universities (Salmi, 2009; Huisman, 2008; Cazorla et al., 2014; Cazorla & Stratta, 2017), designing strategies, structures and processes aimed at improving research and innovation.

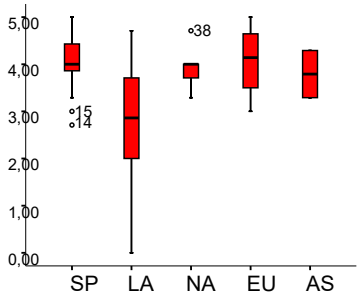

Figure 2. Mean and range of the strategies, structures and processes by geographic area.

In terms of the possible differences in the variable based on how long the EI services have been established in Spanish universities, although for the MStrategy variable no significant differences were found based on the age of the EI services, the mean for the oldest (4.24) is somewhat higher than the newest (3.95).

Amongst the evaluation of different strategies for supporting EI in universities (table 3), the most highly rated are calls for EI projects (EIPs), followed by the implementation of services or departments dedicated specifically to EI, with staff to support with the management of EI projects. This result confirms the teachers' tendency for project-based work, in a similar way to research groups. Training the faculty to develop their teaching skills is also highly rated due to its effectiveness for driving change. The least rated aspects are regulations relating EI (standards, group regulations) and the recognition of achievements related to EI, as they are less prominent in universities' governance.

Therefore, a higher rating is given to aspects related to the resources provided by professors and lower ratings are given to those related to organisation and governance. This demonstrates that the governance of EI is still in the relatively early stages of maturity in many of the universities.

Response	Item	1	2	3	4	5
The institution's **Strategic Plan** includes aspects and strategies related to *EI* with specific measures that provide the university with benefits and services that support the faculty in EI	8	0	3.7	3.7	51.9	40.7
There are Structures, Services or Departments specifically for *EI*, with staff (Administration and Services) to support with *EI* project management	9	0	3.7	0	33.3	63
There are specific calls for promoting *EI* projects and training activities	10	0	0	3.7	14.8	81.5
There are regulations relating to EI (standards, group regulations)	11	15.4	15.38	11.5	19.2	38.5
The governance strategies are aimed at promoting an *EI* culture and **recognition of achievements related to *EI***	12	0	3.85	34.6	30.8	30.8
There are specific activities and resources for improving **EI training amongst the faculty**	13	0	0	11.1	40.7	48.2
There is a relationship between **Quality services** and *EI* services	14	11.1	7.41	22.2	22.2	37.0

Table 3. Evaluation of the EI strategies, structures and processes (%)

3.1.3. Educational innovation projects

EI projects stand out as one of the dimensions of EI governance, with a presence in 84% of the universities. The mean for this variable is only significantly lower amongst Latin American universities compared to Spanish universities, for a confidence interval of 95% (figure 3). In this case the effect size is 1.114.

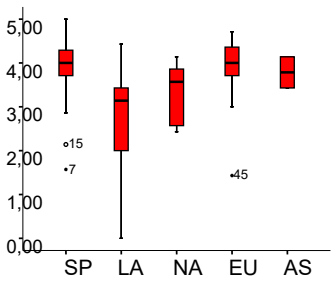

Figure 3. Mean and range for Projects by geographic region

These results demonstrate a **clear trend, associated with working on EI projects,** as a horizontal axis for more effectively improving teaching quality and providing results and strategic changes that can be evaluated. As is the case in the research field, many of the universities' EI projects are linked to society's needs and problems (Cazorla et al, 2019; De los Ríos et al, 2016; De los Ríos and Pesantez, 2016; Fidalgo-Blanco et al, 2014; Finkel, 2013).

In a similar way to research universities, governance provides project management systems (IPMA, 2017) so that they are aligned with a strategy and vision, ensuring that all the efforts are closely aligned to the university's mission of generating new knowledge.

This EI project-based work is enabling professors to work collaboratively to transform the educational context, implementing changes aimed at improving the quality of teaching practices, which has qualitative and quantitative impacts on students and the wider society. In research universities, these EIPs are generally set-up and managed by "temporary organisations", referred to as EI groups and research groups, formed by professors who belong to different institutes.

The EIPs have therefore become the main tool for sharing experiences and research in the field of EI, through different "learning laboratories" (Cazorla et al, 2016; De los Ríos et al, 2016). Many of these "laboratories" are aimed at the development of project-based learning skills (Chinnowsky et al., 2006; Padmanadhan & Katti, 2002; De los Ríos, et al, 2010, 2015), supporting new ventures (Goldfarb y Henrekson, 2003, Rappert, 2004; Salgado et al, 2017), innovation (Etzkowitz et al, 2000; Blass et al, 2012), and service-based learning or service-learning (Bringle and Hatcher, 2000), combining the development of skills with a service that responds to social and environmental needs. Currently, these projects are centred on the United Nation's Sustainable Development Goals (SDG) framework (Cazorla et al 2019). This "project-based" model has been replicated in the majority of universities, and they have adapted regulations and policies in order to establish innovation groups as a strategy for improving their rankings (Cazorla et al, 2016; De los Ríos et al, 2017).

The results that were obtained for this governance dimension are detailed in Table 4.

Response	Item	1	2	3	4	5
The reach and environment in which the EIPs are implemented are based on the university's vision and mission	15	0.0	3.7	22.2	51.9	22.2
There is planning and scheduling for EIPs, with opening and closure processes	16	3.8	3.8	3.8	7.7	80.8
There are processes and systems (indicators, criteria, tools) for measuring the quality of the results and benefits of the EIPs, as well as tracking and control	17	11.1	7.4	11.1	48.1	22.2
There are processes and systems in place for managing human resources	18	8.0	12.0	28.0	32.0	20.0
There is budget planning in place with financial resources and infrastructure for EIPs	19	7.4	7.4	0.0	37.0	48.1
Scientific publications are produced by the EIPs and the results are shared	20	0.0	7.4	25.9	33.3	33.3
The institution has a database or portal that enables it to share lessons learned and the results of the EIPs	21	0.0	14.8	14.8	14.8	55.6

Table 4. Evaluation of educational innovation project-based work (%).

The results primarily show the great importance of EI project-based work, with 89% of the respondents agreeing or completely agreeing that their universities require planning and scheduling of EIPs with opening and closure processes. This is the most highly rated option, confirming the results obtained in the previous section and validating that the universities have "specific calls for promoting projects and training activity for EI". Furthermore, 85% agree or completely agree that there is budget planning with financial resources and infrastructure for EIPs, which indicates that the universities dedicate their own resources to EI projects (items 16 and 19).

