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Influential agents in the online education diffusion at a Mexican University: What the Social Network Analysis REVEALS

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Abstract

Through a Social Network Analysis applied to a survey at a Mexican University the diffusion of online education dynamics in a 13 year period was determined. For the analysis, the 13 years was divided into four periods. Teachers answered the survey by identifying by name the people or University initiatives, including people outside the University, which influenced his decision to venture into online education. The most influential agents for each period were determined by their In-Degree value. For the analysis, inter and intra periods influence of agents was considered. Three agents who held great influence in the diffusion in the most part of the period were identified, one of which kept the higher In-Degree value among teachers, and slightly lower than the node of University initiatives that promote online education. Is considered that the level of online learning diffusion in this University have been very limited without the influence of two influential agents in the overall process.

Keywords: Gephi Program, Innovation Diffusion, Online Learning, Social Network Analysis

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1. Introduction

The vertiginous development of Information and Communication Technologies (ICT) in recent decades has substantially transformed society as a whole. As a consequence of this development, authors such as Dolence and Norris (1995) speak about the transition of industry period to the information period. Likewise, organizations like World Bank (2002) and the OECD (1996) contemplate a new economy based on the knowledge which Higher Education Institutions (HEI) demand. (Malik, 2002) It is a change of paradigms in the teaching-learning processes promoted in México by the Secretariat of Public Education (SEP) (2001) and the National Association of Universities and Institutes of Higher Education (ANUIES) (2000).

For HEI, the pressure of the external context to incorporate ICT in their educational and administrative processes has focused to turn substantial resources in infrastructure that are not always implemented for the best (McAnally-Salas, 2007). On the other hand; teachers have technologies which they can use in their teaching, but without a full understanding of how to use them effectively from an educational perspective.

In this context of technological growth, the Internet is a disruptive technology that has changed rapidly HEI daily lives, and it is precisely this ubiquity of Internet, what allows enrichment of teaching practices by facilitating transition to focus the educational process into learning. Although web tools, initially find their common use in distance education as a way of replacing limitations of interaction in traditional remote models, its utilization is not restricted to this educational modality (McLoughlin, 2000). In general we can say that in México, as in the whole world, the incorporation of Internet in HEI without a long tradition in distance education favored its incorporation and experimentation into the traditional modality as a complementary support (Mahony Wozniak, 2005) that evolved from the online course topics, and alternating the study of online content with one-to-one sessions (Belanger & Jordan, 2000; Horton & Horton, 2003) to make available complete courses on line ready to be taught via Internet.

Universidad Autónoma de Baja California (UABC) first researches related to online education started in 1996 with an acceptance, formalization and institutional support somewhat irregular over time (McAnally-Salas, 2007). Therefore, the aim of the work is focused on knowing the process of online educational dissemination in UABC in 1996-2009 period, as well as the general characteristics of teachers involved in such modality, their social networks for the design of their courses, and what are some of their beliefs about online education and some of their online teaching practices.

2. Method

The UABC teachers involved in online education were the subject of interest, and 4523 invitations were sent through institutional email obtained from UABC employs database. The purpose was for them to answer a survey, provided that the first questions were not intended for administrative staff and teachers whom were not involved in online education.

LimeSurvey system was used for design and application of the online surveys. This system allows exporting results in formats that make easier a subsequent manipulation into a spreadsheet.

The survey asked teachers to write down the year of involvement into the online teaching modality and the name of the person(s) responsible of their involvement in online education. The information was anonymous and registered in codes of two-letters and a number. The first letter from campus of origin and the second letter from the maximum level of education followed by a number.

The data obtained from involvement process into online education was coded and manipulated for its analysis as social networks in Gephi program.

3. Results

We obtained 324 valid surveys of the 4523 invitations that participate, because were the only ones fulfilling inclusion criteria into accurate analysis and teaching practices; and for dissemination process analysis we obtained 201 valid surveys. The survey was online for eight weeks and approximately every 15 days a reminder was sent to those who had not participated. Table 1.

Table 1. Number and percentage of teachers whom answered the survey.

