

La innovación en la educación superior ecuatoriana

Innovation in Ecuadorian higher education

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Resumen

Este artículo remarca la importancia de concentrar los esfuerzos de innovación en generar más valor para los clientes, afirmando que, en el caso de la educación universitaria, es necesario considerar a los estudiantes como los beneficiarios últimos de la innovación. Así, partiendo de este concepto, este artículo muestra la percepción de una muestra de estudiantes universitarios ecuatorianos sobre la idoneidad de los medios puestos a disposición de los mismos, por parte de las mismas universidades. Para ello, se elaboró un instrumento de encuesta y, luego de explorar los datos recolectados para verificar su confiabilidad, a través de un análisis factorial confirmatorio, se realizó una regresión múltiple, para mostrar los elementos que explican el grado de idoneidad de los medios ofrecidos por las universidades. En particular, considerando razonable la diferencia existente entre las necesidades de los estudiantes de ciencias sociales y exactas, este estudio propone un análisis diferenciado para cada una de estas categorías consideradas.

Palabras claves: Innovación, Ecuador, Universidad, Educación

Abstract

This article highlights the importance of concentrating innovation efforts on generating more value for customers, stating that, in the case of university education, it is necessary to consider students as the ultimate beneficiaries of innovation. Thus, based on this concept, this article shows the perception of a sample of Ecuadorian university students on the suitability of the means made available to them, by the universities themselves. For this, a survey instrument was developed and, after exploring the data collected to verify its reliability, through a confirmatory factor analysis, a multiple regression was carried out, to show the elements that explain the degree of suitability of the media offered by the universities. In

particular, considering the difference between the needs of students of social and exact sciences, this study proposes a differentiated analysis for each of these categories considered.

Keywords: Innovation, Ecuador, University, Education

Introduction

To talk about the Ecuadorian education system, it is necessary to consider the Latin American panorama, despite the cultural differences, there are similar economic, political and social indicators that have an impact on the region. The impact that globalization entails makes education have changes, modernity in Latin America corresponds to the need for development and freedom. During the last decade, the Ecuadorian university education system crossed for a quality improvement due, above all, to major governmental investments on education and research (Vélez & Espinosa, 2018). Indeed, through the adoption of the last Constitution, in compliance of the art. 353, and of the art.15 of the “Ley Orgánica de Educación Superior del 2010” (LOES), the “Consejo de Educación Superior” (CES) and the “Consejo de Evaluación, Acreditación y Aseguramiento de la Calidad de la Educación Superior” (CEAACES) were formed with the aim of ensure the “planning, regulation and internal coordination” CES (2018) of the processes related with the quality CEAACES (2018) of the institutions belonging to the national higher educational system. So, universities were subjected to the fulfilment of quality standards, as much in internal processes, as in teaching and researching. This way, a global improvement was produced in higher educational sector. As it can be observed in several international rankings, considering the size of Ecuadorian economy, and its consequential possibility of bearing the necessary expenditure for educational context, the positioning of its most important universities is not negative at all. Also, nationally research realized has progressively improved: according to the indicator SJR (2017) the number of cited articles has grown from the 138 of the year 2000, to the 2996 of the 2017. Even if this data could be

considered positive, the current national economic situation could prejudice those good performances. Indeed, the less national incomes and the high rate of external debt has led the government to consider the possibility to reduce by 10% the national educational budget for 2019 (El Comercio, 2018). This is the reason why, due to the partial absence of the needed economic resources to allocate to higher education system, it is necessary to think about a way to rationalize the outcomes, to distribute the resources according to real needs. Moreover, the government only finances the public or (in a different way) cofinanced universities, while private ones are left in a condition of discretionary opportunity of choosing the resources to allocate for innovation (in the sense it will be explained later). This causes that the resources are frequently divided horizontally among the different faculties or based on a logic of particular and short-term goals. Moreover, frequently, as the direct observation can suggest, universities give more resources to the faculties of exact sciences, betting on the biggest visibility that good results in this area could generate to the institution, so leaving the social sciences faculties without the necessary means to impulse innovation.

So, the purpose of this study is to aware political authority on the need to produce data on this topic, starting by the students, and use them with the aim of directing the innovation to real and effective purposes (Rosales & Cerbone 2020).

