
Customer Relationship Management applied to higher education: developing an e-monitoring system to improve relationships in electronic learning environments

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Abstract: Customer Relationship Management (CRM) has usually been associated with business contexts. However, it has recently been pointed out that its principles and applications are also very appropriate for non-profit making organisations. In this article, we defend the broadening of the field of application of CRM from the business domain to a wider context of relationships in which the inclusion of non-profit making organisations seems natural. In particular, we focus on analysing the suitability of adopting CRM processes by universities and higher educational institutions dedicated to electronic learning (e-learning). This is an issue that has much potential but has received little attention in research so far. Our work reflects upon this matter and provides a new step towards a CRM solution for managing relationships of specific customers, such as students. Indeed, the main contribution of this article is specifically characterised by the proposal and empirical application of

an e-monitoring system that aims to enhance the performance of relationships in e-learning environments.

Keywords: Customer Relationship Management; e-CRM; electronic learning; e-learning; e-monitoring systems; higher education.

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1 Introduction

Universities and public administration have made important efforts to improve the quality of higher education, often at the behest of market forces. As a result, universities rethink their strategic orientation in order to respond adequately to the various transformations they face (Hemsley-Brown and Oplatka, 2006). This is the case of student demands, the needs and patterns of differentiated behaviour, the increasingly competitive global markets, the frequent innovation in teaching/learning procedures, etc. In this context, it is not surprising that universities opt for intelligence and information systems and Customer Relationship Management (CRM) technologies (Neville, Heavin and Walsh, 2005; Seeman and O'Hara, 2006) in order to identify those students who require greater attention and provide them with a more personalised service, thus reducing the number of dropouts and maximising the value of the service on offer.

Though most CRM studies and applications have usually been developed for the profit-making organisation framework, its essential foundations make CRM highly suitable for non-profit making organisations (Weir and Hibbert, 2000; Arnett, German and Hunt, 2003). This idea is strongly related to a wider subjacent view of the customer concept that is more appropriate nowadays, which transcends the consumption framework.

The adoption of CRM systems is coherent in those organisations, which practise a customer-centric approach. The final aim pursued by any organisation that uses such systems is to provide its customers an added value based on the individualised understanding of their preferences. This philosophy of management thanks to the intelligence coalition of Information Technologies (IT), working processes, analytical methods for databases, knowledge management capabilities, etc. should contribute to 'build and sustain a profit-maximising portfolio of customer relationships' (Zablah, Bellenger and Johnston, 2004, p.481).

The non-profit making organisations are suffering increasingly competitive pressure, which has led them to offer services of quality. This explains why non-profit making organisations like universities, now more customer/student focused (Neville, Adam and McCormack, 2002) and attracted by the advantages associated with them, have begun to adopt CRM systems (Neville, Heavin and Walsh, 2005; Hemsley-Brown and Oplatka, 2006; Seeman and O'Hara, 2006). Besides, the adoption of these kinds of systems by institutions, whose organisational culture defends a long-term relational orientation, favours the achievement of institutional goals, as well as the generation of positive results for both their own organisation and its primary stakeholders; mainly, students and scholars (Jayachandran et al., 2005). In short, the adoption of CRM systems should be viewed as a plausible mean to strengthen the adding-value process of universities. However, we ought to be aware of the fact that just investing in these technological systems does not guarantee a competitive advantage. On the contrary, any CRM system developed and adopted by a university must achieve an in-depth knowledge about its customers, and use such knowledge to properly evaluate the state of relationships, take the right decisions, and address appropriate actions. This is the gist and challenge of any CRM adoption process at the universities.

Developing CRM systems in higher educational contexts is not always a mere translation of those applied in the business field. This is why CRM technologies, applications and processes require adaptation to the distinguishing characteristics of the institution (Fjermestad and Romano, 2003; Raman, Wittmann and Rauseo, 2006).

Particularly, if we focus on the e-learning arena, the adoption of the CRM systems is even more interesting and challenging. In the electronic context defined by the internet framework, e-CRM systems are very convenient for revealing the relationships with the primary stakeholders of the universities. In this regard, one of the most critical tasks in the determination of the whole value provided to the students depends on how the institution monitors learner behaviour during the interaction with scholars, classmates and the e-learning system in general (Rodrigues, Bressan and Ruggiero, 2006); i.e. our main concern is the online monitoring of the students' e-learning process.