Campus	Teachers by campus ²	Teachers involved in Online Education who answered the survey	Percentage who answered the survey
Ensenada	1238	124	10
Mexicali	2136	109	5
Tijuana	2050	85	4
Tecate and San Quintín	28	6	21

3.1. Online Education Diffusion Process

To analyze the responses of 201 teachers whom indicated the year that were involved in online education and mention to the person(s) that motivate them to get involved in this teaching modality, four periods were defined starting in 1996 until the end of the survey on December 2009. Periods go from 1996 to 1998, another from 1999 to 2002, also from 2003 to 2007, and 2008 to 2009. The periods correspond to four different administrative periods in UABC university, where the first and last ones include partial periods.

There are two essential data for the analysis: one is that a teacher has indicated the startup period and the other is that at least he has mentioned someone else, or that she or he has been mentioned by another teacher. The preceding creates two data groups; a first group that at least mention one teacher who responded to the survey indicating its initial period, and a second group that also mentions to other teachers of UABC or external teachers but the initial period is unknown, this includes mentions to institutional programs or employees involved in these programs.

By the nature of the question (to mention the person(s) that led you to get involved in online education) the generated networks are directed and the most important is the In-Degree.

This analysis is presented for periods that describe primarily the characteristics of the network in which only UABC teachers are involved with defined period and then, to describe the network including external agents, institutional programs and teachers of UABC whom have not their

² UABC. Annual Survey on Organizational Climate 2011. Encuesta anual. Cuadernos De Planeación y Desarrollo Institucional. Mexicali, Baja California: Universidad Autónoma de Baja California, April 2012.

period of involvement in the online education. In this analysis scheme will be incorporated the different periods as correspond.

3.1.1. 1996-1998 period

From the amount of teachers whom responded to the survey and say they have initiated in this period, there are 13 elements that make up a network with only 6 nodes connected by the influence of modality involvement as shown in Figure 1. In this group are identified in blue 10 teachers of Ensenada campus (E), 8 doctorate degree (D) and 2 persons with master's degree (M). 2 teachers in the Mexicali campus were recorded in red, one of them with a Master Degree and the other one with a Bachelor Degree (L), while only 1 teacher of Tijuana in green color with a master degree. In this figure are identified with an asterisk 3 nodes that are identified as responsible, in year 1996 of first studies of online education registered at the university; ED190, ED189 and ED191.

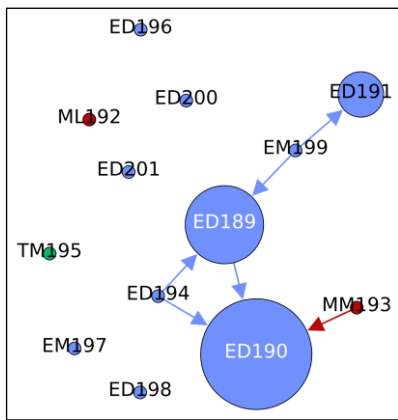


Figure 1. Teachers involved in online education between 1996 and 1998, the node size represents their relative importance to the network measured by their In-Degree value and colors define their Campus; blue for Ensenada, red for Mexicali and green for Tijuana.

The giant network component is formed by six nodes connected while the remaining are isolated. The average degree of linkage of the network is 0.462 with 6 links, 3 of them to ED190 node gives a In-Degree of 3, and defined as the most influential node of the period. The density of the non-directed graph is 0.055.

3.1.2. 1999-2002 period

In this period, 32 teachers are involved in online education with 15 links where there are 16 teachers of Mexicali, 6 Doctorates, 9 teachers and 1 person with a bachelor degree; in Ensenada we have 12 teachers, 8 Doctorates and 4 persons with a master degree; and from Tijuana we have 4 teachers, 3 with a Master Degree and one with a Bachelor Degree.

Figure 2 shows that the network has 3 components; the giant component of the network with 10 nodes and two additional components with 3 and 2 nodes. The most influential node of the period was the MD162 with an In-Degree of 5, followed by the node MM168 with an In-Degree of 3. In this case the density of the non-directed graph is 0.036.

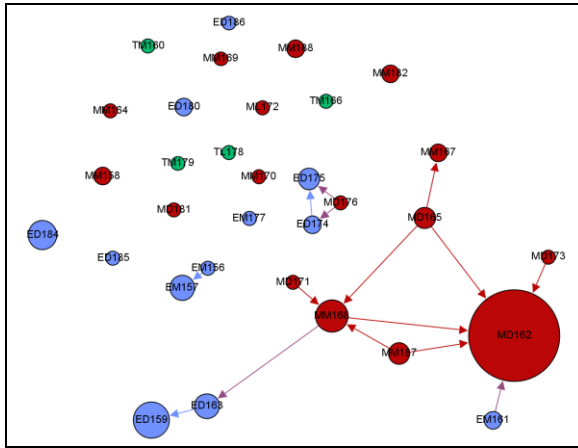


Figure 2. Teachers involved in online education between 1999 and 2002, the node size represents their relative importance to the network measured by their In-Degree value and colors define their Campus; blue for Ensenada, red for Mexicali and green for Tijuana.