Development

The idea of innovating takes place in such a great number of different contexts that is a hard work giving a univocal definition of this term. Innovation was initially conceived as the generation of new values through technology and its constant change over time, which leads to economic development (Schumpeter, 1934). In this line, the idea that there is innovation after creative destruction is incorporated Schumpeter (1942), indicating that innovation entrepreneurs are exposed to continuous risks where profits cannot always be perceived, corroborating that economic development is irregular. Schumpeterian innovation considers the

combination of resources to create value, to which Teece (1987) adds the importance of protecting property rights. Some researchers Chiatchoua, Nuñez, Nuñez, & Ortigoza (2016); Lugone (2008) & Montoya (2004) agree in attributing a major importance to the definition given by Joseph Schumpeter, because he was the first in defining the areas to which this concept could be applied; particularly: introducing new goods into the market; finding new production and transport and method; finding new markets; finding new raw material supplier; optimizing the organization and the administration processes (Schumpeter, 1978).

Naranjo-Valencia, Naranjo-Herrera, Serna-Gómez & Calderón-Hernández (2018) state that innovation is defined as a search for creative, unusual or novel solutions, forms of new technologies and processes, as well as new products and services, constituting a source of the most important sources of competitive advantage, not only The Oslo Manual, published by the Organization for Economic Cooperation and Development OECD (2018), indicates that technological innovation refers to those activities related to products and processes, but also Krugman (2018) corroborates that innovation is the process by which new products are created. From a practical point of view, this definition is complemented by the vision of more authors, according to whom to effectively generate innovation, it is necessary creating value for the ultimate beneficiaries of this. For example: according to Amit & Zott (2012) the value in a innovate business is created through the bargaining power, as greater the amount of value greater the innovation is, moreover Gulyaz, van der Veen, Venugopal & Solaimani (2015) indicates that innovation creates superior customer value when you increase the perceived benefits. In addition, Teece (2010) mentions that an innovative business model creates value for the customers of the company that formulate it. Such value, which could consist both in tangible and intangible benefit Anonymous (2015), must be created, distributed, and captured, during the phases of ideation, production and selling by a company Brea, Hine, & Kastle (2016), both if it dedicates to the production of material goods and services. In the area of

services, the topic of innovation in the institution of higher education acquires progressively a major importance because, as Croda & López (2016) say, in this context innovation could have a direct influence in the process of improvement of the reality in which we live, by stimulating the “social innovation”. From this idea, takes place the debate on the possibility of considering universities as social enterprises Miles, Verreynne, McAuley, & Hammond (2017), where “better citizens” are formed” Dudau, Kominis, & Szocs (2017) as main pillars for the social innovation of a country. Besides, this kind of innovation could carry positive consequences both for national economy Friberg (2018) and for its development (Torres, 2015). Indeed, the correlation between the improvements of educational system and economic growth is constituted as an axiom that finds its empirical verification in a growing number of scientific studies. For example, Zhou & Luo (2018) analyse how economic growth depends on technological innovation; but such kind of innovation belongs to the inputs generated by the academic system. Some other authors consider how the innovation generated in the universities produces advantages to the internal processes of the enterprises too (Barreno, López & López, 2018). So, if we stand for the idea about which, universities could constitute the centre of the social internal innovation processes Croda & López (2016), to allow them to fulfil this task, the need of strengthening them arise. So, the same universities have to start a change directed to the innovation. In this sense, some authors agree about some processes which could be applied in a university institution. They are teaching, research and administration Cai (2017) & Rubio (2012) which could be subjected to different path of innovation. About teaching, for example, a big number of researchers agree that the main element to obtain good and value generators outcomes is the introduction of technology in teaching-learning process Colina & Bustamante (2009); Pillo & Bermúdez (2018) & Revelo (2017) Indeed, Arancibia, Araneda, Cabero-Almenara & Valdivia (2017) state that new technologies could facilitate the interaction among students. This way, it assists the learning process, even in presence of different types of

intelligence. Moreover, Li (2018) affirms that new tools available in education, among which augmented reality, could help universities to replace the lack of space intended for practice, by using the “learning by doing” process, which Toner (2010) talked about. Besides, technologies can help to customize the education Martínez-Usarralde, López-Martín, & Pérez-Carbonell (2018), mostly by using the web, which constitutes a tool useful to individualize the access to education. In this case, the MOOCs are identified as the best way to obtain a greater inclusion in the context of higher education (Flynn, 2013).

