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ORIGINAL

# Determination of the Innovative Capacity of Ecuadorian Universities

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**ABSTRACT**

Today the Higher Education Institutions are immersed in a world of constant change, and it is necessary to adapt to this environment with skill and speed. This has forced universities to adopt practices that create or strengthen their capacity to innovate, based on the determination of factors that influence it positively. This study is centered on the implementation of the Innovation Model of Higher Education (MIES) prepared by Villa, Escotet and Goni (2007), adapted to the university context. This model allows Higher Education Institutions to diagnose their innovative capacity. This model is developed in the field of academic innovation, which is defined as the organizational competence of institutions to respond to the environment quickly enough, to cover existing needs and to anticipate future ones. As a case study, MIES was applied to Ecuadorian universities where the perception of different university actors was obtained and the factors driving innovation in this context were determined as a reference for the application of strategies promoting innovation.

**KEYWORDS:** HIGHER EDUCATION, INNOVATION, UNIVERSITY, EDUCATIONAL INNOVATION

## 1 INTRODUCTION

An important mission intrinsic to the nature of university is its role in generating knowledge and intellectual creation. Therefore it follows that it provides input for solving problems in all areas of life, a fundamental feature of universities is to exercise their reflective capacity to anticipate events, foreshadowing the possible scenarios and the viability of their proposals.

Currently universities are directly responsible for the production, distribution and transmission of knowledge. New social, economic and political structures that are observed in society require significant changes in university management. Innovation and adaptation to change is an organizational competence that should be present in the generation of new mechanisms of knowledge production. The absence of this competency is a weak point in most universities. Although policies exist, they are isolated attempts with little measurable effects at the institutional level.

The term innovation is now used in many contexts, and it means to introduce something new or bring about a change, which obtains a result that satisfies improvement or activities or processes carried out in the context of their application. Zaltman, Duncan and Holbeck (1973, p. 3) state that "may refer to the inventive process by which you create new things, ideas or can describe the process by which an innovation grows into a cognitive state adopted and behavioral repertoire". Mohr (2003, p. 3) defines innovation as "the successful introduction in an applied situation of means and ends that are new to the situation". There are many definitions of the term innovation. This study will use the definition of Mohr (2003). As for innovation indicators a relevant benchmark is the concept that appears in the Oslo Manual (2005, p. 56), it states that "an innovation is the introduction of a new or significantly improved product (good or service), a process, a new marketing method or a new organizational method in the internal practices of the company, organization of the workplace or external relations ". This definition encompasses a possible range of innovations, so that it can be adapted according to the context where it is to be applied.

Regarding the education sector, which is the focus of this study, Rivas (2000) defines educational innovation as the consistent action in the process of incorporating something new into the system of the school, resulting in the modification of its structure and operations, to improve its effects in order to achieve educational goals. The concept of innovation in Higher Education is complex and multidimensional. It is associated closely with the intention of strengthening the quality of the

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learning processes of students, that is to say, with results training (Kozanitis, 2012).

One factor that cannot be put aside when discussing educational innovation is assuming the leading role of universities in knowledge societies. As highlighted Henao-García, López-González and Garcés-Marín (2014, p. 257) "this leading role is because Higher Education Institutions are generating of knowledge, enterprising and are called to promote scientific , technical and technological development of a country and with them its economic growth". The same author notes that in terms of innovation, it is key to identify what universities do with this new knowledge and how to reach stringing research and development with innovation (R & D + i); that is, whether there is an effective transformation of those discoveries into innovations.

As noted Casas (2013), research and graduate programs are key elements to support innovation as well as the relevance, virtualization and integration. The university innovation used to be considered an isolated, individual and sporadic element. Now it has become a social and collective phenomenon in which universities should play a key role by combining their scientific and technological activities with other organizational factors.

Genovese (2005) analyzes the reasons why educational innovations fail; the author explains how often such innovations appear on the scene and are widely applied. However, many are soon abandoned in frustration and disappointment. He points out that cooperative learning being accepted as a method of higher education in many institutions does not control individual differences, weakening the potential for innovation at a university.

