Campus information systems for students: classification in Spain

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Abstract

Purpose – First, this article seeks to establish a conceptual model for campus information systems for students, in order to make their comparison possible for strategic management purposes. Second, it seeks to test this conceptual model in a fieldwork on Spanish higher education institutions, in order to relate information system's characteristics with other organizational features.

Design/methodology/approach – The conceptual model was based on socio-technical information systems and knowledge management literature. A holistic vision of higher education student's information needs was kept into account. Data about Spanish universities were gathered by means of structured visits to institutional websites and structured interviews with undergraduate students. Data were analyzed with multivariate statistical techniques.

Findings – From multivariate analysis, a classification was obtained for Spanish universities into three clusters with homogeneous characteristics, in the sense of informational and organizational aspects. These clusters are discussed in temporal terms and with some individual examples.

Research limitations/implications – Campus information systems need to be broadly characterized for strategic information management purposes. The proposed and tested model is a step to address their characterization.

Originality/value – This user centered information systems conceptual framework is set up to obtain a global vision of new information and learning electronic environments in campus. Its application in a fieldwork on Spanish universities offers new insights about informational and organizational features in higher education.

Keywords Universities, Information systems, Higher education, Information management, Spain

Paper type Research paper

Introduction

Electronics-based networks have brought widespread transformations in the way information flows in university campuses. Traditional face-to-face and paper based campuses are now part of a more rich and complex environment where electronic networked information resources have grown in importance. Universities are traditionally highly decentralized organizations, so corporate information resources management is a challenge (Cornford, 2000; Altbach *et al.*, 2006). Likewise, external pressures due to the rise of the network society pose questions about the role of universities. These questions affect the concept of information systems and their role. It is not just the case to support administrative processes or bounded tasks from an individual basis. Agenda also includes open-ended questions and knowledge creation in a wider sense, in the context of learning communities. Having this context in mind, a conceptual model for campus information system for undergraduate students is proposed. According to this model, fieldwork was conducted in Spanish universities.

As a result, we have classified Spanish higher education institutions into three clusters with homogeneous informational and organizational features.

The actual situation and challenges for universities' information strategy and the purpose of this paper are exposed in the next section. In the third section, the model for a campus information system is presented. In section four, organizational features of Spanish universities are summarized. The methodology used in the fieldwork for data collection and analysis is explained in section five. In section six the results are presented and discussed. Finally, the conclusions are exposed.

University challenges in information systems strategy and the rise of network society

Campuses offer students an information infrastructure to assist them on different aspects of university life. These infrastructures were traditionally based on two principal elements: paper documents and face-to-face communication (Brown and Duguid, 2000). By the end of the twentieth century, universities had a long experience in physical campus configurations, and had developed different spatial solutions in different geographical and cultural contexts (Cornford and Pollock, 2003). Also, they had thoroughly incorporated bureaucratic information management from industrial era institutions, specially for administrative purposes (Neave, 2006).

However, at the end of the twentieth century, the rise of information technology and electronic communication radically altered the potential for exchanging information in university campuses. The widespread use of the worldwide web, from the mid-1990s onwards produced a qualitative leap in the potential of online information at universities. These changes posed new questions and chances about how to build and properly manage the learning spaces in technology intensive higher education environments (Oblinger, 2006).

The situation of campus online information infrastructure during the years immediately after the widespread use of the worldwide web highlights two interesting features:

(1) The rapid and random spreading of electronic information resources makes them difficult to manage globally, from a strategic point-of-view (Long, 2000). In sectors different from higher education, organizations with large web information spaces face similar problems (Rosenfeld and Morville, 2006).

(2) Although the technologies for electronic information were largely invented within the university environment, their systematic introduction and use in this environment are neither rapid nor easy (Daniel, 1999). The problem of effective introduction was dealt by Bates (2000), who focuses particularly on the application of new technologies in university teaching. More recently, these problems continue and represent social and strategic challenges for higher education institutions (Folkers, 2005; Altbach *et al.*, 2006).

