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Campus networked information systems in Spain: a student-centred countrywide ranking and cluster classification

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ABSTRACT

The availability of broad characterisations of campus information systems for students could be as useful for those responsible for the strategic management of higher education centres as for the orientation of potential university students. First we describe and contextualise a characterisation model for on-line campus information systems for students. This serves as a framework of conceptual reference for fieldwork on Spanish universities. Information was gathered by means of structured visits to institutional websites and structured interviews with undergraduate students. Analysing the information collected enables us to position the institutions individually and to compare them, as well as obtain a descriptive view of the whole group of Spanish universities from an informational point of view. The universities were also classified into groups with homogeneous characteristics, in the sense of their informational and organisational aspects. Finally, we discuss future research on this subject.

KEYWORDS

information system, campus information system, information resources evaluation, information for students, higher education, strategic information management

SUMMARY

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Campus networked information systems in Spain: a student-centred countrywide ranking and cluster classification[1]

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Abstract

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[1] This article is based on the doctoral thesis "El sistema d'informació de campus per a estudiants en les universitats espanyoles: caracterització i anàlisi" (The campus information system for students in Spanish universities: characterisation and analysis) presented in January 2005 at the Universitat de Girona, www.udg.es. The research for the thesis was financed partly by the Spanish Ministry of Education, Culture and Sport ("Programa de Estudios y Análisis para la mejora de la calidad del sistema universitario") (Programme for studies and analysis to improve the quality of the university system) and partly by the Internet Interdisciplinary Institute of the Universitat Oberta de Catalunya www.uoc.edu.

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Keywords

Information System, Campus Information System, Information Resources Evaluation, Information for Students, Higher Education, Strategic Information Management

1. Introduction

Ever since the first universities were founded in Europe during the Middle Ages, their campuses have had information infrastructure available for the students, to assist them with different aspects of their university life. These infrastructures were traditionally based on two principal elements: paper documents and face to face communication (Brown & Duguid, 2000). However, at the end of the 20th century the opening up of information technology and electronic communication radically altered the potential for exchange of information on the university campus. In the first half of the 1990s, there were perceptible changes in the situation on campus (McClure & Lopata, 1996). But it was the common use of the *World Wide Web* (WWW), from the mid 1990s onwards, which produced a qualitative leap in the potential of on-line information at universities.

The situation of campus on-line information infrastructure before and after the widespread use of the WWW shows two rather interesting features: first, the rapid and random spreading of electronic information resources makes them difficult to manage globally, from a strategic point of view (Long, 2000); and secondly, 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 with by Bates (2000), who focuses particularly on the application of new technologies to university teaching.

The research described in this article attempts to make a contribution towards obtaining an up to date view of these questions. Thus we propose a characterisation model of the campus information system for students, with the idea that it could be useful as much in the area of strategic management as for the orientation of prospective students. The networked information system was considered in the context of on-campus teaching, as an infrastructure to improve the capabilities of the physical campus and not as a substitute for it. For this reason distance learning by electronic means was excluded.

By students we mean undergraduate students, in their role as users of the campus information system. We consider the state of the system as far as the university's general corporate information resources are concerned, those which are in use. On the other hand, we do not take into account those resources which may exist, for example, as a result of the individual initiative of lecturers or of student associations. Nor do we consider resources which are in trial periods or "under construction", or those which are not regularly used by the lecturers, if this fact prevents them from being regularly used by the students.

In order to know the situation with reference to the characterisation model, a fieldwork was carried out on Spanish universities (65 institutions, practically the entire higher education system in Spain, with the exception of distance learning universities and those very recently founded).

This research may be of interest in the changing context of universities at the beginning of the 21st century. Institutions are under diverse and often contradictory pressures to change from such outside factors as the labour market (Glaros, 2004), the technological environment (Twigg & Oblinger, 1996), the political environment (Daniel, 1999 and, in the Spanish case, legislative changes brought about by the Ley Orgánica de Universidades (Organic Universities Act) in 2001). The controversies and preoccupations in Spain concerning the future of universities in the face of the challenges of the turn of the century are made extremely clear in Michavila (2001).

In the next section we describe and contextualise a characterisation of campus information system for students. Next, we present the results of fieldwork conducted on higher education institutions: a ranking and a cluster classification. Finally, conclusions and possible future research are exposed.

2. Characterisation model of the system

In order to formulate a conceptualisation and characterisation of campus information systems adequate to the case and context being dealt with, we took into account the state of the art (detailed in Cobarsí, 2005) with respect to three principal areas: first, the theoretical precedents concerning information systems, both those which were specific to the university context (in particular McClure & Lopata, 1996; EDUCAUSE, 2003; Hanna, 2003) as well as those of a more general nature (Boisot, 1998; Checkland & Holwell, 1998; Mingers, 2002; Galliers, 2003; Boisot & Canals 2004); secondly, the demands and habits of the students as users of the on-line system (Brown & Duguid, 2000, Cornford, 2003); and thirdly, the methodological experience of other field studies on universities and information technology carried out on broad groups of institutions (McRae, 1999; Bernstein et al., 2000; Buenadicha et al., 2001).

2.1 The Spanish university environment

For a better understanding of the results presented on the information situation in universities, it is necessary to take into account the general context of the Spanish higher education system.[3] With regard to geographical distribution, the 65 Spanish universities that are at least three years old are shown in the map at Figure 1. This does not include distance learning universities. It can be seen that there are higher education institutions in all Spain's autonomous communities and almost all provinces. The communities with the most universities are Madrid (13), Catalonia (10) and Andalusia (8).