Innovation in education often concerns the teaching methodology, also. On this topic, Montalvo (2011) proposes a major academic and curricular flexibility, founding in it the right component to allow universities to keep pace with the times. This responds to the needs of an increasingly complex society, where education has a strategic role, most of all, when succeeds into combine these new trends with human resources “technologically empowered” (Dominici, 2018).

Instead, about innovation in research, many authors state that it necessary to create strategic networks (with enterprises and the public sector), on the example of the “triple helix model” of crated by Etzkowitz & Leydesdorff (1995), because they allow universities to generate concrete solutions for the society Leo Dhohoon & Deok-Ho (2017) & Thorsteinsson (2013), and new proposal for the market (Cai, 2017). Obviously, in research, the existence of a favourable political environment Friberg (2018) & Torres (2015), a correct incentive programme Faria, Wanke, Ferreira, & Mixon (2018) and an adequate social environment Evenhouse, & others (2017) have positive global effects. For these reasons, we can say that the most important element to innovate in research is the existence of a functional ecosystem.

Finally, also on the administration different visions exist Andrade, Loaiza & Salazar (2017) focus on the need to augment the quality level of the higher education institutions, by

adopting strategic plans and politics, among which continuous assessment of the staff is contemplated.

By a different point of view, Chang (2015) affirms that it is important for each institution having a strong organizational culture, by showing how the lack of such could have negative effects on the others innovation processes.

From what has been said previously, we can conclude that the different higher education institutions can begin different innovation paths; nonetheless, it is necessary that this path coincides with the creation of major value for customers that, in this particular case, is to say the students. This is the reason why, this study proposes to analyse the factors that negatively affect the development of the academic activities, with the aim to manage innovation through a better and real decision-making for universities.

According with the purpose of this study, the outcomes of survey, realized among the students of the universities located in Pichincha (Ecuador), will be shown. This way, it will be impulsed in universities a kind of innovation directed to satisfy real needs, which can prescind from the influence of the contingent political ideologies and the administration that lead the different universities. Indeed, both these factors could negatively condition the process of innovation.

Material and methods

The outcomes showed in this article, constitute only a little part of a larger study that, considering the general limitation of space that scientific review contemplate, is impossible to report in its entirety. The study, named “Perceptions on the need of innovating in higher education” had the aim of measuring the perception of the universities students on different topics related with the need of innovating in higher education system.

To reach the purposes planned for this study, it was used a methodology divided in different phases. During the first one, due to the lack of a validated instrument for survey, about the analysis of the perception of university students on the needs to innovate in higher education institutions, a deep bibliography review was done. So, starting from the theoretical model of Table 1

In the third phase, the survey, that took place during the period included between January and March of 2019, was realised: the sample was stratified in three main groups, corresponding to the type of institutions in which the students are registered (public, cofinanced and private universities), considering that the different amount of available incomes own by the universities can produce different impacts in the actions that it is possible to wage with the aim of innovating. For each of those groups there was a division based on the sex of the interviewed. The questions of the created instrument had the aim to analyse the perception of the students on the suitability of the means placed at the disposal from universities. Thus, a Likert scale questionnaire was used. For each question, the answers included values from 0 to 5, and it was added the options “I don’t know” and “I prefer to not answer”, which were codified in data base as “missing”.

So, the question that leads this study was: “What are the elements that explain the perception of the Ecuadorian university students, on the suitability of the means places at disposal by the universities?”

First of all, to answer to this question, after creating a database, data were explored. To test the validity of the survey instrument it was realized a confirmatory factorial analysis³, so proving the existence of four latent factors: i) Organizational structure ii) Infrastructure and

³ The confirmatory factorial analysis is generally used with the aim of reducing a great number of variables in to factors to take into consideration, so that it is easier to calculate the relation among them. But in this case, this technic has the purpose of demonstrating that the chosen variables refer all to the category from which they were extrapolated.

Table 1

Innovation definitions to be considered for this study.