Referring to the model of educational innovation, we speak of a process whose results will provide improvements and innovative changes in the institution, which will contribute to achieving its objectives. Gross and Lara (2009) present two different methodologies of innovation considered by Lester and Piore (2004): analytical and descriptive. Innovation with an analytical approach is based on the proposal and implementation of projects. ,In order to achieve the goals of any project, it is essential to define user roles, resources and expected end product. In the descriptive approach innovation is geared more to the process than the final product; it relies heavily on communication networks and contact with the environment.

The innovation model applied in a Higher Educational Institute will maintain and improve the quality of university teaching. This model should be reflected in policies and strategic plans, evaluating the performance of teachers in order to obtain their motivation and participation. It also suggests that teacher evaluation as a formative evaluation and teacher training are considered as two key elements that contribute to a model of collaborative innovation; so that, innovation, training and evaluation should be considered and integrated into the model (Mayor, 2007).

In the educational field, some universities have adopted models that allow them to measure the degree of innovation in their organizations in order to improve both organizational and educational processes. A model reference for measuring educational innovation at universities is proposed by Universidad Oberta de Cataluña (UOC). For Duart, Solomón and Lara (2006), this model focuses on three key areas: teacher training for online teaching, commitment to technological innovation and research cooperation.

Henao-García et al. (2014) propose a model to measure the capabilities of research and innovation in universities, the Matrix Capacity in Research and Innovation (MCII). This model has been applied at the University of Antioquia. It allows each institution to manage the information properly as it relates to research and innovation, and management indicators for the management of factors that strengthen these two processes. The main use of the MCII is that once identified, the current organizational structure of research and innovation capabilities at the university can take action to improve and focus their policies, strengthening the weak aspects through an efficient allocation of resources.

A model for measuring the innovative capacity of Higher Educational Institutions is the Model of Innovation in Higher Education (MIES) that comes from the proposal developed by Goñi (2004) and adapted by Villa, Escotet and Goñi (2007) at university and in the educational environment at all levels. This model is based on four major factors: environment and society, organizational structures, infrastructure, technology and resources, and people and skills. All these are linked in the management process, which is at its core. These factors are outlined in Figure 1. Guzmán, Maureira, Sánchez and Vergara (2015), which refers to this model, and observe that this is an interesting approach to locate and develop innovation in higher education, noting that in this model the innovation projects become a management strategy, as specified actions modify processes and outcomes in the various roles and responsibilities in universities.

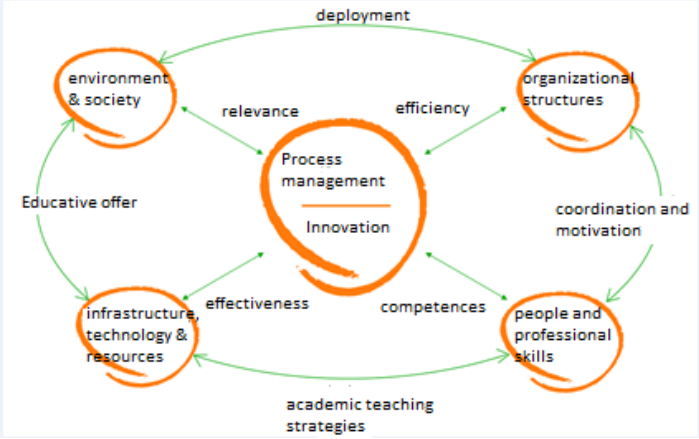


**Figure 1.** Model of Innovation in Higher Education (MIES). Source: Villa et al. (2007).

According to the initial proposals of Villa et al (2007), the main objectives of MIES are:

(1) Serve as a benchmark and indicator of the term innovation in the theories of change and management, which use innovation as a relevant value, but treat it as a complementary element.

(2) Help to assess the results of innovation and change, using the study and development of practices over time as evaluation indicators.