3.1.3. 2003-2007 period

In this period there were 65 teachers who were involved in online education, but only 11 links are recorded. From this group 28 are from Mexicali, 9 Doctorates, 17 master's degree and 2 graduates. In Ensenada 19 teachers are incorporated, 8 Doctorates, 9 with a Master Degree and 2 graduates. In Tijuana 15 teachers, 4 Doctorates and 11 with a Master Degree while in Tecate; a teacher is incorporated and in San Quentin is incorporated one doctorate.

The 11 links cannot form a giant component when they are not concentrated in a few nodes; however the most influential nodes are those that have just a In-Degree of 2 corresponding to MM91 node of Mexicali and Tijuana TM94 node. The density of the non-directed graph is only 0.003.

3.1.4. 2008-2009 period

During this period of two years, 27 teachers were involved in online education, and because of the absence of links between them, it can be say that its influence to get involved into the online modality comes from agents of other periods.

This period incorporates 12 teachers of Ensenada, 4 Doctorates, 6 with a master's degree and 2 with a bachelor degree, Mexicali have 7 new teachers, 3 of them which have doctorate and 4 teachers with a master degree while in Tijuana are incorporated 8 teachers, 6 with a Master Degree and 2 with a bachelor degree. Obviously the not-directed graph density is 0.0.

3.2. Influences between periods

3.2.1. 1996 to 2002 period

The influence that exerted the teachers that adopted online education in the first period of 1996-1998 over the teachers that adopted online education in the next period, 1999-2002, can be seen in the Figure 3 where the node ED190, pioneer in 1996, it is the most influential node with an In-Degree value of 10 followed by the MD162 node.

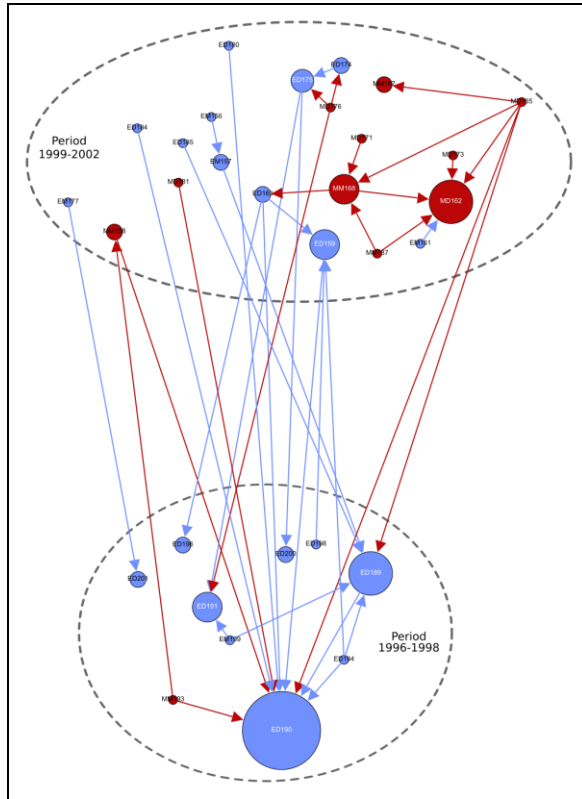


Figure 3. Links between teachers of the periods 1996-1998 and 1999-2002. The size of the nodes represents its importance to the network as its In-Degree; and colors indicate their Campus; blue for Ensenada, red for Mexicali, and green for Tijuana.

Due to the beginning of online education occurs in Ensenada, it is expected that their influence is relevant not only in the Ensenada campus, but in its distribution to other university campuses. So we can see from the first period in Ensenada that 6 of the 9 are mentioned as teachers that were influenced into involved in this modality. The links between Mexicali teachers becomes stronger in the second period.

This network have 31 nodes with 39 edges with a giant component with values similar to the whole network, 29 nodes, 93,55% of total nodes and 38 edges corresponding to the 97.44% of all edges in the network. The density of the non-directed graph is 0.084 indicating a very connected network between all its nodes.