This article shows part of a wider research focused on developing e-CRM solutions to be applied in e-learning environments. In particular, given the limitations of current e-CRM systems to track the student's behaviour in their interactions with the environment and the development of their learning process (Jerman; Soller and Muhlenbrock, 2001; Zumbach et al., 2002), the research supporting this article is aimed at defining and proposing an e-monitoring system adapted to a learning environment.

In order to define this e-monitoring system, some particularities of the higher education contexts have been considered:

- 1 not only the relationship between customers/students and the institution, but also among the students themselves
- 2 the specific needs of information of the various stakeholders (i.e. students, tutors and course managers)
- 3 the importance of collaborative work carried out by students under the guidance of the teacher.

The ultimate aim of the e-monitoring system we have developed and tested in a real e-learning situation is to improve the performance of the CRM processes in any virtual learning environment.

The structure of the article is as follows: first, we carry out a literature review of CRM and, especially, its extension to the field of non-profit making organisations, as in the case of the universities, the institutional field we have taken as the specific framework to develop our CRM solution. In particular, we discuss the clear necessities that such institutions have to monitor their students' behaviour and performance. This led us to build an initial conceptual model, which in turn guided the development of an information system with e-monitoring mechanisms. In fact, the resulting system constitutes an e-Learning Monitoring System (e-LMS) that provides an innovative solution that focuses on monitoring customer/student relationships in a higher e-learning institution. Then, we present and discuss the results provided by the e-CRM solution we propose. Finally, some concluding remarks are given.

2 Conceptual background of CRM

Customer Relationship Management is the result of the evolution in marketing as well as its integration of different ideas and concepts that have arisen from new data, technologies and organisational processes (Boulding et al., 2005; Payne and Frow, 2005). This evolution began in the 1960s with Theodore Levitt, who stated that organisations should assure their long-term future not by placing and selling their products but by satisfying the needs of those who were going to use them (Levitt, 1960). Years later, Berry (1983), the initiator of relationship marketing, proposed the adoption of a business

philosophy (Berry, 2002) in which the service companies focused on attracting, maintaining and improving customer relations. Based on the construction of this relationship, the concept was taken further (e.g. Gummesson, 1987; Grönroos, 1994; Webster, 1992). In addition, the processes and capabilities needed to maintain good customer relationships were studied, which led to the development of market orientation (Narver and Slater, 1990; Jaworski and Kohli, 1993). Alongside, the spread of IT among companies and consequently a huge increase in customer data that it generated, there arose the concepts of one-to-one marketing (Peppers and Rogers, 1993) and massive customisation (Pine, 1993).

Therefore, in the 1990s, many companies began to apply these principles (satisfying the customer by giving value, orientation towards the relationship, marketing intelligence, personalisation of communications, etc.), and especially the marketing relationship (Zablah, Bellenger and Johnston, 2004; Bolton and Tarasi, 2006; Payne and Frow, 2006), combined with technological solutions that came to be called CRM; these were to allow experts to obtain, store and analyse with greater ease data on customer behaviour and its interaction with the organisation. Through this, there emerged a broader concept of CRM now regarded as a strategic approximation through which the management of relationships with the organisation's key clients is appropriately developed (Payne and Frow, 2005).

In accordance with the latest and the most relevant contributions in marketing literature (Zablah, Bellenger and Johnston, 2004; Payne and Frow, 2005, 2006; Bolton and Tarasi, 2006), this approximation defends the creation of value, the intelligent use of technological systems and inter-functional business processes to obtain and spread knowledge on customers as well as the development of advantageous and long-lasting relationships with the customers and the segments of specific customers (Boulding et al., 2005).

3 Marketing, relationships and CRM in higher education

Although most of the research on CRM has concentrated on business, the principles, technologies and procedures that derive from this concept are also applicable to non-profit making areas (Arnett, German and Hunt, 2003; King, 2007; Pan, Tan and Lim, 2006, among others). Therefore, it is important to consider the particular characteristics of the relationship or certain factors that condition its development (Cervera et al., 2001). This idea is coherent, in essence, with the premises defended some decades ago by Kotler and Levy (1969) regarding the widening of the field of application of marketing.