(3) Create educational material around innovation, as a global management practice with teaching, academic and institutional value.

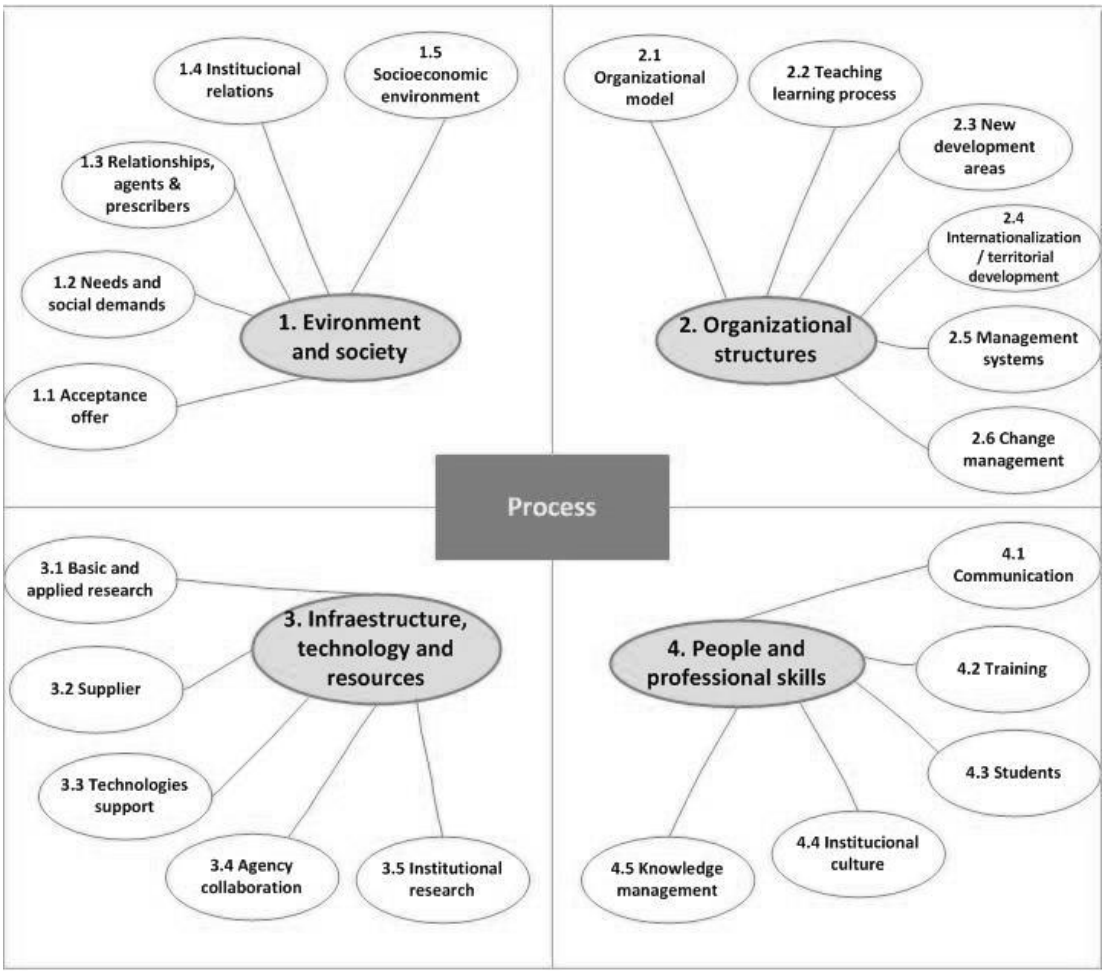


**Figure 2.** Factors y sub-factors of MIES. Source: Villa et al. (2007)

(4) Provide a framework to understand the interaction between the various factors that shape institutional innovation.