Similarly, the rise of network society, as conceptualized by Castells (1996), poses a wide range of external pressures on universities coming from the labor market, such as increasing demands on workforce, including informational competence or collaborative work skills (Duderstadt, 2000; Mutch, 2000). In this context, students increasingly demand wider functionalities from campus information systems in its

widest sense, i.e. including not only academic aspects, but also administrative and social support (Cornford and Pollock, 2003; McClure, 2003).

These issues affect the whole concept of information systems and its role to support not only administrative processes or bounded tasks from an individual basis, but also open-ended questions and knowledge creation in a wider sense, with a community point-of-view. The challenge is to create a campus information system aligned with shift from machine-like industrial era organization's concept to actual learning organization's point-of-view (Morgan, 2006). In this context, strategic management needs to take into account electronic services as conceptualized in Laudon and Laudon (2006) and also how campus information systems can foster informal social networks and communities of active learners (Tsoukas, 2005).

In this context, it is useful for information strategic management to have available broad characterizations of information systems (Davenport, 1997; Orna, 2004). This paper's first purpose is to set up a conceptual model for campus information systems, oriented to strategic management. The second purpose is to test this model in a fieldwork over Spanish universities to get insights about their informational features related to organizational ones.

Campus information system model

The initial technology-focused concept of "academic networked environment" from McClure and Lopata (1996) and the EDUCAUSE (2003) list of information resources useful for students choosing universities, are both relevant conceptual landmarks for campus information systems in this new context. Likewise, a socio-technical view of information systems and information resources in organizations (Checkland and Holwell, 1998) and conceptual relations between data, information and knowledge (Boisot and Canals, 2004) must be considered. Taking into account this conceptual basis, we set a conceptual framework about this topic. First, we take the following working definition of a campus information system for students (CISS): an interrelated group of information resources, accessible by computer through the campus institutional external and internal web environment, that a university places at the disposal of its users to enable them to consult it and/or provide a selection of significant and relevant data, in the wide context of their university life in its academic, administrative and social senses, in order to improve student's knowledge base (Figure 1).
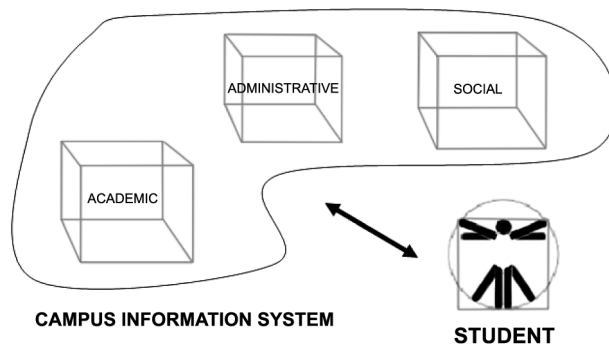

Figure 1.
Campus information system

It should be noted that the system is seen as a support infrastructure for the user, according to Star and Ruhleder (1996), Checkland and Holwell (1998), and Srikanthan and Dalrymple (2005). It intends to provide the user with various selected sets of data to help him or her in university matters. In some cases, the system can enable contact with other people in university in order to enhance informal information exchange or knowledge sharing (Amin and Cohendet, 2004). In addition, taking as a reference the socio-technical concept of information systems, it is considered that the existence of contents and services implies the availability of certain technological elements (computer applications) but, in addition, of an adequate organizational environment. Both elements, the technical and the organizational, form the infrastructure. For instance, the fact that certain online information resources are available to the user implies their effective adoption by the teaching staff that, in this respect, is a part of the organizational infrastructure from the student's point-of-view.

Therefore, a working definition for information resource is needed: an element of infrastructure which enables the transaction of certain selected significant and relevant data, prepared in such a way that they provide content and information services to improve the user's knowledge base. It is necessary to establish some minimum socio-technical requirements for an element to be qualified as a resource. Examples of resources for students are course information prior to registration, course reading lists, and directories.

Similarly, in order to characterize a campus information system, the concept of an information attribute is useful, defined as the qualitative aspect of transactions offered by the resources. Examples of attributes are the level to which the information is structured and the extent to which it can be managed online. Each attribute can be applied to each and every one of the resources and has a finite set of possible values reflecting the extent to which the attribute is present (low, medium and high). This implies the definition of certain decision criteria with respect to assigning a value to a particular attribute.