[3] According to data obtained from the portals: Consejo de Universidades (Universities Council) (http://www.mec.es/consejou) [consulted on 20th July 2004] and Universia (http:www.universia.net) [consulted on 20th July 2004]. A broader and more detailed view of the Spanish higher education system can be found in Cobarsí (2005).

Figure 1. Spanish universities by autonomous community

Table A.1 of Appendix A sets out some basic individual data on the institutions: the autonomous community in which they are situated, their number of students, their date of foundation and whether or not they are public universities. A notable feature of the group, as far as type of institution is concerned, is that in Spain there are considerably more public universities (49) than private ones, whether secular or religious (16). 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 shaping of Spain's current higher education system, marking the legal background of a large quantitative expansion of the system and of qualitative changes in the organisations and their surroundings (this was the first university act in the period of democracy which began with the 1978 Constitution.). It is also possible to classify the universities according to another point of reference concerning their age: those which 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.

2.2 Concept of a campus information system for students

With reference to McClure & Lopata (1996), Star (1996), Checkland & Holwell (1998) and EDUCAUSE (2003), we take the following working definition of a **campus information system for students (CISS)**: An interrelated group of content and services, accessible by computer through the campus's institutional website, which a university places at the disposal of its students to enable them to consult it and/or

provide a selection of data significant and relevant in the context of their university life in its academic, administrative and social senses.

It should be noted that the system is seen as a support infrastructure for the user, following Checkland & Holwell (1998). That is to say it is intended to provide the student user with various data to help him or her in university matters. In addition, taking as a reference point the socio-technical concept of information systems (Checkland & Holwell, 1998; Boisot, 1998), 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 organisational environment in order to make it useful to the student. Both elements form the infrastructure. Thus, the fact that certain on-line information resources are available to the student user implies their effective adoption by the teaching staff who, in this respect, form part of the organisational infrastructure from the student's point of view.

2.3 Characterisation requirements

The principal requirements sought to formulate a useful and practical characterisation of the CISS are set out below.

First we wished to acquire a characterisation which would allow the presentation of synthetic information, which would be maximally comprehensible and informative for the potential student. It must be noted that this could equally be of interest to the managers of the institution. Various authors (McGee & Prusak, 1993; Davenport & Prusak, 1998; Orna, 2004) point out the usefulness of being able to understand and manipulate broad characterisations of information systems to permit their strategic management and policy development. The characterisation must make it possible to arise a quantitative analysis and to position institutions in the context of the Spanish university system.

Secondly, it is known that the number of symbols and options that a person is able to interpret usefully and efficiently is limited (Miller, 1967). On the other hand, to ensure that the data of the model are representative, it is necessary to select a sufficiently relevant and exhaustive group of key characteristics to permit an adequate analysis. We must therefore consider, both in modelling and in the presentation of results, how to solve the possible imbalance between the complexity of the real system and the user's limitations when it comes to processing representative information from the system.

Thirdly, following Codina (2000), the model must be operative and applicable in realistic working conditions. This refers as much to size as to other aspects, such as the practical ability to determine the values of the theoretically defined characteristics in a real fieldwork situation.

Fourth, it was decided to centre the characterisation on the global usefulness of the system to the user. This is understood both quantitatively, in the sense of the diversity and depth of capabilities provided by the information infrastructure (Ryan et al., 2001), as well as qualitatively, referring to either the orientation or the nature of information transactions provided (Boisot, 1998).

2.4 General structure of the characterisation model

The model is principally based on two broad characteristics describing the campus information system for students: information resources and information attributes. To complement these we also take into account information architecture.

The working definition of an **information resource** is as follows: An element of infrastructure which enables the transaction of certain selected significant and relevant data, prepared so as to provide content and information services that can be used directly by the student. It is necessary to establish some minimum requirements for an element to qualify as a resource. Examples of resources are course information prior to registration and course reading lists.

The concept of an **information attribute** is: The qualitative type of an aspect of the information transactions provided by the resources. Each attribute can be applied to each and every one of the resources and has a finite set of possible values. This implies the definition of certain decision criteria with respect to assigning a value from the group of possible values to a particular attribute. Possible values will be discussed in the next section. Examples of attributes are the level to which the information is structured and the extent to which it can be managed on-line.

Finally, to complete and contextualise the information on resources and attributes, we took into account a selection of features of the architecture of the system as a whole, following the definition of Rosenfeld & Morville (2002, page 4): "The structural design of an information space to facilitate task completion and intuitive access to content". For example, the existence of a part of the institutional website dedicated specifically to the students themselves.

2.5 Primary characterisation model

The so-called primary or complete model brings together the group of resources, attributes and architecture elements. First of all, a list of 17 key resources was defined, as set out in Table 1. There are 8 with an academic orientation (coded AC-1, etc.), 3 from an administrative point of view (coded AD-1, etc.) and 6 with a social orientation (coded SO-1, etc.). The classification of resources in these three areas of university life comes from EDUCAUSE (2003). The list of resources is based on the mentioned source and Bernstein et al. (2000). In order to adjust the model to the current situation in Spain, we adjusted the selection of resources and set up a working definition for each one.[4]

Table 1. Information resources for students

Type of resource	Code	Name of the resource
Academic	AC-1	Information about subjects prior to registration
	AC-2	Subject-specific website for students from the same class

[4] We took into account the information gathered in a qualitative study with individual and group interviews to Spanish students and experts. Interviews were semi-structured (Marshall & Rossmann, 1994; Morgan & Krueger, 1998).

