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MODERN UNIVERSITY MANAGEMENT TOOL – EDUCATIONAL PORTAL CASE STUDY: HIGHER EDUCATION IN ECONOMICS

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Abstract
Nowadays, the delivery of learning services is accomplished in a diversity of ways and subordinated to the rules of a competitive market, in the context of a globalization expansion. Moreover, the Internet, the websites and related technologies sustain this unprecedented diversity. In this paper we try to provide a usability requirement analysis from the e-Learning perspective, as psychology studies have demonstrated that users follow their intuition, they are inpatient and want their results immediately, but at the same time they don't always do optimal interaction decisions. In other words, we illustrate user requirements through a method of analyzing educational portal usability for higher education in economics. Using data mining methods, we also built a profile for the students and grouped them in specific clusters based on their preference for e-Learning (instead of traditional methods) for their studies - a very motivating approach which could help both institution and students.
Keywords: University management, Usability, E-Learning, Portals, Data mining, Clusters, K-means.

1. INTRODUCTION

Modernisation of university management operates a number of key concepts such as quality, efficiency, performance. These goals can be achieved and enhanced by giving important new ICT technologies. Ensuring our quality standards harmonized with European universities to progress towards knowledge society requires a student-oriented educational system, flexible and more homogeneous. So, in this

context, the e-Learning has been one of the main topics on the European institutions agendas for more than a decade. This initiative tries to mobilize all actors in order to make faster changes in educational and training systems, so that the European Union can advance towards the targeted knowledge-based economy. In nowadays Romania we observe an increased concern of the executives, civil society and educational system (secondary and higher education) to implement an efficient e-Learning system in universities. E-Learning represents an educational environment with a continuous upward trend, a collaborative process aimed to increase individual and organizational performance. Its success is determined by the efficiency and ease of access to the most up to date information and knowledge, to the latest design patterns and solutions for presentation, interaction, assimilation and evaluation of learning processes, and by the fact that it provides differentiated access for a variety of student categories and meets permanent education requirements. In order to accomplish all this, e-Learning involves web platforms, communication systems, document and knowledge management systems (Brezeanu, Gorghiu, 2009). The Romanian e-Learning system is currently well defined, based on infrastructure development and a spectacular evolution of information and communication technologies' performance indicators. The traditional academic system has invested in several programs oriented towards distance learning development, but there are still gaps and a consistent, common conception that would trigger a paradigm shift towards e-Learning is yet to be defined.

Usability helps organizations stay focused on customers in exactly the right way and supports this paradigm shift. Website usability and accessibility determine the conversion rate, the client satisfaction level, the visitor number, and also the user loyalty. Usability refers to the general site functionality, the navigational elements, the visitor interaction, error prevention and exception catching, but also to factors that are largely subjective. A widely accepted definition is that usability is the efficiency and ease of use of a product interface (be it a graphic user interface of a website) on the way to meeting user requirements and needs (sometimes these needs diverge from the purpose for which the website was created) – the definition is adapted from Wikipedia and Taloi (2007). Thus, on one hand there's the e-Learning as an on-line service provided by educational institutions to those who want to follow a nontraditional model of education. On the other hand, usability, a notion promoted as part of the interaction design theory, has adapted to "website products" such as on-line shops, e-banking and e-insurance applications.

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2. LITERATURE REVIEW

Universities use e-Learning tools and solutions for improving the traditional learning system. This type of complementarities, if properly managed, holds a great potential for extending the range for learning activities. E-Learning or Electronic Learning is considered by M/Cyclopedia of New Media (wiki.media-culture.org.au) as the delivery of educational content via any electronic media, including the internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, CD-Rom, interactive CDs and DVDs, and computer-based training. An e-Learning portal is a modular product which, on one hand, supports the flexibility of managing the educational process through university-specific methodologies and, on the other hand, determines increased efficiency for learning processes, by providing to students and teachers modules for online evaluation, distance working, collaboration, knowledge management and administrative management.

Web 2.0 applied in education is gaining popularity, thus the definition of e-Learning 2.0, a paradigm which shows how the ReadWrite Web can improve education. Such an option creates inevitable difficulties in the educational environment, because changes and reengineering must synchronize with the fluid nature of Web 2.0 design patterns. In order to achieve success, there's a need for innovative spirits, a reconsideration of informal learning and a bet on the mobility and direct access to learning resources. By employing Web 2.0 for education, a university will put at the user's disposal tools inherently created for this generation of websites: blogs, wiki systems, RSS feeds, knowledge aggregators, podcasts and customizable Web interfaces (Brezeanu, Gorghiu, 2009).