Villa et al. (2007) point out that MIES aims to help public and private educational organizations to define and display innovation, proposing the adoption or improvement of a repertoire of detailed practices that create or strengthen their innovative potential, focusing on innovation as a capacity or an intangible asset of an organization to respond successfully to changes that occur abroad. MIES defines innovation as a competitive or organizational capacity manifested in the speed of response to observable changes in the environment through the application of knowledge, organizational topology and people's sills with successful results, continuous and consistent with the mission and institutional strategy (Villa et al. 2007). In the present study, educational innovation is a competition or institutional capacity available to transform the training and organizational actions, which are generators and transformers of values and knowledge.

The MIES model is composed of factors and sub-factors that have a close relationship with each other. Each sub-factor is specifically associated with a particular factor. In this context, to improve its ability to innovate, universities must act on the roots of factors of innovation, which are determinant agents of the innovation capacity of an institution, so that the measurement and improvement of innovation will be reflected in the progress of such practices (see Figure 2).

The MIES attempts to measure the ability of Higher Educational Institutions for transformational change, related to the curriculum based on skills, the extension of training to business, generation and monitoring activities based on institutional values, development of joint interdisciplinary projects with external agencies, etc. This includes the interaction between the factors and sub- factors shown in Figure 2 and the elements that describe the characteristics and applications of each sub- factor, called criteria.

Based on the concepts of innovation identified, a study has been conducted to determine the main factors influencing the generation of innovation in Higher Education Institutions through the implementation of the Innovation Model of Higher Education (MIES) in the Ecuadorian university context, to identify areas for improvement and incorporate good practice in the future. This model has been chosen because it presents a comprehensive framework for measuring innovation in higher education institutions, creating innovative solutions in relation to their environment, technology, teachers, students and processes in the organization and implement actions that contribute to give people the institution and its capacity to innovate.

## 2 MATERIALS AND METHODS

In the present research, the adaptation of the model MIES it is considered in the Ecuadorian context through three stages. First, a documentary qualitative and descriptive methodology is applied (Henao-García et al., 2014). The studies on the measurement of factors, that affect the innovation in university is explored and analyzed, which gives an overview of the

innovation process in Latin American and Ecuadorian context and makes it evident that this is a barely researched and recognized issue.

In the second stage, the instrument proposal by the authors of MIES is adapted to the Ecuadorian context through content analysis techniques. The terms of the original model is fitted to the terminologies used in the Ecuadorian context to guarantee a better comprehension. For this adjustment, the 4 factors, 21 sub-factors and 105 criteria of the original model are considered. These refer to services offered by universities, effectiveness and impact, organizational structures, teaching - learning, internationalization, systems change management, infrastructure, basic and applied research, communication processes and training, institutional culture, knowledge management, among others.

To determine the universities participating in the study, the institutions best categorized in the Ecuadorian context are chosen[i]. Information on 10 public and private universities is gathered with the objective of determining the factors with the greatest impact on the innovative capacity of each institution. The criteria for the selection of participants in the study were established in the broad sense, as outlined by Landeta quoted by Leon and Lopez (2014), these criteria were related to the achievement of different levels of representativeness in order to obtain the perception of all university authorities and evaluate different approaches on innovation generating elements. The selection of participants is focused on their significance rather than the statistical representativeness (León & López, 2014). Approximately 300 university actors are involved among authorities, directors of faculties, deans, career and departmental professors, students, alumni and administrative staff.

A mixed research methodology is used to obtain the information, combining a qualitative study to select the criteria and quantitative one to value them. A personalization of each institution is performed which consisted of the inclusion or elimination of the criteria MIES models and subsequent weight. For this, the university actors decided whether each criterion should be considered or not based on the relevance to their institution. They chose 60 driving force criteria of 105 criteria proposed by the MIES and categorized them as fundamental (40 criteria) and important (20 criteria)

The 60 criteria selected were assigned a weight ranging from 1 to 4 (from least to most significant), considering the potential provided by the criterion as a source of innovation of the institution. This exercise was conducted in focus groups composed of previously designated people and considering the criteria proposed in the MIES model. This process was accompanied by concrete explanations of the model, especially the criteria that affect the processes and activities of the IES participants.