Thus, in order to broadly characterize the campus information system we can define a matrix, with a number of rows equal to the number of information resources selected and a number of columns equal to the number of attributes defined.

We apply this model in a fieldwork conducted in all Spanish universities. A qualitative study was first conducted with Spanish university students to take into account user's point-of-view in order to tune the model. Individual in depth interviews and focus groups were conducted with last year undergraduate students from 6 universities and ten different degrees. Subsequently, data about the information systems of all Spanish universities were gathered by means of structured visits to institutional websites and structured interviews with undergraduate students.

Information resources
A list of 17 key resources was defined for the three areas of university life: eight academic, three administrative, six social (see Table I). The classification of resources in these three areas of university activities comes from EDUCAUSE (2003) and the list is based mainly on the aforementioned source and Bernstein *et al.* (2000).

Type of resource	Name of the resource
Academic	Information about subjects prior to registration
	Subject-specific website for students from the same class
	Library: catalogue
	Library: subject bibliographies
	Library: document acquisition service
	Library: electronic bulletin of specialized news
	Library: complaint and suggestion forms
	Exam archive
Administrative	Financial aid
	Registration
	Provisional final grades
Social	Housing information
	Professional information
	Directory of professors
	Directory of students
	Forums
	Campus news

Table I.
Information resources

Information attributes

Six attributes were chosen based mainly on Laudon and Laudon (2006) and Choo (2006). Each of them was applied, with uniform criteria, to each of the 17 resources in every university and its value depends on the configuration of the resource in each individual case. Three qualitative values were possible for each relation: low (L), medium (M) and high (H). Some examples are given in Table II.

Interactivity. Measures to what extent the student can actively use the resource while consulting and/or entering information (based on Maher *et al.* (1999)).

Hierarchicalization. Measures the focus of the resource on the transaction of information among equals (students) or between students and the teaching staff or administration (based on McPhee, 1988).

Structuring. Measures to what extent a resource promotes the availability of information in records (and, if applicable, the organization of these records in controlled fields) for its transaction (based on Boisot, 1998).

Transactionality. Measures to what extent a resource is focused on enabling transactions to be carried out online (based on Laudon and Laudon, 2006). By transaction we mean a process involving exchanging or viewing either standard documents or physical objects.

Decisionality. Measures to what extent a resource is focused on enabling students to plan and make decisions (based on March, 1994; Laudon and Laudon, 2006; Choo, 2006).

Communicationality. Measures to what extent a resource is focused on the transaction and interpretation of emerging information, such as suggestions, news, opinions or queries, or on working as a group, in order to enhance sense making and knowledge creation (based on Weick, 1995; Laudon and Laudon, 2006; Choo, 2006).

Attributes such as interactivity, hierarchicalization and structuring provide useful information about the orientation of a resource, while attributes such as

Attribute	Example		
	Low	Medium	High
Interactivity	Course information prior to registration if it consists only in a file for passive consultation		Forum because it is by definition open to active participation of any student
Hierarchicalization		Website for a course if the student can provide input, addressed to other members of the class, by means of a subsection for debate	Website for a course if only the lecturer can distribute information to the group, while students can only read what is sent or published
Structuring		Course information prior to registration if it also includes non-controlled fields such as explanations of methodology or aims	Course information prior to registration if it includes only controlled fields such as the name of the course, type of course, number of credits, and the like
Transactionality	Registration process if users can only view information on the regulations or registration periods	Registration process with an online request for an appointment to register in person	Registration process with online registration
Decisionality		Library catalogue because it helps students to find documents to consult at particular moments during the course, on a short-term basis	Recommended course reading list because it offers useful information for the whole course or term
Communicationality	Administrative resources	A library catalogue if it includes a list of new acquisitions	Discussion forum

Table II.
Information attributes

transactionality, decisionality and communicationality provide information about the capacity and degree of a resource development, which is the capability offered to the user.

Organizational features in Spanish universities

The aim of the fieldwork was to determine situation of campus information systems for undergraduate students in Spain according to the model, and to classify institutions into clusters of homogeneous organizational and informational features.