Type of resource	Code	Name of the resource
	AC-3	Library: catalogue
	AC-4	Library: subject bibliographies
	AC-5	Library: document acquisition service
	AC-6	Library: electronic bulletin of specialised news
	AC-7	Library: complaint and suggestion forms
	AC-8	Exam archive
Admini-strative	AD-1	Financial aid
	AD-2	Registration
	AD-3	Provisional final grades
Social	SO-1	Housing information
	SO-2	Professional information
	SO-3	Directory of professors
	SO-4	Directory of students
	SO-5	Forums

Minimum requirements were defined for each resource. In addition, we allowed for a series of optional characteristics which the resource might generally possess, to act as a practical guide for the fieldwork. So, for example, for resource AC-1, course information prior to registration, we took as an obligatory requirement that it should include information about the number of credits and the type of course and that the resource should exist in courses for various degree programmes. On the other hand, elements such as the possibility of accessing surveys results about teaching quality, or information on teaching methods, were considered optional.

Besides confirming or not the existence of information resources at each university, it was decided to characterise their attributes. Each of the 6 attributes 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. For each attribute, 5 possible qualitative levels were defined:

- Level N: the resource does not exist.
- Level L: the resource exists and the attribute's level is low.
- Level M: the resource exists and the attribute's level is medium.
- Level H: the resource exists and the attribute's level is high.
- Level X (not determined): either it has not been established whether or not the resource exists or, if it does exist, the attribute's level has not been established.

The six defined attributes are: 1) interactivity, 2) hierarchicalisation, 3) structuring, 4) transactionality, 5) decisionality and 6) communicationality. These are described below, together with the general criteria and some specific examples illustrating how to assign values within the possible levels (i.e. L/M/H), if the resource exists. The first three attributes are indicators of the system's general orientation, while the last three measure the variety and depth of the specific utilities which the system offers to the student.

1) **Interactivity** is: The attribute which measures to what extent the student can actively enter into the use of the resource while consulting and/or entering information.[5]

- Level L: The student can only consult the system passively.
- Level M: The student can parameterise his passive consultation. That is to say, the student can define which information to recover through the use of a search facility, a simulator or some other means of making a query other than browsing within the resource.[6]
- Level H: The student can write to the system. There are elements which offer the possibility of providing or exchanging information by means of the resource (such as forms, or a link to an email address within the body of the web page). An email address at the foot of the page, which might form part of the details of authorship of the page, is not included here.

Examples: Course information prior to registration (coded AC-1) would, in principle, be assigned level L, since this usually consists of a file for passive consultation. If there were an option to ask for further information by email, it would be assigned level H. A forum (SO-5) would be assigned level H because it is by definition open to the active participation of any student.

2) **Hierarchicalisation** is: The attribute which measures the focus of the resource on the transaction of information between equals (students) or between students and the teaching staff or administration.[7]

- Level L: allows only the transaction of information between students, i.e. horizontally.
- Level M: allows the transaction of information between students and also between students and the teaching staff or university services, i.e. both horizontally and vertically.
- Level H: allows only the transaction of student information with the teaching staff and university services, i.e. only vertically.

Examples: The website for a course (AC-2) might be level M (if the student can provide input, directed at other members of the class, by means of a subsection for debate) or level H (if only the lecturer can distribute information to the group, while the students can only read what is sent or published).

3) **Structuring** is defined as: The attribute which measures to what extent a resource promotes the availability of information in records (and, if applicable, the organisation of these records in controlled fields) for its transaction.[8]

- Level L: hypertext not indexed in records.
- Level M: either hypertext indexed in records, with at least one obligatory non-controlled field, or hypertext indexed in records with all compulsory fields controlled, plus non-indexed hypertext which carries additional relevant information (for example, a help function explaining how to use the query function in a database would not be considered as such).
- Level H: hypertext indexed in records with all compulsory fields controlled.

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[5] Based on Berenguer (1997).
[6] The distinction between browsing and query as methods of recovering information is based on Codina (2000).
[7] Based on Arribas (2001).
[8] Based on Boisot (1998).

Examples: Course information prior to registration (AC-1) would be level H (if it includes only controlled fields such as the name of the course, type of course, number of credits) or level M (if it also included non-controlled fields such as explanations of methodology or aims).

4) **Transactionality** is: The attribute which measures to what extent a resource is focused on enabling transactions to be carried out on-line.[9] By transaction we mean a process involving exchanging or viewing either standard documents or physical objects.

- Level L: no noticeable presence.
- Level M: allows a transaction to be carried out partially on-line.
- Level H: allows a transaction to be carried out totally on-line.

Examples: A registration process (AD-1) with automatic virtual registration would be level H. One with an on-line request for a time to register in person would be level M. If the user can only view information on the regulations or registration periods, this would be level L.

5) **Decisionality** is: The attribute which measures to what extent a resource is focused on enabling the student to plan and make decisions.[10]

- Level L: no noticeable presence in decision-making.
- Level M: useful only for enabling planning and decisions affecting the immediate future.
- Level H: useful for planning and decisions in the medium- to long-term future.