Authors	Definition
(Schumpeter 1934)	Innovation consists of that distinctive attribute of business administration and other disciplines.
(Schumpeter, 1978)	Innovation is the action of introduce new goods into the market; finding new production and transport and method; finding new markets; finding new raw material supplier; optimizing the organization and the administration processes.
(Teece, 2010)	An innovative business model creates value for the customers of the company that formulate it.
(Montalvo, 2011)	Innovation in education often concerns the teaching methodology with a major academic and curricular flexibility, founding in it the right component to allow universities to keep pace with the times.
(Amit & Zott, 2012)	The value in an innovative business is created through the bargaining power, as greater the amount of value greater the innovation is.
(Gulyaz, van der Veen, Venugopal & Solaimani, 2015)	Innovation creates superior customer value when you increase the perceived benefits.
(Brea, Hine, & Kastle, 2016)	Innovation must be created, distributed, and captured, during the phases of ideation, production and selling by a company.
(Croda & López 2016)	In higher education innovation could have a direct influence in the process of improvement of the reality in which we live, by stimulating the “social innovation”.
(Dudau, Kominis, & Szocs, 2017)	University is considered as main pillars for the social innovation of a country, where “better citizens” are formed.
(Rubio, 2012; Cai, 2017)	The innovation in higher education could be explain by processes such as: teaching, research, and administration.
(Thorsteinsson, 2013; Leo Dhohoon & Deok-Ho, 2017)	Innovation in research is linked to create strategic networks with enterprises and the public sector “triple helix model”, so they can allow universities to generate concrete solutions for the society.
(Naranjo-Valencia, Naranjo-Herrera, Serna-Gómez & Calderón-Hernández 2018)	Innovation is defined as a search for creative, unusual, or novel solutions, forms of new technologies and processes, as well as new products and services, constituting a source of the most important sources of competitive advantage.
(OECD, 2018)	The Oslo Manual, published by the Organization for Economic Cooperation and Development OECD (2018), indicates that Technological innovation refers to those activities related to products and processes.
(Krugman, 2018)	Innovation is the process by which new products are created.

Note. These definitions are considered as the most relevant founded through the literature review.

means iii) Professional abilities iv) “Plus” offered by the university. To test the reliability of the factors, the KMO index, the percentage of variance explained, the communalities Williams, Onsmann, & Brown (2010) and the Cronbach alpha Oviedo & Campo-Arias (2005) were checked. After confirming, the existence of interrelation among the different considered variables, a multiple linear regression was done. The dependent variable considered was the perception of the students on the general suitability of the means placed at disposal by universities, while the predictive variables were constituted by the perceived suitability of each of the different means analysed. It was created two different models (one for each sample). To test the reliability of the created models, it was previously checked the existence of collinearity among the variables. Then, it was analysed the coefficient of determination, by using the scale proposed by Rojo (2007), so observing that both models were good. About the regression, the progressive manual elimination method was used (Rojo, 2007).

Results

To facilitate the redaction of the results of this study, it will be used a table of coding of the variables considered. The code of the variables will be used both in the tables regarding the regression and in the discussion section.

The following tables show the outcomes of the confirmatory factorial analyses. For all the cases, the validity of the analysis was confirmed. As the information here presented is only a part of many recollected data on the topic of the perception of the need of innovation in higher education system, the aim of this factorial analysis was to identify the variables to insert in the multiple linear regressions.

The table 3. shows that the considered variables can be associated with a common factor, as the percentage of shared inference is greater than 50%. The alpha of Cronbach also shows the factor consistency.

Table 2
Variables codification

Metacode	Code
(1) University Organization	(1.1) OU
(2) Change Management	(2.1) CM
(3) Communication Management	(3.1) COM
(4) Decision-making	(4.1) DM
(5) Process optimization	(5.1) PO
(6) Organizational culture	(6.1) OC
(7) University Management	(7.1) UM
(8) Opinion and Proposal Management	(8.1) OPM
(9) Collaboration with other institutions	(9.1) COI
(10) Classroom	(10.1) CLA
(11) Laboratories	(11.1) LAB
(12) Library	(12.1) LIB
(13) Other spaces (rooms, offices, etc.)	(13.1) OTS
(14) Electronic Equipment	(14.1) EE
(15) Software	(15.1) SOF
(16) Internet Connection	(16.1) IC
(17) Virtual Platforms Access	(17.1) VPA
(18) Relation with the professors	(18.1) RPR
(19) Curses planning	(19.1) CPL
(20) Time Planning	(20.1) TPL
(21) Research	(21.1) RES
(22) Professors Preparation Level	(22.1) PPL
(23) Material used by the professors	(23.1) MUP
(24) Teaching methodology	(24.1) MET

(25) Content of the Subjects	(25.1) CS
(26) Scholarships by merit Access System	(26.1) SAS
(27) Extracurricular Activities	(27.1) ECA
(28) Forms of divulgation of knowledge	(28.1) FDK
(29) Conventions	(29.1) CON

Note. The considered variables indicated in this table are extrapolated from the literature review.