Finally, as a third stage, the criteria with the highest selection frequency are determined through the assessment of participants, resulting in a group of 17 criteria. In order to establish a hierarchy of preferences criteria against other alternatives, a value of firm belief is adopted that something is more important than other things (Morales, 2009). A group of experts in university innovation made an arrangement assigning each criterion a continuous value between 1 and 17, so that when all subjects assigned 1 to the same criteria that get automatically the value of 100. In contrast, when actors propose the value of 17 for a criterion, this will be assigned as 0. If the rating given by the actors varies, it will be necessary to calculate the V value proposed by Dunn-Ranking and King (1969) applying an adaptation to the formula by López-Yarto and Morales (1985).

It is important to consider that the relative scores calculated indicate the order of preference, but not absolute values. Ordering the proposed criteria and not the valuation assigned to each person and reflecting the hierarchy assigned by the group of experts.

## 3 RESULTS

After the application of MIES to a group of Ecuadorian universities, we observe that the results are grouped into two aspects. The results grouped around two aspects are obtained. First, data of the driving forces of innovation were obtained through the major factors proposed in the MIES. In addition, information on those sub factors and criteria that influence the innovative capacity of the participating universities was achieved in order to determine their current situation and generate useful information for university actors, especially for decision makers in organizations and agents of national government.

Table 1 shows the distribution of the 40 criteria labeled as fundamental and 20 criteria defined as important. It can be seen that 30% of basic criteria are grouped as the *infrastructure, technology and resources* factors, and an equal percentage in *people and professional* skills. A different dynamic was obtained for the important criteria, being mostly clustered in the *environment and society* factor, which hosts 50% of the important criteria.

The results also show that among the important sub-factors more preferably are institutional relations with an acceptance rate of 15%, followed by communication, acceptance of the offer, needs and social demands, knowledge management, socio-economic environment, needs and social demands with 10 % acceptance.

**Table 1.** Distribution of fundamental and important criteria among the MIES factors.

| Factors | Fundamental criteria weighting | Important criteria weighting |
|---|---|---|
| Environment and society | 12,5% | 50,0% |
| Organizational structure | 27,5% | 20,0% |
| Infrastructure, technology and resources | 30,0% | 20,0% |
| People and skills | 30,0% | 10,0% |

Table 2 describes the distribution of the fundamental sub - factors with more weight according to the assessments of university actors involved in the study. It is observed that most of the participants agree that the *basic and applied research* (17.5%) sub-factor is essential to boost innovation in Higher Education, considering that the creation or application of new knowledge are key factors for innovation. The *teaching-learning process* has also been considered as a major area of innovation, taking into account personalized teaching, student autonomy and educational change. Lower values are evidenced in the sub - factors *training and students.*

**Table 2.** Fundamental sub-factors

| Fundamental sub-factors | Weight |
|---|---|
| Basic and applied research | 17,5% |
| Teaching-learning process | 15,0% |
| Training | 10,0% |
| Students | 10,0% |
| Knowledge management | 7,5% |
| Institutional research | 5,0% |
| Environment and society | 5,0% |
| Organizational model | 5,0% |
| Internationalization / territorial development | 5,0% |
| Interinstitutional collaboration | 5,0% |
| Needs and social demands | 2,5% |
| Foreign agents / prescribers | 2,5% |
| Interinstitutional relations | 2,5% |
| Change management | 2,5% |
| Technologies support | 2,5% |
| Communication | 2,5% |
| Basic and applied research | 17,5% |

Of the 17 criteria most commonly acceptance, a hierarchy of preferences was found by an independent estimate of each against the other alternatives. Experts assigned to each criterion a hierarchical rank between 1 and 17. The ranges are summed and a reference value called value V is calculated (López-Yarto and Morales, 1985). That sum is translated into a list of hierarchical order that goes from zero to one hundred, so that the most valued by participants have a higher value (up to 100). Table 3 shows the criteria ordered, which are located in continuous values ranging from 55.6 to 95.6. It is evidenced that *research in the teaching and learning processes* has the higher hierarchy, followed by the *selection of teachers, applied research and dedication of teachers.*