Even though these proposals received a mixed response from those in public and non-profit-making organisations, it has not proved to be an obstacle for the acceptance of the expansion of marketing into public and non-profit-making organisations in general (Cervera et al., 2001) and into universities in (e.g. Gibbs, 2002; Hemsley-Brown and Oplatka, 2006). In universities, the debate on the application of marketing principles continued into the 1990s (for more detail see Sharrock, 2000; Hemsley-Brown and Oplatka, 2006). The main resistance to the use of business concepts and principles came from academics and educators opposed to applying market forces to the university system. They considered that these principles contradicted educational values. This concern about the 'marketisation' of university education led to the debate, for example, on considering the student a customer of the institution (e.g. Barrett, 1996; Franz, 1998).

Curiously, alongside the increased application of marketing to public services and non-profit-making organisations, there has been a greater acceptance of the evolution of the theoretical development of marketing. In fact, the principles that currently carry greater weight are closer to the specific problems of these institutions (Stokes, 1997; Weir and Hibbert, 2000). Today's marketing focus is not so much on getting 'buyers' as on customer satisfaction, giving them what they want and cultivating a relationship with them that is not just strictly commercial, unilateral and impersonal. Thus, the adoption of CRM by educational institutions brings with it the use of appropriate instruments to acquire greater knowledge of the needs of students in terms of training, to help organise services tailored to their characteristics and requirements, to improve the process of education and get better results that reduce the number of dropouts (Neville, Heavin and Walsh, 2005).

However, marketing education literature has not developed uniformly and there is a lack of development of theoretical models that are clearly adapted to educational services (Hemsley-Brown and Oplatka, 2006). As Oplatka and Hemsley-Brown (2004) point out, when literature originated in the 1980s, it was fundamentally theory and norms oriented, based on the application of models initially conceived for business, especially those from marketing communication, to the promotion of educational institutions. Later, the debate was about if students fitted into the 'customer' label (in their 'consumption' of training programmes) or whether it was about 'products' that educational institutions 'offered' to the labour market (Conway, Stephen Mackay and Yorke, 1994; Emery; Kramer and Tian, 2001).

At around the same time, education was being labelled a service, which situated marketing education literature within marketing services (Mazzarol, 1998; Chung and McLarney, 2000). Other subjects that sparked the interest of researchers were the processes of internationalisation in the educational context (Binsardi and Ekwulugo, 2003; Mazzarol, Soutar and Seng, 2003; etc.), as well as factors that determined the choice of a university (e.g. Maringe, 2006).

The adoption of the relationship perspective and the principles and instruments of CRM are considered the latest and most recent subject for study in marketing education. This is mainly due to the fact that the studies applied to non-profit-making organisations have highlighted their rich contribution to the development of the organisation's activities (Arnett, German and Hunt, 2003; King, 2007; Pan, Tan and Lim, 2006). In the specific field of education, studies like those undertaken by Klassen (2002) and Trim (2002), have provided additional support to the organisational philosophy that marketing relationships propose, proving that this orientation is compatible with providing educational services.

Nevertheless, there is still very little specific research on CRM in education. In this sense, based on the literature review we have undertaken in this article, we have only identified two previous studies that examine the CRM impact on the contexts of higher education. Seeman and O'Hara (2006) demonstrate how the development and implementation of a CRM project improves the obtaining and management of information, reduces the number of dropouts and increases student satisfaction with programmes and educational services on offer. These researchers consider that the CRM impact on university education is greater when the institution adopts e-learning systems. Also, Neville, Heavin and Walsh (2005) examined the results of an e-learning management system developed and implanted using a CRM strategy. This study shows that the effectiveness of a virtual educational environment does not depend so much on a system's complex technology as on the teaching-learning methodology, and that the

technology to be used must serve specific educational proposals. More research is required in order to increase understanding of CRM initiatives, as well as the design of specific technologies and instruments for the service of teaching/learning processes (Hemsley-Brown and Oplatka, 2006) in general, and for e-learning in particular.

Apart from the studies we have just reviewed, there are other contributions, which should also be commented on, though briefly. For instance, a study by Mutula (2002a, b) provided insights into how the University of Botswana planned to use web-based technology to enhance CRM. Also, Lam (2005) described how Universities 21 Global, a new online university, developed its online postgraduate (MBA) programmes and, in particular, the teaching of the subject 'e-business'.