Tables above set out some basic individual data on the institutions: their number of students (Table III), the autonomous community in which they are situated (Table IV), their date of foundation (Tables V and VI) and whether or not they are public universities (Table VII). A notable feature of the group, as far as type of institution is concerned, is that in Spain there are 49 public universities, considerably more than 16 private ones, whether secular or religious. Other relevant features become clear when we examine the dates of foundation of the institutions. A little more than half of the universities were founded during the period of the *Ley de Reforma Universitaria* (University Reform Act) of 1983. This indicates the great influence of this act on the

Size (undergraduate students)	Universities
Less than 10.000	23
From 10.000 to 20.000	17
More than 20.000	25
Source: Universia	

Table III.
Universities' size

Autonomous community	Universities
Andalusia	9
Aragon	1
Asturias	1
Balearic Islands	1
Canary Islands	2
Cantabria	1
Castile-Leon	7
Castile-La Mancha	1
Catalonia	10
Extremadura	1
Galicia	3
La Rioja	1
Madrid	13
Murcia	3
Navarra	2
Basque Country	3
Valencia	6
Source: Universia	

Table IV.
Universities'
geographical situation

shaping of Spain's current higher education system, thus being the legal background of a large quantitative expansion of the system and of qualitative changes in the organizations and their environment. This legal framework had a strong and direct influence especially over public universities. It is also possible to classify the universities according to another point of reference concerning their age: those that were founded in what could be called the pre-WWW era (up to and including 1993) and the rest (from 1994 onwards). Only 15 of the 65 universities were founded in this most recent period, that is to say after the emergence of the WWW.

All these organizational features were taken into account in order to relate with the informational ones. This was a wide range of features, which was worth to explore in such a large and varied set of universities, where no previous detailed fieldwork about CISS had been conducted in Spain.

Methodology

The study was carried out on the complete population of 65 Spanish universities that were created in 2001 or earlier. Thus, very young universities were excluded, in order to ensure a population with consolidated organizational features.

The fieldwork to collect data on the universities was carried out in two phases: first, structured visits to institutional websites and, second, structured interviews with current last year undergraduate students. Due to resource limitation it was not possible

Foundation year	Universities
Until 1968 included	19
From 1969 to 1982 (period *Ley General de Educación*)	13
From 1983 to 2001 included (period *Ley de Reforma Universitaria*)	33
Source: Universia	

Table V.
Age according to the date of foundation

Foundation year	Universities
Until 1993 included (pre-WWW period)	50
From 1994 to 2001 included (WWW period)	15
Source: Universia	

Table VI.
Age according WWW

Type	Universities
Public	49
Private non religious	6
Private religious	10
Source: Universia	

Table VII.
Type

for us to observe in great detail the differences between schools or centers of the same university. To deal with this limitation, restrictive protocols and criteria were set in order to have a general university-wide minimum common vision of the information system, and to obtain it with systematic procedures across all universities under study, following Codina (2000) methodological guidelines (see for more details Cobarsí and Bernardo, 2006).

To analyze the data we used in this study multivariate statistical techniques. Two methods have been applied in two different stages: first a multiple correspondence analysis (MCA) and then a cluster analysis (CA).

The aim of MCA is to summarize a large amount of qualitative variables (the low, medium and high categories of the attributes for each resource) into a small number of quantitative axes (Benzécri, 1973; Greenacre, 1993) that can be later graphically displayed or analyzed with other statistical techniques. The data were arranged into six matrices, each containing one attribute referring to all 17 information resources. Each matrix was submitted to a MCA, which resulted in 12 quantitative axes, two for each attribute. These 12 axes were the variables used in the next stage, the CA.

The aim of a CA is to group together elements or objects of a population. The characteristic of the groups is that elements of the same group are homogeneous between them but heterogeneous with elements from other groups (Sneath, 1957; Aldenderfer and Blashfield, 1984). Heterogeneity is measured as the Euclidean distance between universities in the 12-axis space. We used the complete linkage method to build the groups. The three-group solution was found to be the most interpretable. As a measure of goodness of fit we used the percentage of variance of the axes explained by the classification, which was 43 percent. As a measure of robustness we used the percentage of individuals identically classified when comparing the current classification with one using Ward's method, which is 90.8 percent.