The Merriam-Webster dictionary (www.merriam-webster.com) states that an educational portal provides on-line information, widely accessible (but restricted based on authorization levels) to managers, students, teachers, parents and general public, regarding educational processes and indicators. Based on these definitions, we define the key role of a portal to be the unification of various information sources in a single, highly usable, interface. The information presented may have targets with various granularities: for public (news, educational programs etc.), for groups (courses, surveys, forums), for individuals (accounts isolating various information: student grades, performance indicators for managers etc.).

At a national level, several university centers have developed departments for distance learning. We mention the following characteristics of the Romanian's e-Learning university: asynchronous or synchronous communication; multimedia processing; presentation material organized on subjects or themes (unlike the traditional education organized on age groups / classes); own learning rhythm; the presentation material has a static and a dynamic element; possibility of group discussions under the

form of forum; assessment simulations; course fees lower than for the traditional school; free online courses; unlimited access to courses.

Usability can be defined as the extent to which a product can be used by specific users so to achieve specific goals with elevated efficacy, efficiency and satisfaction in a specified use context (Guran, 2009). The main components would be:

- Efficacy – the completeness and correctness with which users accomplish their tasks;
- Efficiency – the ration between consumed resources and the outcome of accomplished tasks;
- Satisfaction – the comfort and acceptance of a system with respect to its users.

Usability can be measured relative to the user performance while executing a set of tasks. According to the specialists, usability evaluation is done with the following methods:

- Quantitative: Metrics, Questionnaires;
- Qualitative: Interviews, Focus groups, Observation.

In (Guran, 2009) it is shown that the fundamental metrics defined in a usability context are:

- Success ratio for a given task;
- The time taken by accomplishing a task;
- The error rate;
- The subjective satisfaction of users;
- The time ratio in which users follow the optimal path for a given task.

3. RESEARCH METHODOLOGY & DISCUSSIONS

In our present research we offer a usability requirement analysis from the e-Learning perspective, illustrating the user requirements for higher education portals. We also focus on a main data mining practice – data clustering. Based on students' reasons for choosing e-Learning for their studies we built a profile and grouped them in specific clusters, using two important algorithms: simple K-means and FarthestFirst. This is a motivating approach which could help the higher education institutions, but also the students who could benefit from the institutions' proficiency and support.

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As the virtual space is exploding on the national educational market, e-Learning is employed more and more often. Today in Romania there are around 113 universities and 58% of them provide e-Learning services. As the usage rate of these services increases, its quality must increase. The implemented solution has to prove successful for the potential student-"internauts". On the Internet, usability is of one of the most important measurement units. A representative Romanian university portal, now, is:

- Created from the university's own resources - The development of an own educational portal is a bold action that involves investing in a team of specialists from various fields; the main disadvantage is that of the extensive time to achieve such a solution.
- A project won and developed by its own team (CNCSIS grants, PHARE funds, other unredeemable funds) or purchased (the existing solutions on the market can be a considerable financial effort, given that prices can range from 20,000 USD to 1 million USD, depending on the number of users, facilities, implementation and maintenance manner).

E-Learning usability identifies with the answer to the question "How are they thinking, those who want to be trained through e-Learning?" The issue at hand is to measure the extent to which current academic websites are able to attract potential students who are interested by the educational offer, the learning platform and want to find out more information about the prestige and guarantees offered by the study program.

As a methodology, we used fundamental metrics on novice subjects. It's a quantitative method applied on 25 subjects. We analyzed the most important 10 faculties of economics of state-own universities (in our opinion), based on reviews made by the Capital Journal and the portal studentie.ro in 2011. The chosen platforms were either open-source (Moodle) or purchased (based on Microsoft Share Point).

The online presence of each faculty was analyzed based on 4 criteria: content, navigability, design and Web 2.0 compliance. The analysis grid is divided in sub criteria, each with its own scale. The points for the sub criteria are added to obtain the final score. The main criteria are considered of equal importance, each weighting 25% of the final score. The 10 faculties belong to the following university centers: București, Cluj-Napoca, Iasi, Timisoara, Constanta, Craiova, Brasov, Sibiu, Suceava, Alba-Iulia.