It is evident that in universities, EIP-based work is constrained by time and cost, with the EIP's timeframe often being the academic year, with some new starters (newly admitted students) and leavers (graduates). Each year, annual teaching goals are defined with the aim of evaluating quality improvements for certain aspects.

With EIPs, the investment in securing resources is almost always arranged by the university (in terms of human resources and infrastructure), with few additional resources. The expectation is that EIPs will provide changes and innovations for the management and utilisation of resources that are already available, and new relationships with society, which can occasionally help to secure complementary resources from external entities who are interested in the results.
As mentioned, universities have official sites or portals that allow them to share lessons learned and results of the EIPs (item 21), with 70.4% agreeing or completely agreeing. However, the quality of these sites varies a lot, and in many cases, they are simple websites with information on the projects.

The statistical analysis confirms that item 19 is significantly different than items 17 and 18; therefore, the lowest rated questions, which are those with the greatest margin of error, relate to the existence of processes and systems for measuring the quality of results and benefits from the EIPs as well as their tracking (item 17) and processes for managing human resources (item 18). However, although they are the least rated questions, some universities do have processes and systems in place for managing EIP resources and quality.

Although there is a growing trend for implementing processes and systems for measuring the quality and results of the EIPs, in general these are generic, and specific indicators for monitoring and controlling EIPs have only been observed in a few universities.

Moreover, it can be confirmed that the reach and environment in which the EIPs are implemented are focused on contributing to the university's vision and mission (74% agree or completely agree). This focus is observed in the most outstanding universities, who not only seek improvements in teaching quality, but also in the relationships with society, as well as research. Many EIPs have enabled new relationships to be established with external agents, through lines of research, contributing to the creation of services and socioeconomic development (De los Ríos et al, 2017).

Analysing how long EI services have been adopted, no significant differences are observed for the MProject variable between both groups, with the mean being very similar in both cases (3.88 vs. 3.93). It can be seen that this trend is extrapolated based on the research groups' experience, which is always more than that of the EI groups. These synergies between research and teaching are further reflected in the scoring for items 20 and 21: 66% of the universities agree or completely agree that scientific publications are produced by the EIPs and the results are shared in journals (item 20) and that they have official databases or portals for sharing the results of the EIPs (item 21). Both aspects are typical of the research universities' experiences, in which the results of R+D+i projects are published in scientific journals and there are official databases for sharing these results.

In conclusion, a form of governance is observed in which the EIPs have become a tool for achieving strategic changes and a permanent revitalisation of teaching, promoting research and links with society. In postgraduate courses in particular, strategic alliances have been formed between universities, as well as greater internationalisation, promoting a culture of quality and innovation (Altbach, 2016; Cazorla et al., 2019). In general, the calls and promotion of projects obtain a higher score than their subsequent control and management.

3.2. Effects of educational innovation

The following section shows the effects of EI based on the three dimensions that have been analysed: improvement amongst teachers, benefits for students, and the university's general improvement. Although only a part of the teachers' staff participates directly in EI projects, the results of these experiences are reflected in the curricula and teaching activities. In this way, the improvements finally have effect beyond the people who have developed the projects. We would like to highlight that the effects described in this section are obtained from managers of educational innovation. Consequently, these results, although important, will be completed in future works with the perspective of teachers and students.

3.2.1. Effects on improvement amongst teachers

The questionnaire results point out that EI helps teachers to improve in various aspects. Firstly, the effect that EI has on improving teaching quality is scored very positively (4.19), followed by the teachers' creativity (4.04). By innovating, they are able to maintain good levels of motivation throughout their professional careers (4.00). Collaboration between members of the faculty (3.78) is also improved by the EI activities.

It is also evident that teachers' motivation and teaching quality go hand in hand. On many occasions, inertia has been described as an enemy for revitalising teaching and being able to fully appreciate the experience that teachers acquire throughout their careers (Díaz Lantada, et al, 2013). Research, development and technological innovation activities, collaboration with companies, and foreign visits are experiences that teachers from technical universities gain throughout the years. These should all translate into innovations in their teaching activity so that students also benefit from them.

Other studies demonstrate that teachers who are reluctant to innovate, by not changing subjects that "work", either as a result of a lack of time or resources, or simply because of laziness, end up with subjects that soon become outdated and are not useful, due to the continuous technological revolution in which we find ourselves (Zomer and Benneworth, 2011). In summary, an openness to change and EI enables synergies to be created between teaching research and innovation, promoting continuous improvement and ensuring that the teachers (and students, as will be shown) remain motivated throughout their university life (Cazorla et al, 2019).

In terms of collaboration, it is important to highlight that many of the future students´ positions involve working with people and coordinating teams and colleagues in a multidisciplinary and international environment. The students should therefore acquire cross-disciplinary soft skills such as the ability to work in teams, effective communication with colleagues from other fields or disciplines, or understanding other cultures and languages, amongst others (Chinnowsky et al, 2006). Therefore, it is important for the university teachers to set an example to students and collaborate with R+D+i projects as well as all other types of teaching-learning activities. As a result, EI activities should also serve to strengthen collaboration between teachers, finding synergies, boosting creativity and achieving excellence.

In the majority of cases, the benefits of EI are joint (student-teacher), helping students to learn more whilst the university teachers also become more productive and improve their teaching skills, as a result of being exposed to new challenges (Finkel, 2013, Echávarri, 2015). Many studies have demonstrated how an evolution, from a more classic type of lecture to more innovative teaching methods and more active teaching-learning processes, results in greater creativity amongst students. They finish their studies being able to confront scientific-technical challenges as well as social and human aspects in a more innovative manner (Cropley, 2015).

3.2.2. Effects on improvements amongst students

The effect that EI has on students, as discovered from the questionnaire, is also interesting, even though the impact of EI seems to be greater on the teachers than on the students, perhaps as a result of the intensity with which the people involved in the questionnaire (teachers and other people responsible for EI) experience the innovation activities. In any case, according to managers' opinion the educational innovation activities have a positive impact on students' motivation (4.12) and the quality of their academic activity (4.12), with less of an impact on improving their creativity (3.85) and promoting collaboration between students and teachers (3.85), even though these are less than initially hoped for.

Considering that students' motivation is a critical aspect for success, for many decades the high dropout rates have been closely linked to a lack of motivation, and the fact that EI improves student motivation should be enough to promote EI services, teams and projects in all technical universities.

Benson et al. (2013), indicate in a similar way to this study, how motivation plays an important role in engineering and how EI, through projects that bring students closer to the reality of the workplace, helps to explain the impacts of engineering and brings a sense of reality to their expectations, contributing to greater motivation and a greater likelihood that they will persist with their studies and end up with a career in engineering.