4 The need for e-monitoring students and virtual teams in e-learning environments

The technological CRM tools available in the field of education allow us to make use of database capabilities, data mining systems and interaction technologies in order to obtain and store huge quantities of information on the characteristics and behaviour of students, and to generate knowledge about the same and make it available to the educator so that he/she can contribute more efficiently to the students' learning process. However, the usual technologies are limited for obtaining and analysing information on student behaviour in a virtual environment, especially when students cooperate in carrying out learning activities. Thus, although these tools allow the educator to consult the most relevant personal and academic data (prior qualifications, academic report on current university course, etc), giving the educator knowledge of the student's educational needs, there are still limitations regarding following the student's behaviour when navigating and interacting with the learning environment (Jerma et al., 2001; Zumbach et al., 2002).

The current limitations of CRM systems when applied to e-learning can be illustrated, for example, by the lack of consideration of relevant variables like frequency of access to the student classroom, the student's consultation of online information and educational resources, their individual contribution to the development of activities in collaboration with other students, etc. Moreover, previous studies on collaborative e-learning focused on conceptual aspects of monitoring (Jeong, 2004; Guerrero et al., 2005), providing simple, limited monitoring instruments (Stahl, 2006).

Studies such as that by Lee et al. (2007) highlights the importance—in learning environments—of the educator's role, the relationship he/she establishes with the student, and the contribution of these aspects to student satisfaction. However, additional questions arise as regards the students' satisfaction about the educator's role in supporting their work and, especially, in providing adequate and timely help with their problems. Certainly, scholars need tools that are able to provide accurate information about the students' performance. Most important, such tools must help the scholars to easily identify problematic situations, in order to rapidly take corrective decisions in an effective manner.

Therefore, we consider that the resulting information from monitoring processes of learning online is particularly relevant for the university and its educators. In fact, it permits them to know the level of progress of each student and team in the development of each activity, motivate the participants according to their level of progress, organise

the working group, etc. (Dillenbourg, 1999; Daradoumis, Martínez and Xhafa, 2006). As a consequence, it is worthwhile researching the development of proposals for the monitoring of added value.

It is possible to resort to a variety of generic methods to be imported and/or adapted to the monitoring of students and working groups to the e-learning field. These methods range from formal methods (e.g. statistical analysis, social network analysis, monitoring through shared information) to informal ones, such as short questionnaires, self – or group-reports and instructors' notes (Reffay and Chanier, 2002; Martínez et al., 2003; Mazza and Milani, 2005). Also, differences exist as regards the sources of information used for monitoring, such as log files of synchronous and asynchronous communication, bulletin boards, and electronic discussion information reports. While log files allow the handling of information sourced by formal methods, discussion information reports require more costly qualitative analysis methods. Besides, the necessity for adequately integrating the application of a particular e-monitoring solution to the rest of the CRM technologies used, as well as to the e-learning environments (as e.g. Basic Support for Cooperative Work or BSCW system, Moodle, WebCT, eClass, etc.), also requires the use of a common data format.

Taking the previous questions as a backdrop, it is convenient to create first a conceptual model that allows us to develop an e-LMS that provides monitoring or activity reports about the primary stakeholders of the institution. In this sense, we have developed a system called Student Activity Monitoring using Overview Spreadsheets (SAMOS), based on the combination of easy-to-use spreadsheet models and MS/OR techniques, for use in tracking a group's and an individual's activity and performance in any e-learning environment.

5 SAMOS: an e-monitoring system to support CRM in e-learning environments

5.1 Description of the e-learning environment selected for developing and experimenting with the system

The successful implantation of these technological solutions in an organisation depends on two main factors: to have adopted an orientation towards the relationship (Jayachandran et al., 2005; Srinivasan and Moorman, 2005); and to have consolidated organisational processes to collect and analyse, distribute and use the acquired information (Jayachandran et al., 2005). For this reason, the SAMOS system was developed and experimented within a university framework that has these characteristics. Specifically, the Open University of Catalonia (UOC, Universitat Oberta de Catalunya) widely considered for its work in e-learning not only in Europe, but also across the world, was the institution chosen for this work.

The www.uoc.edu (UOC) was created in 1994 at the request of the Generalitat de Catalunya in Barcelona (Spain). It has shaped a widely diverse university community, with around 43,000 students from more than 45 countries. These individuals all share the common goals of acquiring knowledge, personal enrichment and lifetime learning, and they all use IT to interact, thereby consolidating a growing, dynamic online community.

The UOC complies with the main characteristics of strategic and organisational order that, in accordance with authors like Sin, Tse and Yim (2005), match CRM. Firstly, it is an institution clearly oriented to the customer/student. This is apparent in its pedagogical model, which situates the student at the centre of the teaching-learning process providing him/her with information in any given place and time, and at the rhythm the student decides. Secondly, it has designed an organisational structure that allows an orientation towards the creation and strengthening of relationships.