The criteria grid, based on studies of other types of portals (Morarasu, 2006), is as follows:

*Criterion **A**. Content:* A1. Information quantity, A2. The virtual tour, A3. The update frequency, A4. The on-line assistance, A5. The notice board. Sub Criterion *A2. The virtual tour demo* was graded as follows: 0 points – if there's no demo, 1 point – if the tour is given through slides, 2 points – if the tour is

given with more complex animations (AJAX, Flash, 3D). Subcriterion *A3*. For the *update frequency*, the score follows the rules: 0 points – if updating is rarer than once a year, 1 point – for 6 months; 3 points – for 3 months; 5 points – for monthly updating.

*Criterion **B**. Navigability -B1. Web interface navigability* the points were given if the number of clicks didn't exceed 4; *B2. Navigation support* - 0 points – no facilities; 1 point – a site map; 2 point – a search engine.

*Criterion **C**. Design:* C1. Aesthetics, C2. Organic search results, 3. Conformity with the institution website

C1. Aesthetics. For this criterion several items have been considered: background, fonts, color schemes and their consistency, animations, spacing, paragraph length, general layout and structure, applications (etc). *C2. Organic search results* Searches have been executed on items such as: faculty name + "e-Learning"; faculty name + "distance learning"; faculty name + "virtual learning".

A point was given if the faculty program was listed in the first 2 pages. We took into consideration the terminology which can vary from one institution to another, by searching for synonyms or related words: center/department, distance learning/open learning, virtual learning/virtual education.

*Criterion **D**. Web 2.0 elements - blogs, RSS, podcast, YouTube insertions etc.* One point was given for each Web 2.0 component, up to the 25 points limit.

The present study reflects a satisfying coverage of the usability criteria in the structure and content of Romanian e-Learning offers. The most satisfied criterion is the content – an average of 20 points (out of 25). This indicates the fact that our faculties acknowledge the importance of content management. The lowest score was given to Web 2.0 elements – an average of 5.9 points (a maximum of 10 out of 25) shows that university portals are not yet adapted to new technologies.

The most homogeneous sub criteria are the conformity to the institution home page (maximum points for all institutions) and the electronic notice board and information center (90% of institutions). The lowest score was given to the virtual tour and tutorial systems for supporting the learning curve of the e-Learning portal. The most important deficiencies are represented by the bland design, the lack of site maps and the accessibility of search engines.

Data mining represents a practice of extracting valid, previously unknown, and eventually understandable and actionable information from large databases and using it to make central business decisions (Hermiz, Skalak, 2002). Our research based on data mining technologies rely on finding

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practical ways to offer the higher education institutions' managers sufficient information to set up new hypothesis, in short time, which was previously inflexible or unattainable, due to large datasets and earlier methods. For that reason, the purpose was to find means to comprehend the students' opinions, satisfactions and discontentment in the on-line educational processes, and to predict their preference for certain courses, the choice in continuing their studies, and to put forward precise correlations between their knowledge and the requirements in the labor market. We collected data from over 300 distance learning freshmen students. From the questions included in the questionnaire, we tried to identify the student – teacher and student – student interaction capacity, defined by: the student's profile (age, gender, high school and/or faculty graduated etc.); students knowledge about e-Learning; ability to use the computer, and implicitly the Internet – the questions grouped in sub-categories: general information on IT usage, knowledge related to the use of computers (basic notions, OS, text processing, spreadsheets, presentations, searching, web pages) etc.

Our recent experiments at the Babes-Bolyai University of Cluj-Napoca, Faculty of Economics and Business Administration were focused one important data mining method in the Weka software: data clustering - an unsupervised method for extraction hidden pattern from large data sets (Khalilian et al., 2010). Building a profile for the students and grouping them in certain clusters based on their preference for e-Learning (instead of traditional methods) for their studies is a very motivating approach which could help both institution and students.

Data clustering stands as a key process in data mining, often applied when no information is accessible regarding the bond of data items with predefined classes (Grira et al., 2005), and has been used for applications in life sciences and over the years has been used in many areas (Zhao, Karypis, 2005) from the analysis of clinical information, phylogeny, genomics, and proteomics etc. What clustering mainly does, is grouping samples based on their high degree of similarity, at the same time as samples in different groups should be dissimilar (Khalilian et al., 2010). Clustering methods are typically separated into two large groups: hierarchical and partitional algorithms (Samson, Bouthemy, 2004). Other scientists utilize a diverse line to categorization (Ivancsy, Kovacs, 2006): Partition-based; Density-based algorithms; Grid-based algorithms; Model-based algorithms; Fuzzy algorithms.