This does not involve reducing the level of abstraction, but rather supporting students from the start and illustrating the applicability of what is being learned, using projects and practical case studies (Cerezo et al, 2019). Bodies such as ABET or EUR-ACE® also propose this approach, as they understand that part of the professional skills that students need to acquire relate to: 1) applying scientific-technological knowledge to solving real problems, 2) planning and implementing experimental activities, 3) working in multidisciplinary teams that are able to solve complex challenges, and 4) being able to design processes, products and services, amongst other things.

Furthermore, the use of new technologies has been highlighted in many occasions as an accelerator for learning amongst university students who are studying technical degrees: The use of "cloud computing" tools (Alaeddine, 2015), or "smartphones" (Muñoz-Guijosa, 2019), or the balanced use of online resources, which are now sometimes supported by artificial intelligence (Tuomi, 2019), have been proposed, amongst others, and are recognised as approaches that promote motivation, learning and access to quality higher education, the cost of which can be optimised thanks to these approaches and technologies.

In this respect, EI is closely linked to ensuring that education is accessible to all.

3.2.3. Effects on the university's improvement

As seen from the questionnaire that was carried out (Table 5), the effects of EI allow universities to improve in various aspects, all of which are of great relevance. Improving the quality and quantity of online content and creating open-access databases, as well improving how results are shared in journals or at the university's own conferences, are amongst those that stand out. Furthermore, the scores given to the improvement in research on EI, social commitment and relationships with other national and international universities, and the university's branding, are also important.

Response	Item	1	2	3	4	5
Improved quality and quantity of online content and creation of open-access databases	31	0.0	0.0	0.0	22.2	77.8
Improved research on Educational Innovation	32	0.0	0.0	7.4	66.7	25.9
Improved social commitment and relationships with other national and international universities	33	0.0	3.7	18.5	51.9	25.9
Improved branding and online presence: Managing and increasing the number of links	34	0.0	7.4	33.3	33.3	25.9
Improved sharing of results through journals or other channels, as well as the university's own conferences	35	0.0	3.7	18.5	48.1	29.6

Table 5. The effect that EI has on the university's improvement.

All of these factors have an impact on improving the indicators in the international rankings. These are useful tools for providing valuable information for the governance of groups and universities, on how their work is perceived and what impact it has. The rankings can be used as reliable tools for university governance and as a reference for research groups as well as EI groups, for one main reason: They provide information on the current state of the university at a national, continental and international level.

The EI groups' activities also contribute to the improvement of those four indicators, transforming the university into a research university. With regards to this, the results from the themes relating to governance have been analysed, based on the national universities' position in the Webometrics rankings. The threshold has been set at position 25, so that the number of universities in the two groups is well-balanced, considering the universities that were analysed. Table 6 shows the statistics for both groups according to their position in the Webometrics rankings. Using nonparametric tests, significant differences were detected for the three variables (MSupport, MStrategy, MProjects from Table 1) between the group of universities at the top of the ranking (up to position 25) and those at the bottom (>25). The significance levels are 0.0037, 0.015 and 0.012 for the support, strategies and projects variables respectively. The effect sizes calculated using Cohen's formula (Cohen, 1992) are 0.788, 0.820 and 0.816 respectively for the three variables, which represents a significant difference.

In terms of the tenure of the universities' EI services, differences were also obtained with a confidence level of 95%, when comparing the position that universities with older EI departments occupy in the rankings. The universities with older EI departments (more than 10 years) hold higher positions in the rankings (mean position of 25.1), than those that were established less than 10 years ago (mean position of 42.5); that is, they are better quality as world-class universities.

Both results demonstrate that the national universities that have adopted EI governance in a more robust manner (with support measures, structures and projects) and have been doing so the longest (more than 10 years) occupy higher positions in the rankings.

		Position in Webometrics ranking	N	Mean	Standard deviation	Standard error of the sample
National	MSupport	> 25	17	3.8671	.98081	.23788
		1-25	10	4.5730	.49867	.15769
	MStrategies	>25	17	3.8912	.57769	.14011
		1-25	10	4.4860	.44167	.13967
	MProjects	> 25	17	3.6547	.79097	.19184
		1-25	10	4.3130	.40852	.12919
	Total	> 25	17	3.8043	.49047	.11896
		1-25	10	4.4573	.33776	.10681
International	MSupport	> 500	33	3.464	1.362	.237
		1 - 500	21	4.389	.650	.142
	MStrategies	>500	33	3.563	1.031	.179
		1 - 500	21	4.293	.606	.132
	MProjects	> 500	33	3.475	1.014	.176
		1 - 500	21	3.890	.885	.193
	Total	> 500	33	3.5008	.98559	.17157
		1 - 500	21	4.1910	.57706	.12592

Table 6. Statistics for Spanish and international universities according to their position in the Webometrics rankings.

Furthermore, **at a global level**, the national and international universities have been analysed and compared**, based on the Webometrics international ranking.** For this purpose, the threshold has been set at position 500, so that the number of universities in each of the two groups is well-balanced (Table 6). Using the Student's t-test for the three variables, there are statistical differences for Support and Strategies-Structures, with p-values of 0.005 and 0.002 respectively. The effect sizes are 0.888 and 0.785. In contrast, there is no significant difference for Projects, with a p-value of 0.13 and an effect size of 0.423. Therefore, this demonstrates how project-based work is becoming a regular practice in the large majority of universities, both at the top and bottom of the ranking. In contrast, not all of the universities equally put into practice EI support measures and strategies and EI structures, and in both cases the universities towards the top of the ranking are more advanced.

Analysing the **EI support measures** in greater detail, it is evident that the universities in the higher part of the ranking (positions 1 to 500) have a wider range of support measures than the group of universities lower than position 500 (Table 7).

		Groups	Portal	Prizes	Training	Conferences	Advisory Committee	Support Services
<500 in the Ranking	Yes	100.00%	80.95%	71.43%	100.00%	90.48%	71.43%	100.00%
	No	0.00%	14.29%	28.57%	0.00%	4.76%	23.81%	0.00%
≥500 in the Ranking	Yes	81.82%	48.48%	54.55%	78.79%	87.88%	51.52%	81.82%
	No	18.18%	51.52%	45.45%	21.21%	12.12%	42.42%	15.15%

Table 7. EI support measures in Spanish universities according to their position in the Webometrics ranking (U<500: Universities in positions 1 to 500 in the Ranking; U≥500: Universities in position 500 or higher in the Ranking).

Similarly, by analysing the strategies, structures and processes related to EI, based on the universities' position in the world rankings, higher scores are observed amongst universities in the better positions for all of the aspects that were rated (Figure 4). In the same way as the isolated case of the national universities, according to the tests carried out, significant differences have been confirmed for questions related to calls for EI projects, EI regulations, recognition of achievements, EI training and the link between the EI support units and quality services.