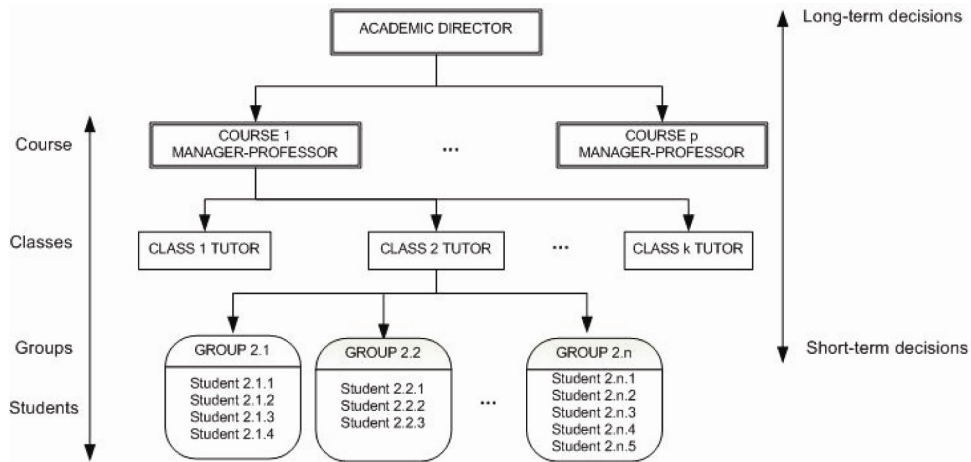
On the one hand, this structure contains groups of varied characteristics (e.g. inter-functional, centred on processes, customers/students etc.), and designs that facilitate inter-functional coordination and integration. Moreover, it includes resources for the identification and satisfaction of customer/student needs, and systems of internal marketing that stimulate the service vocation of educators and management personnel.

On the other hand, the UOC promotes and supports collaborative work and learning in small groups in several courses, which reinforce and create tighter relationships among students. However, collaboration at a distance requires not only additional effort but it also may present problems that can harm members' relationships and thus group cohesion. It is, then, very important for group managers, (e.g. tutors) to be able to supervise and monitor group and member activity in order to identify problematic relationships in time and intervene effectively to improve group dynamics and performance.

This educational context located in the web-based distance learning and teaching arena, is where our e-monitoring system has been developed. We have considered a common scenario where groups of students have to work on long-term software projects, which are problem-solving collaborative practices, supported by the BCSW collaborative platform. Such projects are organised in several phases; each phase corresponds to a target goal.

The instructional design of each target goal includes several learning tasks, adequately linked to each other, that students should carry out individually (such as readings) or collaboratively (activities and exercises) in order to achieve the corresponding goal. In addition, the design of some target goals also dictates the realisation of specific synchronous debates at group (and class) level, aimed at decision-taking on a set of specific questions. The whole project is carried out mostly asynchronously within the scope of several distance learning undergraduate courses, which usually run over a period of 14–15 weeks.

Each of these courses involves several academic agents (see Figure 1): an academic director (responsible for the degree), a course manager–professor (responsible for the course), several tutors (responsible for a virtual class) and the class of students (about 50 per class) distributed among different online groups with four to five members each.

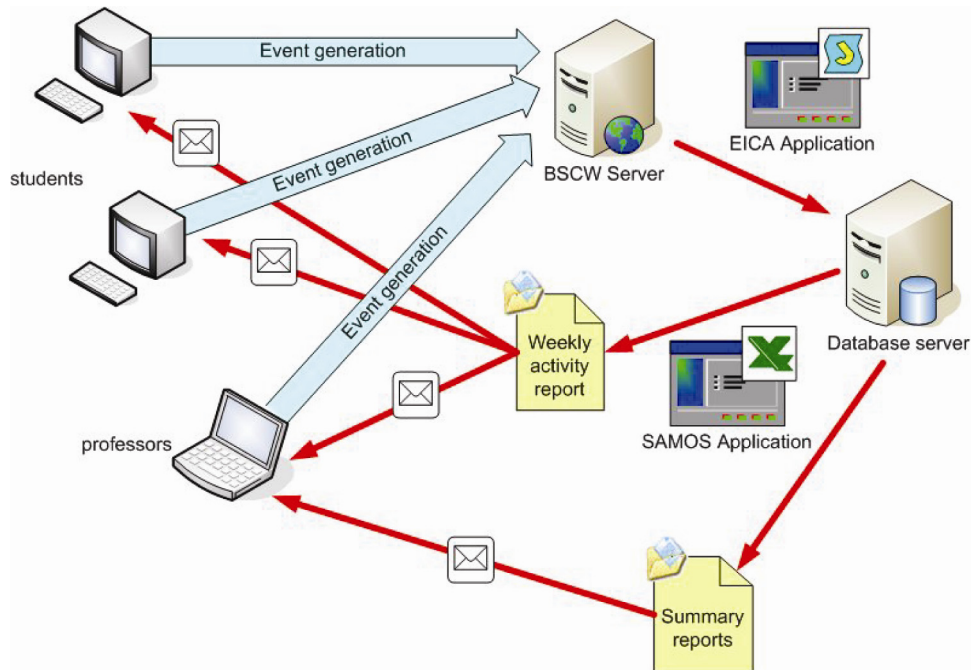
Figure 1 Agents that participate in the e-learning process