**Table 3.** Ranking fundamental criteria

| Criteria | Rank sum | V value (escale 1-100) |
|---|---|---|
| Research processes teaching / learning | 29 | 95,6% |
| Selection of teachers | 41 | 82,0% |
| Applied research | 43 | 80,0% |
| Dedication of teachers | 44 | 80,0% |
| Research partnerships | 63 | 73,8% |
| Dissemination of results of institutional research | 68 | 70,6% |
| Technological equipment | 69 | 68,8% |
| Transfer of research results | 69 | 68,8% |
| Student autonomy | 69 | 66,3% |
| Computing technology for teaching / learning | 72 | 62,5% |
| Professional academic profile | 72 | 61,3% |
| Basic research | 74 | 59,4% |
| Management of the learning process | 83 | 58,8% |
| Professional development | 84 | 58,1% |
| Collaboration with other university faculties | 101 | 55,6% |
| Projects with technology centers and universities | 102 | 55,6% |
| Mobility of researchers | 120 | 55,6% |

## 4 DISCUSSION

The application of MIES adapted to the Ecuadorian context can be a guide for universities to diagnose their institutional innovation capacity, enhance their key factors and offset their weaknesses thus guiding decision making. One of the purposes of the MIES is to generate innovation projects in different areas, dimensions and depth in line with the strategy of change that institutions want to implement. In this sense, innovation projects are necessary tools for an institution to change its processes and thereby provoke, build and install innovations in their daily work.

Sources of innovation can be varied, the application of MIES in a group of universities in the System of Higher Education of Ecuador has allowed the prioritization of the key factors affecting the generation of innovation, both of which can contribute to decision-making and better use of opportunities.

It is evidenced that university actors give great importance to *basic and applied research.* This result is consistent with the tendency to give priority to the research activity of teachers in higher education policy in Ecuador. It is clear that this concern is present in university scenarios making it clear that teaching and learning processes are located in second place in aspects of innovation generators. We cannot deny that research is fundamental. However, student learning and the various teaching processes are the main function of the university.

Other important elements that actors rated as innovation indicators are related to available technologies, infrastructure and resources that institutions have to innovate. This adds people and their skills as major agents' innovation processes. Physical and technological aspects are elements that allow the development of innovation and these aspects have to be related to human talent and subjective issues such as fitness and culture of innovation to change processes and adapt quickly to changes in environment. The factor *environment and society* highlights the importance of knowledge in the current ambit and potential in which universities carry out their activities to give effective responses to the social demands, enabling compliance with one of the basic functions of higher education, linkage and interaction with society.

The *teaching-learning process* has also been considered as a generator of innovation at a university. Personalized teaching, student autonomy and transformations educative must be present as collaborative strategies to guide the change. In this sense, *the student* becomes a generator of innovation as well as the teaching and learning process, which is part of the creation and *management of knowledge and innovation.* Mauri, Coll and Onrubia (2008) also consider these aspects, they point out that among the dimensions used to assess the quality of innovation in teaching is the creation of forms of joint activity between teacher and student to achieve meaningful learning.

Basic and applied research and training are key sub-factors to innovate. Today universities have turned their efforts to permanently qualified teachers and produce basic and applied knowledge to improve the living conditions of the population. In this context, it is important that processes be related to appropriate methodological tools that allow a real contribution to their environment and major social changes.

Undoubtedly, investigations in the teaching - learning process enable continuous improvement of classroom practices and teaching function, necessitating a true knowledge of the real situation, the context under scrutiny and the theory behind it to assume an attitude criticism of reality. It is also this type of

research that guides the transformation of the teaching role from being the sole owner of the information to becoming counselor and agent to support students to construct meaningful knowledge, incorporating TIC, not without having defined the objectives to be achieved, the learning theories that support and the means to accomplish it.