Table 3
Latent Factor: Organizational Structure

Items	Communalities	% σ^2	α Cronbach
		60.555	.918
(1) OU	.589		
(2) CM	.645		
(3) COM	.688		
(4) DM	.638		
(5) PO	.568		
(6) OC	.623		
(7) UM	.596		
(8) OPM	.572		
(9) COI	.531		

Note. Data from the study “Perceptions on the need of innovating in higher education”

As in the former case, the table 4. shows that the variables can be associated with a common factor, as the percentage of shared inference is greater than 50%. The alpha of Cronbach also proves the factor consistency.

The table 5. shows a level of shared inference almost equal to 50%. This suggests considering cautiously the use of this factor. Despite this, the alpha of Cronbach proves strongly the factor consistency.

Table 4
Latent Factor: *Infrastructure and Means*

Items	Communalities	% σ^2	α Cronbach
		54.877	.879
(1) CLA	.683		
(2) LAB	.660		
(3) LIB	.674		
(4) OTS	.605		
(5) EE	.635		
(6) SOF	.692		
(7) IC	.759		
(8) VPA	.688		

Note. Data from the study “Perceptions on the need of innovating in higher education”

Table 5
Latent Factor: *Professional Abilities*

Items	Communalities	% σ^2	α Cronbach
		50.835	.805
(1) RPR	.592		
(2) CPL	.542		
(3) TPL	.572		
(4) RES	.530		
(5) PPL	.504		
(6) MUP	.572		
(7) MET	.195		
(8) VPA	.559		

Note. Data from the study “Perceptions on the need of innovating in higher education”

The table 6. shows a good level of shared inference (65.074%). This element and the level of the alpha of Cronbach strongly proves the factor consistency.

Table 6
Latent Factor: *Plus offered by universities*

Items	Communalities	% σ^2	α Cronbach
		65.074	.819
(1) SAS	.548		
(2) ECA	.646		
(3) FDK	.739		
(4) CON	.670		

Note. Data from the study “Perceptions on the need of innovating in higher education”

As it can be observed, for all the five cases, the explained variance get over the 50%, such as the different alpha Cronbach index, present a value close to 1: both factors show a good level of reliability of this factor analysis.

The following tables explain the results of the multiple linear regressions, both for the case of the student belonging to exact and social sciences faculties.

The model showed by table 7 meets all the requirements to be considered as good, as it presents a corrected R^2 equal to .571 (is to say that the model explains the 57.1% of the variance of the dependent variable), and an estimation error little above the 0.5 threshold.

Table 7
Model of the Exact Sciences Faculties Students

Model	Corrected squared R	Estimation error
Exact Sciences Faculties Students	.571	.62888

Note. Data from the study “Perceptions on the need of innovating in higher education”

Table 8
Multiple linear regression. Model of the Exact Sciences faculties Students

	B	SD	Beta	t	p
(Costante)	0,332	0,173		1,917	0,056
VPA	0,148	0,043	0,152	3,408	0,001
CPL	0,151	0,045	0,159	3,34	0,001
CM	-0,095	0,044	-0,098	-2,159	0,032
MUP	0,216	0,044	0,225	4,85	0
ECA	-0,116	0,042	-0,137	-2,761	0,006
FDK	0,179	0,047	0,195	3,779	0
CON	0,148	0,044	0,172	3,358	0,001
OPM	0,121	0,05	0,13	2,425	0,016
COI	0,169	0,044	0,189	3,803	0

Note. * $p < .05$; ** $p < .01$; $N = 768$).