5.2 Development and implementation of the e-monitoring system

5.2.1 Design of the e-monitoring process

The e-monitoring process starts when a learning activity takes place on the BSCW server. Interaction activity data are captured in BSCW log files, which are not readable and cannot be analysed in a straightforward way. To solve these problems, we have developed a specific tool, called EICA, which automatically reads and processes new incoming log files and stores the extracted data in a single, permanent database. The SAMOS system will then analyse this information using spreadsheet models in order to generate weekly activity and summary reports (see Figure 2). The generation of weekly reports is just a design option, which was decided on after an analysis of the educator's needs and the context of the experience; the fact that the learning activity is carried out asynchronously during a long period of time implies that there is not always a continuous daily work pace, so a week has been considered a reasonable time interval to collect and analyse data and provide feedback. In any case, the system can also generate real time reports that are instantly available upon the educator's request.

At this point, it is important to comment that any web-based environment different from the BSCW system that characterises the e-learning environment of reference will keep similar log files. Therefore, an equivalent model could be considered (obtaining a similar database if not the same one).

Figure 2 Generation flow of weekly activity reports (see online version for colours)

5.2.2 Use of spreadsheets as a tool for developing different e-monitoring capabilities

The SAMOS e-monitoring system has been designed to best exploit the big volume of data (BSCW actions and connections log files) that are stored in the database and produce information that can help different academic agents (student, tutor, group coordinator, course manager-professor, academic director) understand the complex relationships among the participants in the learning process and take adequate decisions. In particular, SAMOS allows academic agents to automatically obtain the following information:

- Weekly monitoring reports on the activity indices of groups and students. In doing so, both group coordinators and tutors could specify short-term policies oriented to increase activity levels in those groups with a low activity index, promote group leadership and prevent student dropouts.
- History information on connection habits that can be used to increase the efficiency of communication within a group as well as between students and tutors.
- Summary information about classes and course performance that academic directors and course manager-professors could use to take long-term strategic decisions regarding course load (in credits), course objectives and methodology, etc.

Having detected these information necessities, SAMOS was implemented to provide important functionalities, such as:

- 1 import data from a database in an easy and reliable way
- 2 perform advanced data analysis on raw data
- 3 facilitate a graphical visualisation of numerical results
- 4 be customisable – depending on the final user information needs (student information needs are different from a manager’s, etc.) – modular and scalable so that additional information functionalities could be easily incorporated in the future without affecting the existing ones
- 5 be able to generate portable reports in a standard file format, so that different academic agents could consult them, from any geographical location, using a simple web browser (independently of the operation system and other application software used)
- 6 be able to automatically send these reports by e-mail as well as to publish them on the UOC intranet, so that users with appropriate permission rights could access them anytime.

We should point out here that we could have developed a stand-alone Visual Basic, C# or Java-based tool able to meet some of the previous specifications – namely, specifications a, d, e and f – but specifications b and c would have been difficult to achieve, and would have required a lot of design and programming effort. Therefore, it seemed clear that the most natural way to develop such an e-monitoring system was by means of spreadsheets, due to their contrasted efficiency when dealing with data analysis, both numerical and graphical. In particular, Microsoft Excel (<http://office.microsoft.com>) proved to be the tool we need, since it has well-known capacities for data import and analysis -including Microsoft Query, pivot tables and filters (Zapawa, 2005), outstanding graphical capabilities (Aitken, 2006), scalability properties (via Add-Ins), portable file generation (XML, HTML, etc.). Perhaps its most important property is the wide variety of options that the VBA programming language (fully integrated in Excel) offers in order to perform advanced data analysis as well as to personalise, generate and distribute reports in an automatic way via the internet (Bullen, Bovey and Green, 2005; Albright, 2006). Next, we present each of the three main e-monitoring capabilities of the SAMOS system and discuss the results obtained when applying it in a real web-based collaborative learning situation.