Results
A description of each group's composition is given in Tables VIII and IX lists the universities belonging to each group. A description of each's group informational features is given in Tables X and XI.

- *Cluster 1*: public organizations with highly interactive, structured and developed CISS. They have high scores in interactivity, transactionality, and decisionality. Made up of 42 universities (65 percent of the population) oriented to the interactivity attribute. The majority of the universities are public (86 percent), and the remainder are private secular and religious (7 percent each).

	Cluster 1	Cluster 2	Cluster 3
Number of elements	42	10	13
Population (%)	65	15	20
Public universities (%)	86	30	77
Private secular (%)	7	30	0
Private religious (%)	7	40	23

Table VIII.
Cluster's composition

Type	Cluster 1	Cluster 2	Cluster 3
Public	A Coruña	Alcalá de Henares	Complutense Madrid
	Almería	Alicante	Córdoba
	Autònoma Barcelona	Vigo	Huelva
	Autónoma de Madrid		Illes Balears
	Barcelona		Jaén
	Burgos		La Laguna
	Cádiz		Oviedo
	Cantabria		Pablo de Olavide
	Carlos III de Madrid		Pública de Navarra
	Castilla-La Mancha		Rey Juan Carlos
	Euskal Herria		
	Extremadura		
	Girona		
	Granada		
	Jaume I de Castelló		
	La Rioja		
	Las Palmas de Gran Canaria		
	León		
	Lleida		
	Málaga		
	Miguel Hernández		
	Murcia		
	Politécnica Cartagena		
	Politècnica Catalunya		
	Politécnica de Madrid		
	Politècnica València		
	Pompeu Fabra		
	Rovira i Virgili		
	Salamanca		
	Santiago Compostela		
	Sevilla		
	València Estudi Generals		
	Valladolid		
	Zaragoza		
Private	Camilo José Cela	Alfonso X El Sabio	Católica de Ávila
	Europea de Madrid	Antonio de Nebrija	Deusto
	Mondragón	Cardenal Herrera-CEU	Pontificia Salamanca
	Navarra	Católica San Antonio	
	Pontificia Comillas	Francisco de Vitoria	
	Ramon Llull	Internacional de Catalunya	
	San Pablo CEU	Internacional SEK	
	Vic		

Table IX.
Universities cluster
classification

- *Cluster 2*: private organizations with highly structured, communicational and lowly interactive CISS. They have high scores in structuring and communicationality and low scores in interactivity. Made up of ten institutions (15 percent of the population) that have no clear tendency towards any attribute. A total of 70 percent of the universities are private, 30 percent secular and 40 percent religious. The other 30 percent are public.

- *Cluster 3*: public organizations with lowly structured and lowly developed CISS. They have low scores in structuring, transactionality, decisionality and communicationality. Made up of 13 universities (20 percent population) that are oriented towards the attributes of hierarchicalisation and structuring. This group includes a high proportion of public universities (77 percent), the remainder being private religious.

In order to better understand the meaning of these three clusters, we need to highlight not only the significant features seen but also informational and organizational characteristics which have been taken into account in the proposed model and in the conducted CA, but which have not seemed to contribute to the differences among clusters. Thus, there are just five out of six model attributes that are seen to be significant (hierarchicalization is not significant). Likewise, there are no groups of resources (academic, administrative or social) that contribute to differences among clusters. The public/private distinction is an important and significant organizational feature of clusters. This was no surprise, because the Spanish legal environment sets stricter guidelines for the internal organization of public universities. But, to our surprise, other factors taken into account showed no relevant inter-cluster differences (university size, age and geographical region), although they may have importance in individual case study.

We should point out that cluster 1 institutions correspond, in general terms, to universities that have more online information resources (see Table X). Whereas cluster 3 institutions usually have fewer resources. Institutions falling into the cluster 2 correspond to those with an intermediate number of online resources. Thus, it would seem that introduction of online information begins with a few lowly structured read-only, and lowly developed information resources, and ends up with a wider range of interactive and developed resources, after an intermediate phase. In this sense, each one of the three clusters seems to correspond, generally speaking, to these three phases.