In addition, the influence of the criteria related teacher profile in the selection of teachers, which consists of incorporating new teaching staff or their promotion, affects the ways of directing, focusing new ideas or complete knowledge areas. The profile of the teacher can be an instrument for generating change and shift towards innovation practices. Another factor is the dedication of teachers, so the organization of teaching time to allow greater flexibility with adequate and effective dedication to research, teaching and projects. In this sense León and López (2014) mention that institutional support is key to the generation of educational innovation, considering the lack of recognition, the processes of teacher evaluation or adverse working conditions as time overload, lack of time, etc. are barriers to the generation of curriculum innovation and seriously affect the quality and effectiveness of teaching.

Strategic research partnerships comprise different internal and external dimensions. An internal alliance relates to projects that develop between the different faculties or areas of Higher Education Institutions, and on the other hand, an external alliance happens when Higher Education Institutions and other institutions join efforts for the development of a specific project. The importance of this point, not only encourages innovation, but also promotes institutional relations and even transcends ideology of competition.

The university actors consider it a less important incidence of the institutional climate and classroom environment in the innovation process. Their interpretation is that these two elements minimally condition or delay the momentum of innovation in higher education institutions. Likewise, the management of the teaching process comprising classroom learning initiatives and guidelines to encourage meaningful learning and self-development of students is also highlighted. This aspect has also been regarded as a generator of innovation capacity in universities. It contrasts with the findings of the investigation by Rodríguez-Gallego (2014), who found that current students are demanding more time to assimilate knowledge and realization of practical, explanations that are more leisurely and active methodologies, key to improving the ability to innovate in the teaching-learning process aspects.

The latter elements identified by the university actors as less important for innovation, justify the current perception and concern of institutions. There is increased attention by research activities, leaving in the background the stage of education and teaching and learning processes. All those who are part of the university community, especially teachers regain the importance of the teaching function and make this the main element in the innovation of Higher Education Institutions.

## 5 CONCLUSIONS

The results achieved in the framework of this research have enabled a major step in identifying the criteria that affect the ability of universities in Ecuador to innovate. It has been identified that higher education institutions are composed of several factors, permanently interconnected. Each is involved in the innovation process, therefore they are dependent and should be known by the university community, therefore it is important that from the personalization and contextualization of each institution its position is diagnosed and identified through those critical aspects from the point of view of educational innovation.

In order to boost an institutional climate oriented innovation in all university actors: managers, researchers, teachers, students, alumni, administrative and service personnel should promote the proliferation of innovation practices, generation of collaborative learning, integration of TIC as a support function teachers, etc. Teachers should take an innovative position and encourage their students in the development of innovation in the different course paths, highlighting the importance of teacher training in this process. León and López (2014) mention that teacher training is a key to spark interest and commitment in innovation, besides providing knowledge, skills and attitudes necessary to perform a successful teaching management factor. It is clear that any proposal for innovation, knowledge and teacher preparation are critical factors.

On the other hand, the development of basic and applied research projects in different stages of training of students will arouse interest in research. This aspect relates to theoretical knowledge and links with society, allowing application in real situations in different institutions. Basic and applied research is the key to generating innovation in universities and plays a leading role in knowledge creation and promotion of scientific development. We cannot ignore the applicability of this new learning and the establishment of mechanisms as a link between research and innovation development.

Institutional support for the innovation process is indisputable. The teacher should feel supported and valued. In addition, the results of innovation teaching from their own experience will encourage their colleagues to participate in different innovation projects.

Finally, we consider it essential to form research partnerships between Higher Education Institutions, as this will be of benefit in the learning process for students and will consolidate the knowledge of their teachers. Furthermore the development of innovation projects composed of different points of view allows for the opportunity to make better proposals for implementation.

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## NOTES

[i] Process developed by the Consejo de Evaluación Acreditación y Aseguramiento de la Calidad de Educación Superior (CEAACES), which considered the application of methodologies for multi-criteria analysis and cluster analysis to the results obtained from the universities of Ecuador under five criteria: academy, academic efficiency, research, organization and infrastructure.

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