3.2.2. 1996 to 2007 period

The influence that teachers had into the inter-and intra-periods from 1996 to 2002 can be seen in the Figure 4 where the most influential nodes remain the ED190 node of the first period and from the second period is MD162 node with an In-Degrees of 20 and 14 respectively . Teachers of the third period mention to 17 teachers of the first period and to 27 of the second period indicating a greater influence of the members of the second period over the third and the first period. Despite this, such individual nodes, the influence of ED190 node from the first period is substantially towards to the members of the third period as is shown by the links of the third period directed at this node. On the other hand it is evident the influence of MD162 node in the second period to the third period teachers.

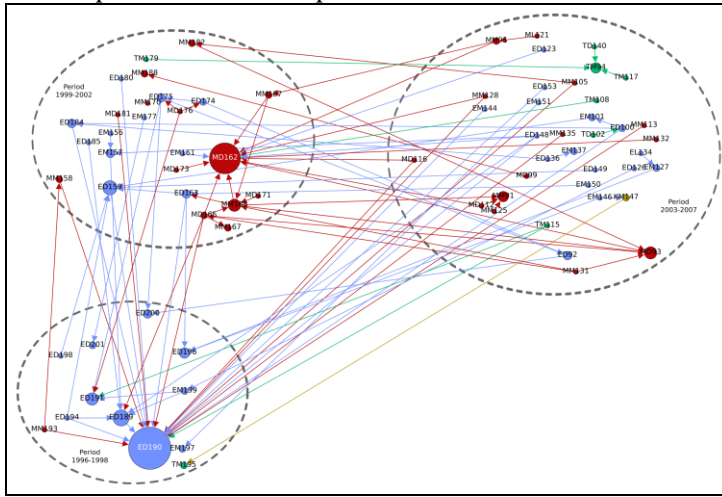


Figure 4. Links between teachers of the periods 1996 to 2002. The node size represents their relative importance to the network measured by their In-Degree value and colors indicate their Campus; blue for Ensenada, red for Mexicali and green for Tijuana.

For the third period, from 2003 to 2007, the MD93 node was the most influential with In-Degree of 4 and analyzing the figure shows that 3 of these In-Degrees comes from the previous period , which suggesting that their influence was accentuated during the third period, possibly influenced by the MD162 node of the second period.

These three periods form a network of 73 nodes and 95 links with a giant component of 63 nodes, 86.3% of the total, and 89 links which correspond to 93.68% of the total. The density of the non-directed graph is 0.018

3.2.3. 1996 to 2009 period

The Figure 5 shows the links of inter-and intra influence of periods that teachers had from 1996 to 2009. The two most influential nodes are repeated from prior periods the ED190 node of the first period and MD162 node from the second period with In-Degrees of 24 and 18 respectively. While into the third period the most influential node is the MD93 with a In-Degree

of 5. The teachers of the fourth period have mentioned to 10 teachers of the first period, 11 teachers of the second period and only 6 of the third period.

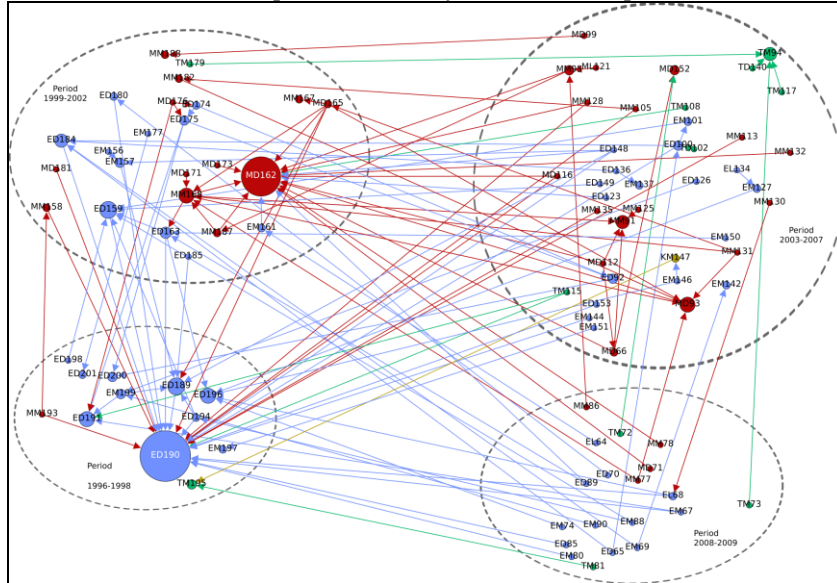


Figure 5. Links between teachers in the periods from 1996 to 2009. The node size represents their relative importance to the network measured by their In-Degree value and colors indicate their Campus; blue for Ensenada, red for Mexicali, green for Tijuana and gold for Tecate (K).