Examples: The recommended course reading list (AC-4) is level H, because it offers information useful for a whole course or term. The library catalogue (AC-3) is level M, because it helps the student to find documents to consult at particular moments during the course, on a short-term basis.

6) **Comunicationality** is: The attribute which measures to what extent a resource is focused on the transaction of emerging information, such as suggestions, news, opinions or queries, or on working as a group.[11]

- Level L: no appreciable presence in this respect.
- Level M: the resource makes these transactions available, but as a non-obligatory option.
- Level H: the use of the resource implies the transaction of emerging information or working as a group.

Examples: A discussion forum (SO-5) is level H. A library catalogue (AC-3) would be level M if it includes a list of new acquisitions. Administrative resources (AD) are usually level L.

In order to complete the model, the four architecture elements chosen are shown in Table 2. These may offer various utilities to analyse the system. Thus they might be used in the first place to help interpret the data on resources and attributes (for example, an Intranet can hide resources which can only be seen in their complete form by current students and not by potential students) or to see the degree of cohesion in

[9] Based on Laudon (2002).
[10] Based on González (2001).
[11] Based on Laudon (2002).

the system (for example, if there is a students' page, this shows an explicit willingness by the institution to offer resources in a clustered way).

Table 2. Architecture elements

Code	Architecture element
EA-1	Web zone for future students
EA-2	Web zone for current students
EA-3	Intranet (restricted access zone for registered students, to provide teaching and/or management support)
EA-4	Map of the web

The primary model or dataset can be represented globally, in graphic form, as shown in Figure 2. The figure shows the possible values of each cell of the matrix of resources-attributes and of the architecture, leaving aside the values which have not been determined.

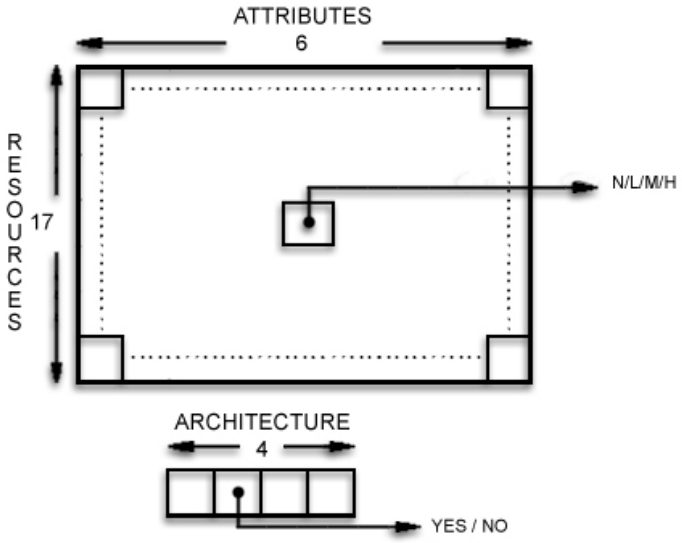

Figure 2. Summary of the primary model

Note that the primary model implies a considerable volume of data on each university. To better understand the campus information system of an individual institution, it is useful to synthesise these data. This is proposed in the next section, with the so-called synthetic model.

2.6 Synthetic model

To condense the detailed information made available by the data in the primary model, and to obtain a summary view for a particular university, we propose the definition of various parameters.

First, we define a score based on the existence of resources, called the **completeness of resources (CoR):** The total number of information resources whose existence has

been confirmed for a particular university. Given that the model has a possible 17 resources, for each university this score has a possible value of any integer between 0 and 17, inclusive. It provides an indicator of the global coverage of the system in relation to the key resources. However, the information as to which of these resources make up the completeness score is lost. In some way, this would be the "total" completeness of the system. But it could also be considered as the sum of "partial" completenesses, with respect to the 8 academic resources, the 6 social resources and the 3 administrative resources. This enables us to retain some of the information relating to specific resources and their thematic type. The situation could then be represented graphically by means of a 3-branched tree diagram (as shown in Figure 3).

As well as completeness in the sense on number of resources, the global situation of the attributes is also described on the basis of scores. This is defined as the **confirmed score of an attribute**. In a university, for a certain attribute ATR_i of a particular resource R_j, the value of the score ATR_{ij} will be: 1, in case of the resource exists and the level of the attribute is low; 2, in case of the resource exists and the level of the attribute is medium; 3, in case of the resource exists and the level of the attribute is high; 0, in case of the resource does not exist, or its existence has yet to be determined, or if it exists but it has not been possible to determine the level of the attribute ATR_{ij}.

This allows us to define scores for each of the 6 attributes in a given university. Each of these 6 scores has a theoretical minimum of 0 and a theoretical maximum of 51 (in the event that all 17 resources are present and each of them has a high level of the respective attribute). These can be represented by a 6-branched tree diagram (as shown in Figure 4). It is also possible to define an **absolute utility score (AUS)**, as the sum of the scores corresponding to transactionality, decisionality and communicationality (that is to say the three so-called utility attributes, as opposed to those of orientation: interactivity, hierarchicalisation, structuring).