Cluster	Information resources average
Spanish average	10.52
Cluster 1 average	11.36
Cluster 2 average	9.50
Cluster 3 average	8.62

Table X.
Number of information resources

Attribute score average	C1	C2	C3
Relative interactivity score average	1.959	1.597	1.83
Relative hierarchicalization score average	2.902	2.94	2.863
Relative structuring score average	2.06	2.061	1.844
Relative decisionality score average	1.326	1.304	1.123
Relative transactionality score average	2.304	2.194	2.157
Relative communicationality score average	1.7	1.797	1.697

Table XI.
Attributes relative score average

Cluster 1 attribute's scores are generally higher, with only communicationality attribute having his maxim value in the intermediate cluster (cluster 2) It should be noted that, in general, private institutions have an intermediate position, as they seem to rely on more traditional systems, rather than online ones, for exchanging information on campus. Most campus information system are not yet in the maturity phase, and thus are not yet reflecting all real information needs of the organization, as defined by Nolan (1979).

As an example of opposite informational situations we may take two renowned public universities in Madrid: Carlos III and Complutense. Carlos III has an highly developed system (cluster 1) with 14 resources (out of 17 possible), and high scores concerning utility attributes (transactionality, decisionality and communicationality). Complutense has a lowly developed system (cluster 3) with just seven resources, and low scores in utility attributes. While Carlos III was created in 1989 and has 14,000 students, Complutense has a much longer history (founded in 1508) and larger size (97,000 students). Examples such as this suggest the need for detailed case studies in selected higher education institutions. Drawing from the broad vision of Spanish campus information systems supplied by this study, we should go in depth into the relationship between informational and organizational features across time.

Conclusions
A conceptual framework for campus information systems, tested in a study of Spanish higher education institutions, has been defined involving university life in a wide sense, including academic, administrative and social aspects. A two-dimensional model based on information resources and information attributes is proposed.

According to this model, campus information systems for students in Spanish universities were classified. A 46-university cluster shows an orientation towards interactivity, structured and developed resources, which can be seen as positive in general terms. On the opposite, a ten-institution cluster has a lowly structured and lowly developed system, which we envision as a negative situation. Finally, a group of 13 institutions has no defined orientation. In general terms these three clusters seem to match three phases in introduction of on-line information resources. Most of private institutions are placed in the intermediate cluster, so that they do not have, in general terms, a pioneer role in introducing online information in Spanish campus.

The current study has enabled us to obtain a group view of the information situation in Spanish universities in terms of the general orientation of the system available to the students. This work could serve as a basis for later research about these systems in individual institutions. Case studies could be carried out on universities, which may be selected taking into account the results presented here.

With a view to the future, we need to make a clearer distinction between those elements that are likely to represent a significant advantage to both the student and the institution, and those that everyone is keen to incorporate into the system (and could therefore be left out) (Folkers, 2005; Winkvist, 2005). In this respect, the ability of the campus information system to integrate the student into an extensive and diverse network of relationships and personal contacts during his or her time at university and beyond should be taken into serious account as a valuable benefit to offer to the student (Coates, 2005). These are the elements which are found above all in those

defined as social resources and in the communicationality attribute, which could be re-thought and re-formulated with a view to the evolution of the model.

Concerning future research, we must also note that the attributes and resources collected in the model were intended to seek points in common for the analysis of a broad group of institutions, while considering a generic student profile. However, they can also serve as a basis for discussion, to define the campus information system that a university would like to have, and the type of students that it wishes to attract specifically. This idea of types of universities and the students fitting in each is emphasized in Veloutsou *et al.* (2004) and is consistent with the need for Spanish higher education institutions to diversify, pointed out in Michavila (2001).

Finally, we must acknowledge that resources available were limited for collecting data into a set of 65 institutions. So, it was not possible for us to collect with detail the differences between schools or centers into the same university, but criteria were set in order to have a general minimum common university-wide vision of the information system obtained with homogeneous criteria and systematic procedures across all universities under study.

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