No significant differences can be confirmed in relation to whether there is a strategic plan with specific measures to support EI, or whether there are specific EI structures or departments to support the management of EI; although the results do show that the universities that have a higher position in the rankings have higher scores for all of these questions, as shown in the following figure.

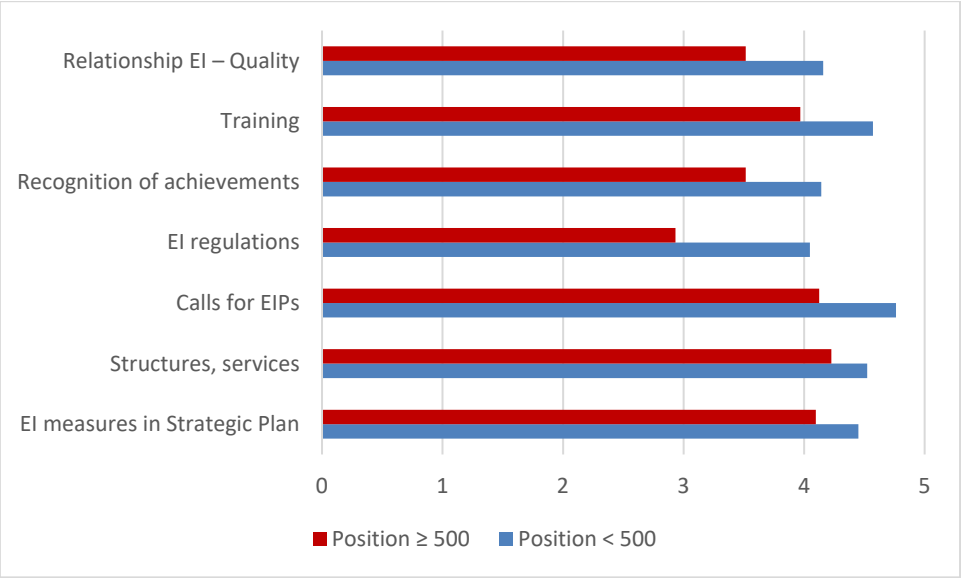

Figure 4. EI strategies, structures and processes according to the position in the World Rankings

Finally, the complete analysis of governance is presented, combining the variables that have already been analysed: "Support Measures", "Strategies, structures and processes", and "Projects", both at a national and international level. At a national level, significant differences are observed between the two groups with a confidence interval of 99%, both in the parametric and nonparametric tests (4.46 for the universities in positions 1 to 25 and 3.80 for the rest). The results at an international level are similar, with significant differences between the two groups (4.18 for universities in positions 1 to 500, and 3.50 for the rest).

On the one hand, we have seen that the questionnaire allows us to obtain a measure of the support that the institution gives to EI, especially through the implementation of projects. On the other hand, the Webometrics ranking organizes the classification of the institutions according to some indexes that can be grouped in three blocks: scientific production; availability of diverse teaching materials and documentation; general information of the infrastructure and support of the institution (departments, groups, services, personnel, etc.). All this gives a general measure of the university's research and teaching activity, as well as its potential.

The statistical results obtained show that there is a clear correlation between the support provided by the institutions to EI and their position in the ranking. Initially, two interpretations are possible. The first hypothesis is that the universities that show more general activity, among all their activities, also promote EI. The second possibility is that EI activities generate more productivity related to project development and dissemination. From our point of view, the most plausible possibility is that both hypotheses feed off each other. In this way, the institutions that occupy better positions in the ranking because they favour different activities are those that most promote EI, and in turn, the activities carried out in the context of EI help to strengthen the position in the ranking, since they help to improve the indicators.

Therefore, we can deduce that there is a clear relationship between EI governance and the position in the rankings at a national and international level, and as a result, EI is a key factor for the overall improvement of universities. The universities, both at a national and international level, that have adopted EI governance as a strategic element (with support measures, structures and processes), and that have done so for the longest amount of time, occupy higher positions in the rankings.

These results indicate that EI governance is related to and contributes to the universities' overall improvement at a global level, improving their position in the Ranking Web of Universities (Webometrics), based on the Shanghai Ranking, but using cybermetric data extracted from the universities' websites. It is important to highlight that these results also agree

with those from other relevant studies, which illustrate how several universities have achieved international recognition and improved positions in rankings, through thoughtful EI strategies and EI management. The cases of University College London, TU Delft, Singapore University of Technology and Design and Charles Sturt University, stand out in this respect, as presented in "The global state of the art in engineering education" (Graham, 2018), together with the well-known history of Aalborg University (Fink, 1999).

3.3. Discussion on EI good practices

The information gathered leads to a discussion on possible good practices for implementing EI strategies, improving EI governance and, hence, enhancing universities globally.

Typically, some of the initial improvement actions adopted by universities are aimed at strengthening organisational capabilities and procedures relating to projects and programmes, identifying possible organisational changes that can be made, planning the necessary resources and involving external parties, the business and manufacturing sectors and society in general.

Implementation strategies have been adopted by applying the foundations of the organisational maturity models, which are proven to be strategic tools for governance, both in public and private organisations, enabling areas of improvement to be identified and prioritised (Kerzner, 2002; Kwak et al., 2015). Universities have usually opted for continuous improvement practices (Kooli, 2019), prioritising the development of competences, in order to adapt to the constantly evolving social and business environment, from a holistic perspective that covers three governance areas or dimensions:

Firstly, in terms of the people and their purposes dimension, many universities have adopted strategic measures to align their management teams and teachers to a common vision for good EI governance. These processes have included directors of Research Groups, EI Groups, Management and Administrators, in order to drive strategic improvements and projects that lead to improved quality through the established regulations and standards. This "common vision" has normally enabled the creation of permanent associations for teachers, providing continuity for the changes and driving synergies between research and teaching.

For this dimension, on the basis of presented results, but considering also authors' personal experiences and discussions, the following can be considered as best practices: (1) Creating EI teams, as meeting places for teachers, administration staff and students who want to explore and develop topics that are specific to EI, in a similar way that research teams are able to research specific subject areas, (2): Activities for training university teachers, especially in relation to the transition towards research activity and everything related to methodologies and resources for teaching-learning processes that are constantly evolving; and (3): Establishing strategic alliances (University-Company Chair) for integrating EI and research, as a way of addressing the links with society and spreading an innovative culture to other colleagues, sharing initiatives and learnings together.