Data from the study “Perceptions on the need of innovating in higher education”

Table 9
Model of the Exact Sciences Faculties Students

Model	Corrected squared R	Estimation error
Exact Sciences Faculties Students	.666	.53915

Note. Data from the study “Perceptions on the need of innovating in higher education”

The second model has a corrected R^2 equal to 0.666 (66.6% of explained variance).

Table10
Multiple linear regression. Model of the Social Sciences Faculties Students

	B	SD	Beta	t	p
(constante)	.030	.172		-.175	.861
CLA	-.126	.052	-.137	-2.432	.016
LAB	.153	.047	.171	3.249	.001
OTS	-.081	.037	-.095	-2.198	.029
SOF	.117	.043	.128	2.702	.007
RPR	.125	.042	.137	2.974	.003
UM	.094	.048	.093	1.979	.049
PPL	.149	.043	.151	3.443	.001
SAS	.135	.037	.149	3.588	.000
CON	.154	.045	.170	3.436	.001

Note. * $p < .05$; ** $p < .01$; N=768). Data from the study “Perceptions on the need of innovating in higher education”

Regarding to the second model, the variables that explain the most the model are SAS, OPM, which present the best level of significance and Beta index. The variables of CLA and OTS has negative Beta index, which indicates that these variables explain indirectly the correlation with the dependent variable.

As we can see, the linear multiple regression, of both models, is good, according to the scale proposed by (Rojo 2007).

Discussion

By observing the regressions, it could be deduced that the perception of the interviewed on the level of suitability of the means placed at disposal by the universities, is different for the students belonging to exact and social sciences faculties. Particularly, the students of the exact sciences faculties express major needs at least in three out of four analysed factors. Indeed, about the factors “Organizational structure”, only two out of nine elements explain the model, while one variable (CM) explains the negative opinion that, the students have on the suitability of the means. About “Professional abilities”, only three out of nine elements considered for each factor is considered as suitable; meanwhile, about the factor “Infrastructures and means”, the elements considered were totally perceived as unsuitable. The factor that, in a major way, satisfies the expectations of the students is “Plus offered by the university”, because the only variable perceived as unsuitable is “access to scholarships by merit”.

According to the interviewed students belonging to social sciences faculties, the level of perception is similar, in the sense that this kind of students also thinks that most of the means placed at disposal are unsuitable. Particularly, about the factor “Organizational structure” only three out of nine variables were considered as suitable, while about the factor “Professional abilities” only two out of nine elements were considered positively. About the factor “Infrastructure and means”, two out of seven elements respond to the expectation of the students, and two elements (CLA y OTS), express the negative opinion on the general suitability of the means. Finally, about the factor “Plus offered by the university”, two out of four variables were perceived as suitable. These data confirm the idea about which to innovate in higher education institutions it is necessary to take in consideration the different needs of the students,

mostly based on the category of science which they belong to. It suggests that, horizontal innovation policies could go towards failure.

Conclusions

First of all, as a conclusion it is necessary to remark that exist different perceptions on the suitability of the means analysed, depending on the type of students considered. Nevertheless, it could say that both kinds of students perceive a great need of innovation in their own universities, in all the considered factors.

Particularly, if both kind of students perceive a need of innovation, both in the organizational structure and the professional abilities that they observe in their universities, according to the students belonging to exact sciences faculties, it exists a great perceived necessity of innovation for what concerns the infrastructure and the resources placed at disposal by the universities (which is to be considered as normal, because of the great need of technologies that characterizes the developing countries as Ecuador); meanwhile, the students of social sciences faculties think that the range of the “plus” offered by the university should be widen (that is an interesting point, considering that some of the plus considered in the survey carry no costs for universities).

By way of conclusion, the goodness of this study relies in its proposal of generating a different approach on the planning and administration of the resources directed to innovation, starting from the perceived needs of the students, considered as the ultimate beneficiaries of the innovation processes. So, as a recommendation, it is suggested to widen this study to a national level (by conducting the survey by provinces), so testing the validity of the survey instrument by enlarging the range of interviewed, stratifying the sample for faculties, without cluster them, with the aim of obtaining major and most specific outcomes. Moreover, it could be interesting analyse if it exists a different perception among the students, based on the type of university (public, private and cofinanced), the gender, the geographical or the cultural context,

considering that factors like these (especially in Ecuador) could influence the perception, that is the object of this kind of study.

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