5.2.3 Weekly reports for monitoring group and individual activity

Regarding the weekly activity reports, our interest was focused on obtaining numeric and graphical information that speeds up the classification of the different entities (groups or students) according to their level of participation in the learning activity (software project development). In addition, they allow us to easily identify and highlight those entities that were bound to maintain extremely high or extremely low activity levels (we were especially interested in the latter, since we needed to apply performance correctional policies to them). In this sense, we opted to establish three different activity levels: high, medium and low.

Besides, we considered the distribution of the random variable N_Events (number of events generated by an entity), and we classified each entity according to its position with respect to the sample distribution quartiles. That is, level one corresponds to a low-level activity (below the lower quartile or Q1), level two corresponds to a medium-level activity (between the lower and the upper quartiles), and level three corresponds to a high-level activity (above the upper quartile or Q3).

At the group aggregation level, the weekly report generated by SAMOS offers us output about group activity in three different formats, all of them based on the N_Events variable (which shows the representation possibilities of different result types that the e-LMS can offer):

- 1 A listing of all the groups sorted by the variable N_Events (number of events generated by each group up to the current week), which offers a group classification by activity level. In addition, this output also provides us with the frequencies associated with each kind of action or event; i.e. for each group, it shows the number of create-type events ($N_CreateEvent$), change-type events ($N_ChangeEvent$), move-type events ($N_MoveEvent$) and read-type events ($N_ReadEvent$) generated by the group (see Figure 3).
- 2 A graphical representation of the previous list is made by a histogram with two added bands, representing the lower and upper quartiles (that is, Q1 and Q3), respectively. Again, three activity-level areas are well defined, allowing for a visual classification of each group in one of these areas (see Figure 4).
- 3 For each group in the class, a chart shows, first, a time series representing the group historical evolution (number of events generated by the group at each week). Secondly, it shows quartile-based activity areas representing the aggregated historical evolution; i.e. for week n , $Q1(n)$ and $Q3(n)$ are represented, where $Q1(n)$ and $Q3(n)$ are the lower and upper quartiles associated with the sample distribution of the variable 'number of events generated by a group at the n th week' (see Figure 5). This chart allows us to follow the group evolution along the weeks and can be especially useful when observing if short-term policies (activated by group coordinators or tutors) are having the expected effects on the groups they have been applied to. In the sample screen below, we observe the weekly evolution of group 25, 02, 292: it has performed above $Q3(n)$ at weeks 1, 2, 4, 7, 8 and 12, and it has only performed below $Q1(n)$ at week 14.

In the case of individual students, the weekly report offers us the same type of numerical and graphical output described before (in Figures 3–5). In this way, weekly reports provide an up-to-date classification of students according to their activity level.

In addition, for each group in a class the system generates a time series chart that describes the historical evolution of each group member (see Figure 6). This graph shows the number of events generated by each of the four members of the group '25, 02, 292' at week n . From this chart, group leaders and group non-attending members (that is, students who are not cooperating enough to develop group tasks) can be easily identified and tutors can immediately activate policies aimed at preventing negative situations such as inefficient distribution of group tasks or even student abandonment.

Figure 3 Groups accumulated activity – numerical weekly report (see online version for colours)

Week 15							
Group_Id	N_CreateEvent	N_ChangeEvent	N_MoveEvent	N_ReadEvent	N_Events	P_Events	Activity
2510336	598	159	117	2653	3527	12,7%	3-High
2516274	404	72	16	2500	2992	10,8%	3-High
2516784	343	93	365	2159	2960	10,7%	3-High
2513581	416	20	128	1713	2277	8,2%	3-High
2516780	283	39	175	1617	2114	7,6%	2-Medium
2502292	320	78	80	1622	2100	7,6%	2-Medium
2513563	335	43	24	1402	1804	6,5%	2-Medium
2516788	159	28	31	1371	1589	5,7%	2-Medium
2513550	292	70	104	1108	1574	5,7%	2-Medium
2516792	196	9	31	1267	1503	5,4%	2-Medium
2510293	185	33	27	1158	1403	5,1%	2-Medium
2512520	160	37	52	1114	1363	4,9%	1-Low
2512491	238	16	44	994	1292	4,7%	1-Low
2516239	114	43	19	886	1062	3,8%	1-Low
2516796	20	0	0	191	211	0,8%	1-Low
Total	4063	740	1213	21755	27711	100%	
P_Events	15%	3%	4%	78%	100%		