A second dimension is made up of management processes and resources. This represents the necessary practices for improving EI activities and financial-administrative management activities, as well as the quality management of research and innovation project results. A form of governance with a focus on EI project-based work is observed, replicating the research model and creating structures for working in teams, specific administration and management services or units with administration and service staff. Since the implementation of the Bologna Process, Spanish and European universities have turned to EI as a strategic measure for improving the quality of education. For this dimension, the following may be considered as best practices: (4): Establishing an EI service, as a key part of the organisation with its own entity, and with the appropriate human and financial resources, to promote and support the university's transformation using EI, and to share and communicate these innovations; (5): Implementing a series of annual calls for EI, that include support from the EI teams for those carrying out EI projects, facilitating the continuous improvement of teaching teams and rewarding the best experiences that are shared; (6): Internationalisation of the university through EI, supported by calls for student and staff mobility and through the promotion of international EI initiatives, such as: "global classrooms", PBL activities between teams from different universities, global competitions, international programmes, etc. (7) Incorporating EI in quality management systems, including the creation of EI groups, the implementation of EI projects, the publication and communication of results on teaching methodologies and experiences, and international mobility and collaboration actions, as aspects that can evaluated when it comes to measuring university quality; and (8): Implementing an open-access online database, with information relating to all the EI activity.

Finally, a third dimension, projects and their results, leads to change and improvement at the universities. It is only possible to achieve excellence if the university manages projects with results and impacts that respond to the needs of society and businesses. The trend for EI project-based work demonstrates a cross-functional nature, which has led to the interdisciplinarity between areas of knowledge. EIPs have become a tool for achieving strategic changes and driving permanent change in teaching, strengthening research and links with society, whilst achieving synergies between these.

In this respect, according to authors' personal views and discussions, evolving from the questionnaire's results, the following can be considered as best practices: (9) Promoting projects with links between EI and research and (10) projects with links between EI and society, for example, through service-learning activities, in which the students contribute to solving real and relevant problems, related to the United Nations' Sustainable Development Goals (SDGs), if possible in collaboration with the voluntary sector; and (11): Sharing project results through an online database, with information relating to the university's EI activities, including an overview of its EI groups' activities and EI projects, as well as educational resources and accessible publications.

These actions involve both top-down strategies and bottom-up approaches, as they focus both on governance and resources management, on the experience and training of educators, and on the involvement of students for making them drivers of change.

4. Conclusions

This international study has been developed to evaluate the global improvement in universities, as a result of educational innovation governance, which can be considered a fundamental pillar of the so-called world-class universities. The results show that EI has become a strategic driver of change for improving the quality of universities at a global level.

Accordingly, the project-based governance model is directly extended to world class universities, both in terms of R+D+i activities, as well as regarding EI activities.

In general, the EI groups' activities have generated results which, to a greater or lesser extent, drive improvements amongst universities. Both at a national level in Spain as well as an international level, it is evident that there is a clear relationship between the maturity of EI governance and a better position in the international rankings. It can be argued that EI governance leads to an overall improvement in universities, with positive impacts for students and teachers.

A common practice is that the university's governance establishes general strategic lines, via calls for EI projects. However, the teaching staff is really the one who makes the changes in teaching effective through the development of projects and the implementation of new academic activities. This strategy, including both top-down and bottom-up actuation lines, has become a driving force of change both in the field of research (i.e. H2020 program) and in the field of educational innovation.

Although educational research and innovation groups are autonomous organizations, with overlaps and synergies between them, with their own strategies, governance, interests, culture and values, they insert within universities, supporting the formulation of EI projects, following the previously mentioned top-down and bottom-up approaches.

This work has explored the point of view of managers of educational innovation. They provide their opinion about the main actions to improve the education and the benefits observed from them. This vision, although important, will be completed in future works adding the perspective of teachers and students.

Acknowledments

The authors thank the Educational Innovation Service of the Universidad Politécnica de Madrid. They also thank the universities and associations participating in the dissemination of the survey: the GIE-UCA of the University of Cádiz, AEIPRO (IPMA-Spain), and the David Rockefeller Center for Latin American Studies (DRCLAS) at Harvard University, and the Massachusetts Institute of Technology (MIT).

References

Abad, F. J., Olea, J., Ponsoda, V., & García, C. (2011). *Medición en ciencias sociales y de la salud*. Madrid: Síntesis.

Aguillo, I. F.; Ortega, J. L. & Fernández, M. (2008). Webometrics ranking of world universities:Introduction, methodology, and future developments. Higher Education in Europe, 33(2/3), pp. 234–244.

Alaeddine, N.; Parsaei, H.; Kakosimos, K.; Guo, B. & Mansoor B. (2015) "Teaching innovation with technology to accelerate engineering students' learning" American Society for Engineering Education.

Altbach, P. G. & Salmi, J. (2016). What Is the 'Special Sauce' for University Innovation? International Higher Education, 85:123-135.

Altbach, P. G. & Salmi, J. (2011). The road to academic excellence: The making of world-class research universities. World Bank Publications. Washington, DC.

Altbach, P. (2003). The Costs and Benefits of World-Class Universities. International Higher Education, (33). https://doi.org/10.6017/ihe.2003.33.7381

Altbach, P. G. (2008). The complex roles of universities in the period of globalization. Boston College USA. Higher Education in the World, 3:5-14.

Altbach, P. G. (2016). Global Perspectives on Higher Education. JHU Press.

Aydar, M. Kalimullin, K. (2016). The System of Management of Innovation Projects at a Higher Education. Receiver 04.

Ávila, HL. 2006. Introducción a la metodología de la investigación. Biblioteca Virtual de la Universidad de Málaga. Texto completo en www.eumed.net/libros/2006c/203/.

Barbero, M. I. 1993. Psicometría II: métodos de elaboración de escalas. Universidad nacional de educación a distancia-facultad de psicología. 580pp. Madrid, España.

Bartkus, K.R. (2001). Skills and Cooperative Education: A conceptual Framework, Journal of Cooperative Education, 36(1): 17–24.

Benson, L.; Kirn, A.; Morkos, B. (2013) "CAREER: Student Motivation and Learning in Engineering". Psychology.

Blackmore, P., and Fraser, M. (2007). Research Based Learning Strategies for Successfully Linking Teaching and Research. Journal of Education, 13(2): 1-13.

Blass E.; Jasman A.; Shelley S. (2012). Postgraduate research students: You are the future of the Academy. Futures, 44:166–173

Blass, E. & Hayward, (2014), Innovation in higher education; will there be a role for "the academe/university" in 2025, BioMed Central Ltd: https://doi.org/10.1007/s40309-014-0041-x

Bodea, C.-N.; Dascălu, M.-I. Modeling Project Management Competences: An Ontology-Based Solution for Competency-Based Learning. In *Communications in Computer and Information Science*; Lytras, M.D., Ordonez de Pablos, P., Avison, D., Sipior, J., Jin, Q., Leal, W., Uden, L., Thomas, M., Cervai, S., Horner, D., Eds.; Springer: Berlin, Germany, 2010; Vol. 73 CCIS, pp. 503–509 ISBN 978-3642131660.