The combination of scores and other characteristics allows the institutions to be individually positioned in rankings. Thus, the position in the global ranking (the results of which are shown in Table 4) are produced by applying the following parameters in the order shown: 1) completeness of resources (CoR); 2) number of non-determined resources; 3) the existence of a web page directed at the students themselves; 4) absolute utility score (AUS); and 5) the number of non-determined scores in those for the utility attributes of the resources. As a result, the position in the ranking is decided above all by two parameters: first, by how many of the key resources have been confirmed (CoR) and, secondly, by the AUS as a representation of the degree of confirmed development of the resources with respect to the global utility offered to the student. The remaining parameters, as shown in Table 4, have in practice less influence on positioning, contributing towards it in a more subtle way.

Apart from the defined scores, it is possible to apply a multivariate statistical analysis to the qualitative values of the attributes of the complete model for each resource. This makes it possible to create clusters of universities with similar features. These results are shown in Section 3. Appendix B.2 shows the methodology of this analysis.

As a whole, we consider the proposed model to be representative of the system, realistic and viable for collecting data through fieldwork, and adequate for the analysis and presentation of results. It is true that the properties defined for resources, attributes and architecture elements require some training and systematisation if they

are to be applied correctly and with ease. But it is precisely this which provides the characterisation with educational value (Codina, 2000), that is, the ability to clearly show details which would be invisible to an untrained observer.

3. Information situation at Spanish universities

In order to establish the situation in Spanish universities according to the model described, a fieldwork exercise was carried out covering the 65 universities that are at least 3 years old (excluding distance learning universities). Appendix B.1 shows the methodology of the fieldwork. The results are presented below.

The information collected in accordance with the model allows us to establish a global ranking of the universities, defined according to the criteria set out in the previous section. The situation of the institutions is collected in Table 4, where the 65 universities are placed in 57 different places. The three best-situated universities in the global ranking are Politècnica de València, Carlos III de Madrid and Pompeu Fabra, while in the lower positions we find Francisco de Vitoria, Complutense de Madrid and Pública de Navarra.

In addition we applied a multivariate statistical analysis to the qualitative values of the attributes of the complete model (for methodology see Appendix B.2). This allowed us to obtain a classification of the 65 universities into 3 groups or clusters, designated according to their distinctive features. The group each institution belongs to is noted in the left hand column of Table 4.

- **Cluster 1: Public Interactive.** Made up of 46 universities which occupy predominantly medium and high positions in the scores ranking. They are oriented to the attribute of interactivity. There is a high proportion of public universities (76.9%), and the remainder are private religious universities (23.1%).
- **Cluster 2: No Man's Land.** Made up of 13 institutions, principally in medium to low positions in the ranking. This group has no clear tendency towards any attribute for the group of resources. It is made up of a balance of public universities (30%), private secular universities (30%) and private religious universities (40%).
- **Cluster 3: Public Bureaucratic.** Made up of 10 universities, mainly in low positions in the ranking. They are oriented towards the attributes of hierarchicalisation and structuring. This group includes a high proportion of public universities (85.7%) compared with private secular universities (7.1%) and private religious universities (7.1%).

Table 4. Ranking of the universities and cluster classification

Cluster 1
Cluster 2
Cluster 3

Cluster	Ranking place	University	Resources (CoR)	Undeterm. resources	Student page (EA-2)	Utility score (AUS)	Undeterm. utility score
1	**1**	Politècnica València	14	0	1	74	2
1	**2**	Carlos III de	14	0	0	66	3

Cluster	Ranking place	University	Resources (CoR)	Undeterm. resources	Student page (EA-2)	Utility score (AUS)	Undeterm. utility score
		Madrid					
1	**3**	Pompeu Fabra	13	1	1	60	8
1	**4**	Sevilla	13	0	1	73	0
1	**5**	Girona	13	0	1	72	0
1	**5**	Navarra	13	0	1	72	0
1	**6**	Cantabria	13	0	1	70	0
1	**6**	Politècnica Catalunya	13	0	1	70	0
1	**7**	León	13	0	1	69	0
1	**8**	Miguel Hernández	13	0	1	68	0
1	**9**	Salamanca	13	0	0	70	1
1	**10**	La Rioja	13	0	0	69	0
1	**11**	Politécnica de Madrid	12	0	1	70	0
1	**12**	Burgos	12	0	1	68	3
2	**13**	Alicante	12	0	1	67	0
1	**14**	Autònoma Barcelona	12	0	1	64	0
1	**15**	Jaume I de Castelló	12	0	1	63	0
1	**16**	Vic	12	0	1	61	0
1	**17**	Camilo José Cela	12	0	1	60	3
1	**18**	Lleida	11	1	1	57	3
2	**19**	Internacional de Catal.	11	0	1	64	0
1	**20**	Autónoma de Madrid	11	0	1	59	0
1	**21**	Cádiz	11	0	1	58	0
1	**22**	Murcia	11	0	1	57	0
1	**22**	Politécnica Cartagena	11	0	1	57	0
1	**23**	Rovira i Virgili	11	0	1	56	0
1	**24**	València Estudi Gen.	11	0	1	54	0
3	**25**	Católica de Ávila	11	0	1	53	3
2	**26**	Alcalá de Henares	11	0	0	60	0
1	**27**	Las Palmas Gran C.	11	0	0	58	0
1	**28**	San Pablo CEU	10	1	1	56	3
1	**29**	Almería	10	0	1	55	0
1	**30**	A Coruña	10	0	1	49	0
1	**31**	Zaragoza	10	0	1	61	0
1	**32**	Europea de Madrid	10	0	1	55	0
1	**32**	Valladolid	10	0	1	55	0
1	**33**	Granada	10	0	1	54	0
1	**33**	Euskal Herria	10	0	1	54	0
1	**34**	Extremadura	10	0	1	53	1