K-means clustering algorithm has been a very popular technique for partitioning large data sets with numerical attributes and is regarded as a staple of clustering methods, due to its ease of implementation (Khalilian et al., 2010). It is a local search algorithm and partitions *n data points into k clusters* in this way: (Vattani, 2009)

- seeded with k initial cluster centers, it assigns every data point to its closest center,

- then recomputes the new centers as the means (or centers of mass) of their assigned points,
- this process of assigning data points and readjusting centers is repeated until it stabilizes.

K-means works well for many practical problems, particularly when the resulting clusters are compact and hyper spherical in shape (Khalilian et al., 2010). The time complexity of K-means is O (N.K.d.T), where: (Khalilian et al., 2010)

- T is the number of iterations.
- Since K, d, and T are usually much less than N, the time complexity of K-means is approximately linear.
- Therefore, K-means is a good selection for clustering large - scale data sets.

Before applying the clustering method the filter StratifiedRemoveFolds which generates subsets of data by dividing them into a number of borderline by cross validation and reduces to only one of them that will be layered. After applying this filter we obtained 115 instances, the number of attributes remains the same, namely 18. It is worth mentioning that we have chosen a fixed number of partitions (3) for dividing the data set, derived from the values of why_eLearning class attribute: combined, own_pace, lower_cost.

Based on the students' reasons for choosing e-Learning for their studies (Class attribute: why_eLearning) we divided them into 3 groups , each presenting specific centroids, with a fair result after Weka validation (41.7391 % of the instances were incorrectly clustered): Group 0: Students choose e-Learning due to the possibility of combining work with continuing education (combined); Group 1: Students choose e-Learning so that to study at their own pace (own_pace); Group 2: Students choose e-Learning because of lower costs (lower_cost).

Continuing our experiments on the same filtered data, we then applied the Farthest First algorithm. This represents a unique clustering algorithm (Tan et al., 2008), which uses the basic idea of agglomerative hierarchical clustering in combination with a distance measurement criterion that is similar to the one used by K-Means. It assigns a center to a random point, and then computes the k most distant points. The algorithm works in the following manner: (Dasgupta, Lon, 2005).

- first select an instance to be a cluster centroid randomly,
- then compute the distance between each remaining instance and its nearest centroid,

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- the algorithm decides that the farthest instance away from its closed centroid as a cluster centroid,
- the whole process is repeated until the number of clusters is greater than a predetermined threshold value.

We still relied on the students' reasons for choosing e-Learning for their studies (Class attribute: *why_eLearning*), divided them into 3 groups, but this time we obtained an optimistic result after Weka validation (only 21,7391% of the instances were incorrectly clustered).

The last experiment was indeed an accomplishment, because the three clusters do not contain similar value fields of the same attribute (at the same time), therefore the result containing relevant information for the segmentation process.

The students' preferences of certain types of courses and exams (*exam_course_preference* attribute) play a substantial part in differentiating the clusters population:

cluster 0 - course_online & exam_inclass

cluster 1 - course & exam_online

cluster 2 - course_inclass & exam_online

The same situation is observed in the case of the following attributes: highscool_profile, Internet_access, computer_use, learning_technology, technology_percent, found_about_eLearning, exam_course_preference, desired_faculty_specialization, why_this_specialization.

4. CONCLUSIONS

When correctly considered and applied, usability will increased the return to investment of an e-Learning portal, will influence the learning abandon rate and will reduce the rate of usage errors and exceptions. For distance learning the abandon rate is high in the first year, one of the main reasons being the adaptive means and flexibility of platforms, and of students. This is why building a profile for the students, and their grouping based on their reasons for choosing e-Learning can be a very motivating approach that could support both universities and students. Higher education institutions could discover students content/discontent concerning its education processes, curricula, courses etc., and comprehend student abandonment, thus being able to maintain but also attract new students for distance education programs.

We agree with the idea that shifting the e-Learning paradigm towards the 2.0 generation is greatly affected by five topics:

- Process and governing;
- Technology and standards;
- Organizational culture and learning;
- Local and global resources;
- Skills and competence.

We consider usability to be fifth category factor. There's no doubt that in the Romanian academic environment there are enough free Web 2.0 tools, both for personal use, and for institutional use. But, for now, few universities adopted coherent strategies for the pedagogic integration of the social Web and the development of the best methodologies for centering the learning process on IT extensions. Our future research will continue to explore the area of e-Learning at the interference with data mining, statistics and new information and communication technologies (ICT).

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