Brew, A. (2003). Teaching and Research: New relationships and their implications for inquiry-based teaching and learning in higher education, Higher Education Research & Development, 22:1, 3-18.

Buddlemeyer, H, Jensen, PH, Webster, E (2010) Innovation and the Determinants of Company Survival. Oxford Economic Papers62 (2): 261–285.

Bringle, R. G. & Hatcher, Julie A. (2000) Institutionalization of Service Learning in Higher Education. The Journal of Higher Education, 71:3, 273-290, DOI:

Cazorla, A. & Stratta, R. (editors) (2017). La Universidad: Motor de Transformación de la Sociedad. FGUPM, pp. 32–51.

Cazorla, A.; De los Ríos, I., Jordana, J. & Yagüe, J. L. (2014). Bases estructurales para el cambio en la UPS: Hacia una universidad docente con investigación. In: Cuaderno de Reflexión Universitaria 14: Hacia una comunidad académica que investiga. Editorial Universitaria Abya Yala. Universidad Politécnica Salesiana. Ecuador.

Cazorla, A.; De los Ríos, I.; Díaz-Puente, JM. (2017). How to prepare planners in the Bologna European education context: Adapting Friedmann's planning theories to practical pedagogy. In: Insurgencies and Revolutions. Reflections on John Friedmann's Contributions to Planning Theory and Practice. Rangan, H.; Kam, M.; Porter L.; Chase, J. Eds. Publisher: New York, Routledge., pp. 46–58

Cazorla, A.; De los Ríos-Carmenado, I.; Pasten, J.I. (2019). Sustainable Development Planning: Master's Based on a Project-Based Learning Approach. Sustainability, 11, 6384.

Cerezo, A.; De los Ríos, I.; Pastor, A. Yagüe, JL. Otero, M. (2019). Project Management Competences by Teaching and Research Staff for the Sustained Success of Engineering Education. Education Sciences, 9, 44.

Chatterton, Paul, and John Goddard. (2000). The Response of Higher Education Institutions to Regional Needs. European Journal of Education 35: 475–96. doi:10.1111/1467-3435.00041.

Chinnowsky, P.; Brown, H.; Szajnman, A. & Realph, A. (2006). Developing knowledge landscapes through project-based learning, Journal of Professional Issues in Engineering Education and Practice, 132 (2), pp. 118-125.

Cohen, J., A power primer.(1992) Psychological Buletin, 112(1) pp. 155-159. Jul

Colomer, J.; Serra, L.; Cañabate, D.; Serra, T. (2018). Evaluating Knowledge and Assessment-Centered Reflective-Based Learning Approaches. Sustainability, 10, 3122.

Commission of the European Communities. (2003). *Communication from the Commission. The role of the universities in the Europe of knoweldge*. Brussels: Commission of the European Communities.

Cropley, D. H. (2015). Promoting Creativity and Innovation in Engineering Education, Psychology of Aesthetics, Creativity and the Arts, 9:2, pp. 161-171.

Cronbach, LJ. 1951. Coefficient alpha and internal structure of a test. Psychometrika, 16, No. 3, pp. 297-334.

Cummings, W. K. (2009). Teaching versus Research in the Contemporary Academy. In Research Institute for Higher Education. (Eds.), The Changing Academic Profession over 1992-2007: International, Comparative, and Quantitative Perspectives pp. 39-57

Fernández, C., Delpiano, C., De Ferrari, J. M. (2006). Responsabilidad Social Universitaria. Una manera de ser Universidad. Teoría y práctica de la experiencia chilena. Santiago de Chile- Editado por Proyecto Universidad: Construye País

De los Ríos, I. & Rodríguez, F. (2015). Promoting professional Project Management skills in Engineering Higher Education: Project-based learning (PBL) strategy. International Journal of Engineering Education 31 (1B), pp. 1–15.

De los Ríos, I.; Cazorla, A.; Díaz, J. M. & Yagüe, J. L. (2010). Project–based learning in engineering higher education: two decades of teaching competences in real environments. Procedia: Social and Behavioral Sciences, 2 (2), pp. 1368-1378.

De los Ríos, I.; Cazorla, A.; Sastre, S.; & Cadeddu, C. (2015). New university-society relationships for rational consumption and solidarity: actions from the Food Banks-UPM Chair. In Envisioning a future without food waste and food poverty. Societal challenges. Escajedo, L.; De Renobales, M. Eds. Publisher: Wageningen Academic Publishers, pp. 181–190.

De los Ríos-Carmenado, I.; Sastre-Merino S., Fernández C., Núñez del Río C., Reyes E, & García, N. (2016). Proposals for improving assessment systems in higher education: an approach from the model Working With People. Journal of Technology and Science Education JOTSE, 2016, (2): 86–102.

Dede, C., (2013). Connecting the Dots: New Technology-Based Models for Postsecondary Learning, National Science Foundation and held at MIT.

Desay, J. 2013. Innovation Engine, Published by John Wiley & Sons, Inc., Hoboken, New Jersey. Published simultaneously in Canada.

Díaz Lantada, A., Lafont, P., Muñoz, J., Muñoz, J. Echávarri, J.,Muñoz, J., Chacón, E., De la Guerra, E. (2013). Towards successful project-based learning experiences in engineering education". International Journal of Engineering Education, 29(2), 476-490.

Donovan, R. A., & Ponce, A. N. (2009). Identification and measurement of core competencies in professional psychology: Areas for consideration. *Training and Education in Professional Psychology, 3*(4, Suppl), S46–S49. https://doi.org/10.1037/ a0017302.

Elton, L. (2001) Research and teaching: what are the real relationships?, Teaching in Higher Education, 6(1): 43 –56.

Etzkowitz, H., & Leydesdorff, L. (2000). The Dynamics of Innovation: From National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations. *Research Policy, 29*(2), 109-123.

Fernández, J. A., Rancaño, I., & Hernández R. 1999. Propiedades psicométricas de la versión española del cuestionario PECVEC de perfil de calidad de vida en enfermos crónicos. *Psicothema, 11(*2), pp. 293-303.

Fernández Pello, C. (2017). La vinculación con la sociedad en las universidades de investigación. In: Cazorla A, Stratta R (editors). La Universidad: Motor de Transformación de la Sociedad. FGUPM. pp. 52–61.