This network has 96 nodes and 126 links with a giant component of 85 nodes which is the 88.54% of all the nodes, and 119 links that corresponding to the 94.44% of links of the network and a density of the non-directed graph of 0.028.

3.2.4. Periods and agents without a starting period reported

The influence of all the registered agents is shown in Figure 6 that corresponds to a network with 185 nodes and 259 links with a giant component of 157 nodes and 241 links which corresponding to 84.86% and 93.05% of the total respectively. The density of the non-directed graph is 0.015. This figure shows the influence of institutional programs in the node of UABC and external agents to the university into the External node. The most influential node considering all periods, is the UABC node with a value of 29 in its In-Degree, followed by ED190 node of the first period with a value of 27, the MD162 node of the second period with a value of 21 and External node with a value of 13 In-Degree.

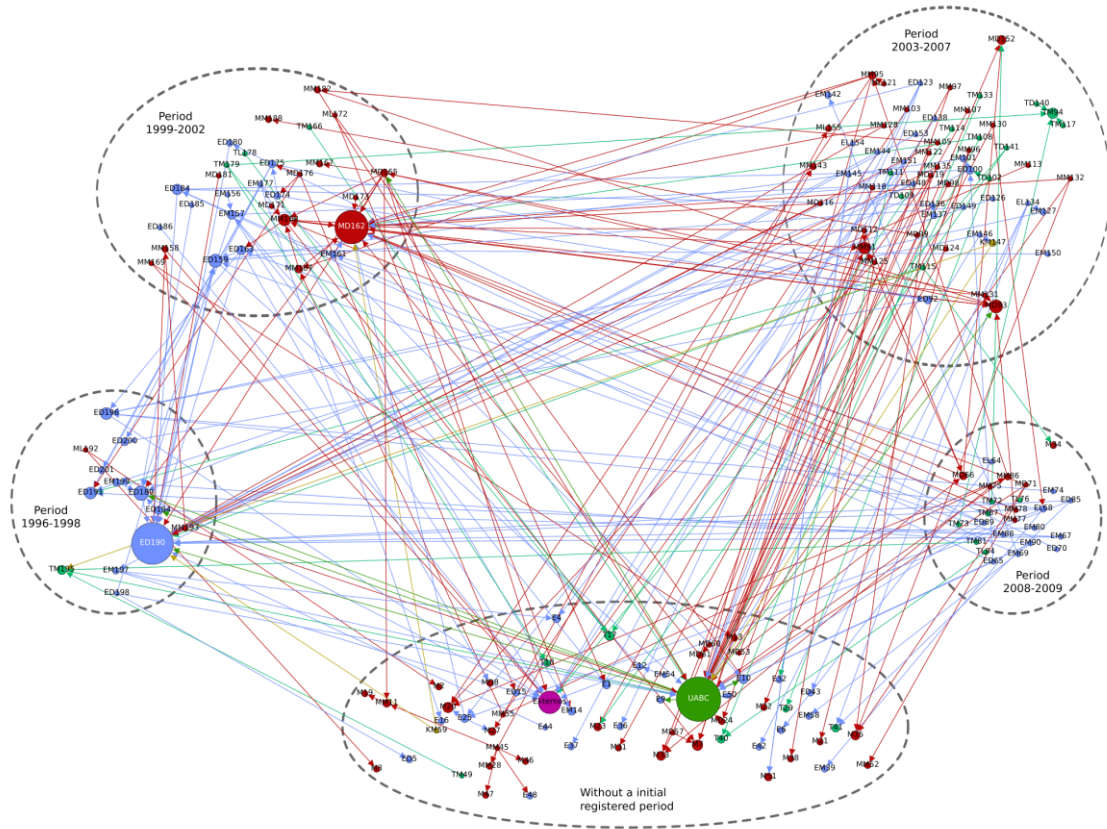


Figure 6. Links between teachers in all periods and agents which its period of involvement is unknown. The node size represents their relative importance to the network measured by their In-Degree value and colors indicate their Campus; blue for Ensenada, red for Mexicali, green for Tijuana, gold for Tecate (K), dark green for UABC and purple for External agents.