Cluster	Ranking place	University	Resources (CoR)	Undeterm. resources	Student page (EA-2)	Utility score (AUS)	Undeterm. utility score
3	**35**	Pablo de Olavide	10	0	1	53	0
1	**36**	Ramon Llull	10	0	1	52	0
2	**37**	Vigo	10	0	1	51	3
1	**38**	Castilla-La Mancha	10	0	1	51	0
1	**38**	Málaga	10	0	1	51	0
2	**39**	Cardenal Herrera-CEU	10	0	1	45	5
1	**40**	Pontificia Comillas	10	0	1	42	5
2	**41**	Católica San Antonio	10	0	0	56	0
1	**42**	Mondragón	10	0	0	51	0
2	**43**	Antonio de Nebrija	9	0	1	54	0
3	**44**	Illes Balears	9	0	1	50	0
1	**45**	Barcelona	9	0	1	49	0
3	**46**	Deusto	9	0	1	47	0
3	**46**	Oviedo	9	0	1	47	0
1	**46**	Santiago Compostela	9	0	1	47	0
3	**47**	Huelva	9	0	1	46	0
3	**48**	Jaén	9	0	1	43	4
3	**49**	Córdoba	9	0	0	48	0
2	**50**	Alfonso X El Sabio	8	0	1	42	0
3	**51**	Rey Juan Carlos	8	0	1	42	0
2	**52**	Internacional SEK	8	0	1	46	0
3	**53**	La Laguna	8	0	1	40	0
3	**54**	Pontificia Salamanca	7	0	1	39	1
2	**55**	Francisco de Vitoria	7	0	1	38	0
3	**56**	Complutense Madrid	7	0	1	33	3
3	**57**	Pública de Navarra	7	0	0	36	0

It must be noted that the global ranking of scores which separates the 57 places and three groups mentioned above were obtained in different ways and complement each other. Thus, the medium and high zone of scores is occupied principally by universities from Cluster 1 (those whose attributes have a tendency towards interactivity, a definite and positive tendency, compared with the other two groups, where there is no tendency at all, or one towards bureaucracy), while the majority of institutions in the other two groups are concentrated in the low zone. This serves to reinforce and confirm the information provided by the ranking for the great majority of universities. For each of the three clusters, Table 5 shows the average number of academic, social and administrative resources and the utility attributes scores. The better relative global position of Cluster 1, as opposed to the other two groups (specially Cluster 3), is clear.

On the other hand, in the few individual institutions where there is no matching between their position in the ranking and in the clusters, the latter provides an interesting slant on the information provided by the ranking. This is the case of Barcelona, Alacant or Antonio Nebrija.

Table 5. Number of resources and utility scores by clusters (averages)

	Academic resources	Administrative resources	Social resources	Transactionality score	Decisionality score	Communicati-onality score
Global Spanish	4	2.27	4.25	13.58	23.91	18.05
Cluster 1	4.33	2.28	4.69	15.07	25.33	19.36
Cluster 2	3.40	2.80	3.40	12.40	22.90	17
Cluster 3	3.31	1.85	3.46	9.69	20.08	14.62

In addition, descriptive statistical analysis was applied to the scores of number of resources and attributes based on various organisational characteristics. The Spanish global average for number of resources (CoR) is 10.52, with a standard deviation of 1.81. Thus, although a list of 17 key resources was defined, a good many of these are still not in place in many institutions. There are marked differences depending on the type of institution: the average CoR of the CISS of public universities, compared with secular and religious private universities (10.88, 9.33 and 9.50 resources respectively) shows a clear advantage in favour of the public universities when it comes to the number of resources. There are also variations between autonomous communities. Cantabria, La Rioja and Valencia (with an average of 13, 13 and 12 resources) are in the high zone, while Aragon and Galicia (with 9 resources) are in the low zone. The autonomous communities with the most universities find themselves in the middle: Catalonia (11.50), Madrid (9.85), Andalusia (10.11). As a group, the Catalan-speaking autonomous communities and some autonomous communities with only one university are in a better position. On the other hand, the differences of the average CoR in terms of other organisational characteristics (such as the age of the institution) are very slight.

The Spanish averages of academic, administrative and social resources, are shown at Figure 3. Figure 4 shows the average scores of attributes. Tree diagrams of this type can be used to represent the informational system of either groups of universities or individual institutions.

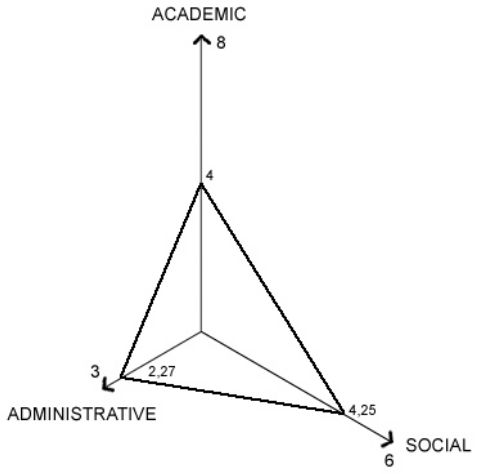

Figure 3. Number of information resources (Spanish averages)