Fidalgo-Blanco, A; Sein-Echaluce, M.L. and García-Peñalvo, F.J. Knowledge Spirals in Higher Education. (2014). Teaching Innovation. International Journal of Knowledge Management, 10(4): 16-–37.

Fink, F.K. (1999). Integration of engineering practice into curriculum-25 years of experience with problem-based learning. FIE'99 Frontiers in Education. 29th Annual Frontiers in Education Conference. Designing the Future of Science and Engineering Education. Conference Proceedings.

Finkel, A., & King, R. (2013). *Innovative approaches to engineering education, paper presented at the CAETS*. Budapest: International Council of Academies of Engineering and Technological Sciences.

Flórez-Parra, J. M., López, M. V., & López, A. M. (2014). The corporate governance of universities: Study of the top 100 universities in the Shanghai ranking corporate governance, analysis of the top 100 universities in the Shanghai ranking. Education Magazine, 364, 170-196.

Fouad, N. A., Grus, C. L., Hatcher, R. L., Kaslow, N. J., Hutchings, P. S., Madson, M. B., … Crossman, R. E. (2009). Competency benchmarks: A model for understanding and measuring competence in professional psychology across training levels. *Training and Education in Professional Psychology, 3*(4, Suppl), S5–S26. https://doi.org/ 10.1037/a0015832.

Geuna, A., Muscio, A., 2009. The Governance of university knowledge transfer: a critical review of the literature. Minerva 47, 93–114.

Gijselaers, W. H. (1996). Connecting problembased practices with educational theory. In L. WILKERSON, & W. H. GIJSELAERS (Eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice* (pp. 13–21). San Francisco: Jossey-Bass Publishers.

Goddard, R. (2000). Collective Teacher Efficacy: Its Meaning, Measure, and Impact on Student Achievement VL - 37DO - 10.3102/00028312037002479JO - American Edztcaliortal Research Journal Summer ER.

Goldfarb, B. and Henrekson, M. (2003), 'Bottom-up versus top-down policies towards the commercialization of university intellectual property', Research Policy, 32: 4, pp. 639–58.

Gosling, S.D., Vazire, S., Srivastava, S., John, O.P., 2004. Should we trust web-based studies? A comparative analysis of six preconceptions about internet questionnaires. Am. Psychol. 59 (2), 93–104. https://doi.org/10.1037/0003-066X.59.2.93.

Graham, R. (2018). The global state of the art in engineering education. Massachusetts Institute of Technology, pp. 1-162.

Gunasekara, C. (2004). The third role of Australian universities in human capital formation. Journal of Higher Education Policy and Management, 26(3), 329 – 343

Gunasekara, C. (2006). Reframing the Role of Universities in the Development of Regional Innovation Systems. The Journal of Technology Transfer 31(1): pp. 101-113.

Harman, K. & Treadgold, E. (2007) Changing patterns of governance for Australian universities, Higher Education Research & Development, 26:1, 13-29.

Healey, M. (2000) Developing the scholarship of teaching in higher education: a discipline based approach. Higher Education Research & Development, 19(2): 169–189.

Healey. M. (2005) Linking Research and Teaching to Benefit Student Learning. Journal of Geography in Higher Education, 29:2, 183-201

Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. Journal of Research in Science Teaching, 48(8), 952 - 984.

Huisman, J. (2008). "World-Class Universities". Higher Education Policy, Vol. 21 (1): 1-4

IPMA (2015). Individual Competence Baseline for Project, Programme and Portfolio Management. Version 4.0. ISBN: 978-94-92338-00-6.

IPMA OCB. (2016). Organisational Competence Baseline for Developing Competence in Managing by Projects; International Project Management Association: Amsterdam, The Netherlands; ISBN 978-84-616-8576-9.

Ischinger, B., & Puukka, J. (2010). Universities for Cities and Regions: Lessons from the OECD Reviews. *Change: The Magazine of Higher Learning, 41*, 8–13. https://doi.org/ 10.3200/CHNG.41.3.08-13.

Jamieson, A.; Morris, P.W.G. Moving from corporate strategy. In The Wiley Guide to Managing Projects; Pinto, J.K., Morris, P., Eds.; John Wiley & Sons: Hoboken, NJ, USA, 2004; pp. 177–205. ISBN 9780471233022.

Jenkins, A., Blackman, T., Lindsay, R. & Paton-Saltzberg, R. (1998) Teaching and research: student perspectives and policy implications. Studies in Higher Education, 23(2): 127–141.

Jenkins, A., Breen, R., Lindsay, R. & with Brew, A. (2003). Re-shaping Higher Education: Linking Teaching and Research (London: Routledge / SEDA).

Johnston, R. J. (1996) Quality in research, quality in teaching and quality in debate: a response to Graham Gibbs, Quality in Higher Education, 2(2): 165–170.

Kezar, A. & Eckel, P. (2002). The Effect of Institutional Culture on Change Strategies in Higher Education. The Journal of Higher Education. 73. 435-460. 10.1353/jhe.2002.0038.

Kerzner, H. (*2002*) Strategic Planning for Project Management Using a Project Management Maturity Model. John Wiley and Sons, New York.

Kooli, C. (2019). Governing and managing higher education institutions: The quality audit contributions. Evaluation and program planning, 77, 101713.

Kooli, C., Jamrah, A., & Al-Abri, N. (2019). Learning from Quality Audit in Higher Education Institutions: A Tool for Community Engagement Enhancement. FIIB Business Review, 8(3), 218-228.

Kwak, Y. H., Sadatsafavi, H., Walewski, J., & Nigel, L. Williams (2015). Evolution of project based organization: A case study. *International Journal of Project Management, 33*(8), 1652–1664. https://doi.org/10.1016/j.ijproman.2015.05.004.

Lane, K., McAlpine, J., Earl, B., Feola, S., Lewis, J., Mertens, K., . . . Stains, M. (2020). Innovative teaching knowledge stays with users. Innovative teaching knowledge stays with users, published online. doi:10.1073/pnas.2012372117

Larmer, J. Mengeldoller, J. Boss, S. (2015). Setting the standard for project based learning: A proven approach to rigorous classroom instruction". ASCD & Buck Institute for Education.

Larmer, J. (2014). Project-based learning vs. Problem-based learning vs. X-BL". Edutopia.

Lavalle, C., de Nicolas, V.L. (2017) Peru and its new challenge in higher education: Towards a research university. PLoS ONE 12(8): e0182631. https://doi.org/10.1371/journal.pone.0182631

Lester, R., Breznitz, D., Chakrabarti, A., et al. (2005). Universities, Innovation, and the Competitiveness of Local Economies. MIT Industrial Performance Center Working Paper 05-010

Likert, R. (1932). A technique for the measurement of attitudes. Archives of Psychology, 22 140, 1-55.