Considering the intensity of links between the five networks, we can observe a higher intensity between the agent network without a defined period and teachers of the third period with 52 links followed by the second period from where emerge 29 links, the teachers of fourth period has 18 links and finally the first period with 17 links. This implies that agents without a defined period provide 116 of the 259 links that make up the totality, the 44.78%.

4. Discussion

The results indicate that the online education diffusion in the UABC has been more a gradual process with an unclear purposes. It has responded to a series of individual efforts, rather than an explicitly and clearly oriented institutional policy. Besides, its behavior changes as frequently as administrative periods of the university. Thus, in each administrative period the diffusion of online education behaved differently.

Initially the online education diffusion in UABC was started by individual initiatives undertaken by academics who perceived it as a complementary alternative to conventional

university education. Thus, the period 1996-1998 was characterized by the emergence of agents of change, which not only started to practice in this modality, but stimulated the interest of other academics. In this way, the influence of these agents led to the gestation of small communities (sub-networks), whose members shared information on their practices and experiences from their involvement in online education. This dynamics resulted in the offer of the first bachelor's and master's degree online courses, the implementing of workshops for teachers interested in the modality, and a proposal to UABC authorities for the creation of a Distance Education area in the university.

The first stage results stimulated that the institution, in the next administrative period (1999-2003) take a more active role in the online education's dissemination process, implementing some strategies, such as: 1) the incorporation of an strategic program for Online Education in the UABC; 2) the design and implementation of the Open and Distance Learning System; and 3) the in-licensing of Virtual-U has the LMS of choice at that time. However, in this same period is pending the formal incorporation in the university structure, of the proposed area for Distance Education. Besides the technological factor it is privileged over pedagogy.

This series of strategies, added to the inertia of the first stage, achieved that the network of this period increase in its number of nodes. Thus, to the 13 academic participants in the first period were joined by 32 academics, which resulted in the emergence of other change agents whose influence led to the articulation of new sub-networks and new positions of power.

The arrival of the third administrative period (2003-2007), brought a clear and structured focus around the use of ICT as a means of teaching and learning. However, its implementation was not carried out as originally conceived. The incipient groups around online education from previous periods were reassigned, and the design and implementation of the system in a major scale, were disrupted. However, in 2006 some change agents in a position of power manage to create the Open Education Center (OEC). As part of their first actions was to initiate a new campaign to involve academics into online education.

Such a scenario modified the evolving dynamics of online education into the UABC as during this third period the increase in the number of nodes was remarkable. At 45 participants from 1996 to 2002, they were joined by 65 new academics where involved in the online education modality. It is reasonable to assume that this growth was the result of the natural inertia of the first two periods and the actions taken by the OEC at the end of the third cycle. Moreover, in the network, the UABC appears as a dominant node for the first time, because along this period many of those involved indicate that UABC was the agent that influence them to get involved in online education, probably because of the actions defined by the OEC.

Finally, in 2008-2009, the new university administration does not define a clear policy regarding online education, this could explain why a significant drop in new participants was recorded into the incorporation of new participants in contrast with the 2003-2007 period. Only 27 new teachers were involved in online education, and no emergence of new agents of change and new sub-networks were registered. However, another important factor to consider is the fact that in the last period, only data from the first two years were obtained, so the number of new nodes incorporated is unknown for the complete period.

The trend that detects the dissemination of online education along these four periods suggests the need to clearly define a institutional policy and strategy to promote the online education potential in the university context. This policy, beyond of establishing guidelines and regulatory standards, should create the conditions for the diffusion of online education in a natural way throughout university and to encourage the emergence of changing agents within the own

university community, who in addition to encouraging the adoption of this type of education are also able to identify new tendencies and niche of opportunities.

Encouraging the emerging of changing agents within the university, would create a more strong and distributed network that would allow online education maintain continuity in adverse contexts and that proper operation did not depend significantly on a small number of nodes. In turn, having a large number of agents of change stimulates the formation of communities that promote diversity of ideas and flow through the network, a fundamental element of any innovation process.

Finally, to rescue of previous experiences during this diffusion process is a valuable source of information that allows you to identify good practices and avoid to replicating those that do not contribute to the positioning of online education as a element of innovation and change in the institution.

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