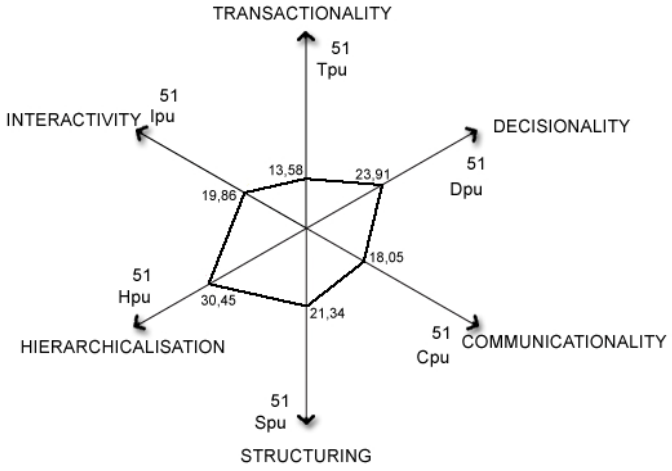

Figure 4. Scores of information attributes (Spanish averages)

In addition, looking at an individual institution's ranking can point out various considerations: for example, the very unfavourable position of institutions such as Complutense de Madrid or Universitat de Barcelona, in contrast with the academic prestige and history of these institutions. Taking into account the data collected during this study of the Spanish university system, it seems that the few very large institutions (broadly speaking, those with more than 50,000 students) may have considerable difficulty managing corporate information resources of a global nature. However, there would need to be a case study of the particular institutions to confirm and justify this impression.

4. Conclusions and future research

The condition of a university's CISS can be determined, in broad terms, by elements outside the institution (whether researchers, prospective students, etc.) by combining

the information that can be seen from the institution's external website and that which is available to current students. Thus, leaving aside its global prestige, which may come from many different factors outside the scope of this work, it can be positioned and compared with others as far as the state of its CISS is concerned.

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 (maintaining the same general structure of the model but adjusting the list of resources and/or the the list of orientation attributes). This idea of types of universities and their students fitting in with each other is emphasised in Veloutsou et al. (2004) and is consistent with the need for Spanish higher education institutions to diversify, pointed out in Michavila (2001). For example, they could consider specific profiles such as international students, students by areas of study, etc.

Systematic encouragement of the use of electronic information resources by the teaching stuff is essential if the student is to have effective use of certain academic resources, such as course websites. This ought to be presented as part of the course teaching strategy. In the broader sense of university life, the existence of social resources (such as directories, campus news, etc.) should also be considered as part of the training value provided by the university and its CISS needs to encourage this.

The CISS situation is on average better in public institutions than in private ones, whether secular or religious. The private institutions do not seem to have seen this as a priority in terms of their global prestige and the value offered to the students, besides in Spanish context private universities use to have less available financial resources than public ones. The autonomous communities best situated are some of those with only one university (La Rioja, Cantabria) and the main Catalan-speaking ones (Valencia, Catalonia). Madrid and Andalusia find themselves below the average, with internal variation. By contrast, no significant differences were found based on other organisational characteristics, such as the date of foundation of the institutions.

As to the individual information position of the institutions, Table 4 provides a synthesis. This shows the position in the global ranking of scores and in one of the three orientation groups, the latter created by means of multivariate statistical analysis. The 40 institutions with at least 10 out of the 17 resources and oriented towards interactivity achieve at least minimal development and adequate orientation. The situation in the 15 institutions which do not achieve either of these two requisites could clearly be improved. The 10 remaining universities fall somewhere in between.

The current study has enabled us to obtain a group view of the information situation in Spanish universities in terms of the capabilities and orientation of the system available to the students. This global descriptive work can, for example, serve as a basis for later research on the implementation and/or impact of these systems in individual institutions. Case studies will be carried out on these universities, which will be chosen taking into account the results presented here.

In addition, and with a view to future characterisation models for a campus information system, we need to distinguish between two types of characteristics. On the one hand there are those which are minimum or basic necessities, but which produce no advantage because they are, or end up being, short-term in all institutions (for

example, on-line registration). On the other, there are those elements which can indicate a difference between institutions (such as certain social resources or the configuration of the course website). Some of these elements are found in the characterisation presented here, which was prepared at a time when many Spanish universities are still in the early or intermediate stages of implementing these systems**.** But, with a view to the future, we need to make a clearer distinction between those elements which are likely to represent a significant advantage to the student and those which everyone is keen to incorporate into the system but which make no difference (and could therefore be left out). In this respect, the ability of the campus information system to integrate the student into an extensive and diverse network of relationships and useful personal contacts during his time at university and beyond should be taken into serious account as a valuable benefit to offer to the student. 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.