Maylor, H.; Brady, T.; Cooke-Davies, T.; Hodgson, D. (2006). From projectification to programmification. Int. J. Proj. Manag. 24, 663–674.

Marsh, H. W. & Hattie, J. (2002) The relation between research productivity and teaching effectiveness: complementary, antagonistic, or independent constructs?.Journal of Higher Education, 73(5): 603–641.

Massey, F. J., Jr. (1951). The Kolmogorov-Smirnov test for goodness of fit. Journal of the American Statistical Association, 46, 68–78. https://doi.org/10.2307/2280095

Mulcahy, D. (2000). Turning the contradictions of competence: competence-based training and the beyond. Journal of Vocational Education and Training, 52(2), pp. 259-280.

Muñoz-Guijosa, JM.; Díaz Lantada, A.; Echávarri Otero, J.; Chacón Tanarro, E. (2019). "Using smartphones physical interfaces in engineering education: Experiences in promoting student motivation and learning". International Journal of Engineering Education, 35(5), 1290–1305.

Muscio, A; Quaglione, D, Vallanti, G. (2013). Does government funding complement or substitute private research funding to universities?. Research Policy, Vol 42, Issue 1: 63-75.

Neumann, R., Parry, S. & Becher, T. (2002) Teaching and learning in their disciplinary context, Studies in Higher Education, 27: 405–417.

Ordorika, I., & Rodríguez, R. (2010). El ranking Times en el mercado del prestigio universitario. Perfiles educativos, 32(129): 8-29.

Otero-Mateo, M.; Pastor-Fernández, A.; Portela-Núñez, J.-M. (2014). Sustained success from the perspective of project management. DYNA Management, 2(1). [9 p.]. https://doi.org/10.6036/MN7044

Padmanadhan, G. & Katti, D. (2002). Using community-based projects in civil engineering capstone courses, Journal of Professional Issues in Engineering Education and Practice, 125(1), pp. 12-18.

Parsons, C.; Caylor, E. & Simmons, H. (2005). Cooperative Education Work Assignments The role of Organizational and Individual Factors in Enhancing ABET Competencies and Cp-op Workplace Well-Being, Journal of Engineering Education, 94(3): 309-316.

Perkmann, M., Walsh, K., 2009. The two faces of collaboration: impacts of university–industry relations on public research. Industrial and Corporate Change 18 (6), 1033–1065.

Peterson, M., & Spencer, M. (1991). Understanding academic culture and climate. In M. Peterson (Ed.), ASHE reader on organization and governance (pp. 140–155). Needham Heights, MA: Simon & Schuster.

Pemsel, S and Müller, R (2012). The governance of knowledge in project-based organizations. *International Journal of Project Management* 30 (2012) 865–876.

Poell, R.F. and Van der Krogt, F.J. (2003). Project-based learning in organizations: towards a methodology for learning in groups. *Journal of Workplace Learning*, Vol. 15 No. 5, pp. 217-228. https://doi.org/10.1108/13665620310483912

Razak, A. and Saad, M. (2007), The role of universities in the evolution of the Triple Helix culture of innovation network: The case of Malaysia, International Journal of Technology Management and Sustainable Development Volume 6 Number 3.

Robertson, J. & Bond, C. (2001) Experiences of the relation between teaching and research: what do academics value?,Higher Education Research and Development, 20(1): 5–19.

Rowland, S. (1996) Relationships between teaching and research, Teaching in Higher Education, 1(1): 7 – 20.

Salgado, J.P.; De los Ríos, I.; López, M. (2017). Management of innovative and entrepreneurship projects from project-based learning: a case study on the UPS University in Ecuador. In Case study of Innovative Projects. Successful real cases. Llamas, B.; Mazadiego, F.; Storch, L. (Eds.). Chapter 8. In Tech.

Salmi, J. 2009. The Challenge of Establishing World-Class Universities. Directions in Development; human development. World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/2600 License: CC BY 3.0 IGO.

Salmi, J. (2018). Higher Education Equity Policies across the Globe. International Higher Education, 98: 4–5.

Saroyan, A., & Trigwell, K. (2015). Higher education teachers' professional learning: Process and outcome. Studies in Educational Evaluation, 46, 92 - 101. doi:http://dx.doi.org/10.1016/j.stueduc.2015.03.008

Scott, P. (2002). High wire. Guardian Education, 8 January pp. 13.

Shapiro S. S. and Wilk M. B. An Analysis of Variance Test for Normality (Complete Samples). Biometrika. 52(3/4). pp. 591-611. 1965

Sharma, M; Kumar, U¸ Lalande, L. (2006). Role of university technology transfer offices in university technology commercialization: case study of the Carleton university foundry program, Journal of Services Research, Volume 6, Special Issue (July, 2006) © 2006 by Institute for International Management and Technology. All Rights Reserved.

Shulman, L. (2016) Educational Innovation with Open Eyes and No Excuses: The Challenges and Opportunities of Learning from Experience. Revista de Gestión de la Innovación en Educación Superior REGIES, I, p.p.13-28 Issn 0719-742X; E-Isnn 0719-7624

Sonka ST, Chicoine DL (2004) Value and University Innovation. American Journal of Agricultural Economics 86(5):1337–1344

Storberg-Walker, J., & Torraco, R. (2004). Change and higher education: A multidisciplinary approach. Higher Education, Change, Action Research, 37(3), 811–818.

Tuomi, I.; Punie, Y.; Vuorikari, R.; Cabrera, M. (2019). "The impact of Artificial Intelligence on learning, teaching, and education". EU Commission Report.

UNESCO. (2015). *Global citizenship education: Topics and learning objectives*. Paris: UNESCO.

van Winden, W., Hagemans, W., & van Hemert, P. (2019). The Street-Wise University: The Amsterdam Knowledge Mile as an Intermediary and Place-Making Concept. *Social Sciences, 8*(8), 229. https://doi.org/10.3390/socsci8080229.

Wagner, R.F. (2012). Organisational competence in project management—New perspectives on assessing and developing organisations. J. Proj. Progr. Portf. Manag, 3, 45–57.

Zamorski, B. (2002). Research-led teaching and learning in higher education: a case. Teaching in Higher Education, 7(4): 411–427.

Zomer, A. and Benneworth, P. (2011). The rise of the university's third mission'. In: Enders, J., Boer, H. F. de and Westerheijden, D. F. (eds) Reform of Higher Education in Europe, pp. 81–101. Rotterdam, the Netherlands: Sense Publishers.