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Appendix A: The Spanish university system

Table A.1 Basic data about Spanish universities (Sources: Universities' Council, Universia)

University	Number of undergraduate students	Autonomous community	Date of foundation	Type
A Coruña	26,035	Galicia	1989	Public
Alacant	26,342	Valencia	1979	Public
Alcalá de Henares	19,754	Madrid	1977	Public
Alfonso X El Sabio	9,494	Madrid	1993	Private
Almería	13,809	Andalusia	1993	Public
Antonio de Nebrija	1,965	Madrid	1995	Private
Autònoma de Barcelona	38,094	Catalonia	1968	Public
Autónoma de Madrid	30,704	Madrid	1968	Public
Barcelona	56,836	Catalonia	1450	Public
Burgos	10,318	Castile and Leon	1994	Public
Cádiz	23,243	Andalusia	1979	Public
Camilo José Cela	209	Madrid	1998	Private
Cantabria	12,731	Cantabria	1972	Public
Cardenal Herrera-CEU	5,890	Valencia	1999	Private
Carlos III de Madrid	13,581	Madrid	1989	Public
Castilla-La Mancha	32,218	Castile-La Mancha	1982	Public
Católica de Ávila	548	Castile and Leon	1998	Private
Católica San Antonio	3,920	Murcia	1996	Private
Complutense de Madrid	97,388	Madrid	1508	Public
Córdoba	23,391	Andalusia	1972	Public
Deusto	14,284	Basque Country	1886	Private
Europea de Madrid	6,471	Madrid	1995	Private
Euskal Herria	55,161	Basque Country	1968	Public
Extremadura	28,186	Extremadura	1973	Public
Girona	12,722	Catalonia	1991	Public
Granada	59,814	Andalusia	1531	Public
Huelva	13,255	Andalusia	1993	Public
Illes Balears	13,256	Balearic Islands	1978	Public
Internacional de Catalunya	2,334	Catalonia	1997	Private
Internacional SEK	1,490	Castile and Leon	1997	Private
Jaén	15,113	Andalusia	1993	Public
Jaume I de Castelló	12,847	Valencia	1991	Public
La Laguna	25,533	Canary Islands	1927	Public
La Rioja	7,293	Rioja	1992	Public

University	Number of undergraduate students	Autonomous community	Date of foundation	Type
Las Palmas de Gran Canaria	22,314	Canary Islands	1979	Public
León	14,807	Castile and Leon	1979	Public
Lleida	10,354	Catalonia	1992	Public
Málaga	39,744	Andalusia	1972	Public
Miguel Hernández	8,246	Valencia	1996	Public
Mondragón	3,202	Basque Country	1997	Private
Murcia	30,017	Murcia	1915	Public
Navarra	11,364	Navarre	1952	Private
Oviedo	37,073	Asturias	1574	Public
Pablo de Olavide	4,721	Andalusia	1997	Public
Politécnica de Cartagena	5,858	Valencia	1998	Public
Politècnica de Catalunya	32,587	Catalonia	1971	Public
Politécnica de Madrid	43,496	Madrid	1971	Public
Politècnica de València	33,763	Valencia	1971	Public
Pompeu Fabra	7,920	Catalonia	1990	Public
Pontificia Comillas	8,596	Madrid	1890	Private
Pontificia de Salamanca	8,355	Castile and Leon	1940	Private
Pública de Navarra	9,562	Navarra	1987	Public
Ramon Llull	12,820	Catalonia	1991	Private
Rey Juan Carlos	9,069	Madrid	1996	Public
Rovira i Virgili	12,729	Catalonia	1992	Public
Salamanca	32,880	Castile and Leon	1218	Public
San Pablo CEU	7,740	Madrid	1993	Private
Santiago de Compostela	41,654	Galicia	1495	Public
Sevilla	72,403	Andalusia	1505	Public
València	53,813	Valencia	1499	Public
Valladolid	33,600	Castile and Leon	1292	Public
Vic	3,171	Catalonia	1997	Private
Vigo	29,673	Galicia	1989	Public
Zaragoza	42,602	Aragon	1542	Public

Appendix B: Methodology

B.1: Fieldwork

The fieldwork to collect data on the 65 universities was carried out in two phases: first, structured visits to institutional websites and, second, structured interviews with current undergraduate students.

The visits to the institutional websites were done simultaneously by two observers who periodically compared and contrasted criteria and results. A template and documentation were used to establish definitions, criteria and to clear up specific doubts (which arose primarily in the first 10 institutions). As a result of these visits, the values of the majority of the model characteristics were obtained or, if not, recorded as doubtful.

Afterwards structured interviews were held with final-year students from two different centres at each university. That allowed us to complete, confirm and, in a few specific cases, correct the information collected from the institutional website visits. That was especially useful in relation to resources such as subject-specific course websites (AC-2), normally not accessible from outside the university network. Restrictive criteria were used so that when there were discrepancies among students, the entire university was assigned the most unfavourable value.

The detailed methodology, templates and questionnaires are found in Cobarsí (2005).

B.2: Multivariate statistical analysis

The multivariate analysis consisted of two phases: first, multiple correspondences analysis (Benzecri, 1973; Greenacre, 1993) and, in a second phase, cluster analysis (Aldenderfer & Blashfield, 1984).

The analysis of multiple correspondences aims to synthesise the information from the 17x6 qualitative variables (combinations of attributes and resources) in a few numerical axes. An analysis was made for each attribute and two interpretable axes were found. They explained between 32% and 59% of the corrected inertia according to the formula of Benzecri (1979). The still unconfirmed resources were treated like "missing" data according to the method proposed in Zárraga & Goitisolo (1999) and implemented with standard software in the way suggested by Coenders et al. (2002).

Cluster analysis aims to find groups of universities with similar informational and organisational features and was done with the complete linkage method, also known as the farthest neighbour method, using the squared Euclidean distance. The analysis was repeated using Ward's method and 91% of the universities were identically classified.

A more detailed explanation can be found in Cobarsí (2005).