Figure 4 Groups accumulated activity – chart accumulated report (see online version for colours)

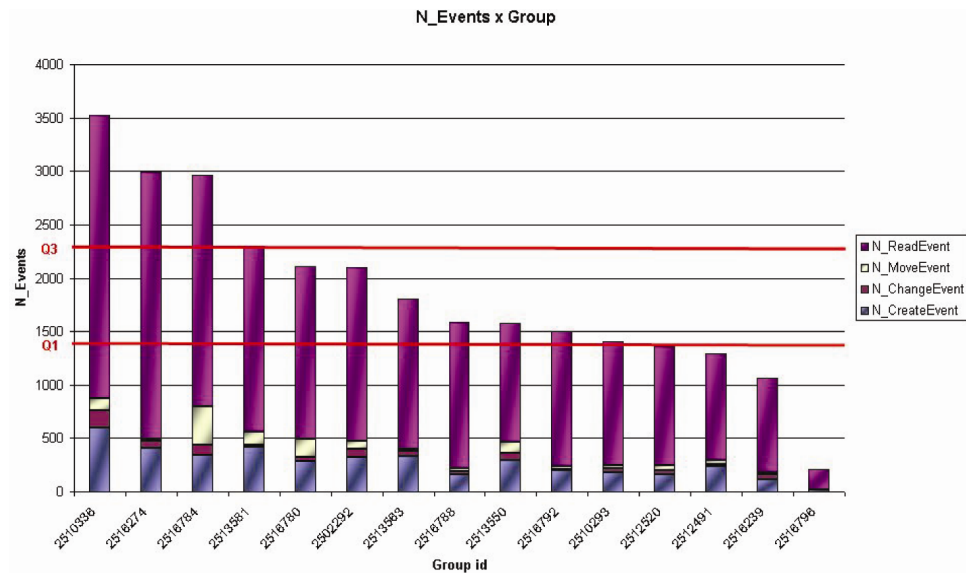


Figure 5 Individual group historical evolution vs. aggregated historical evolution (see online version for colours)

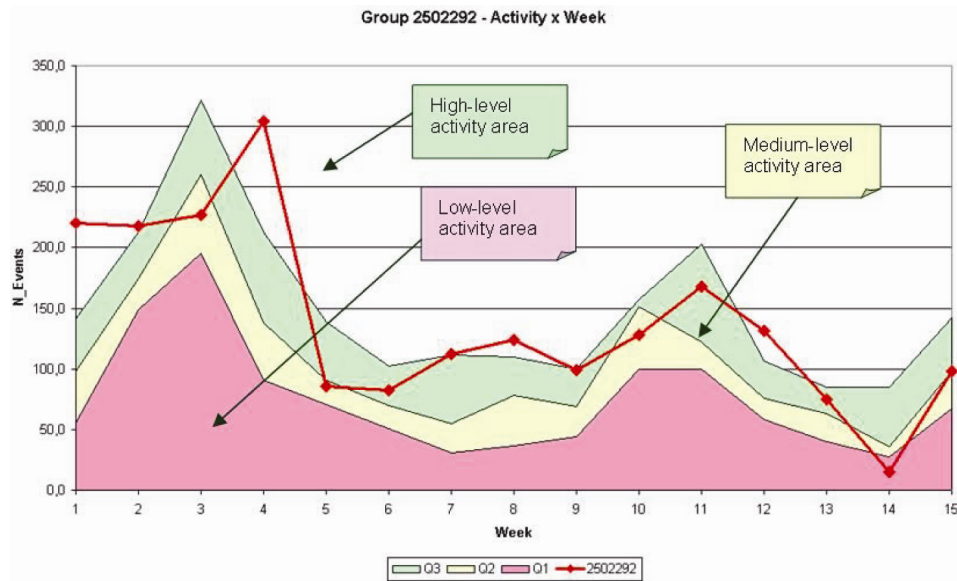
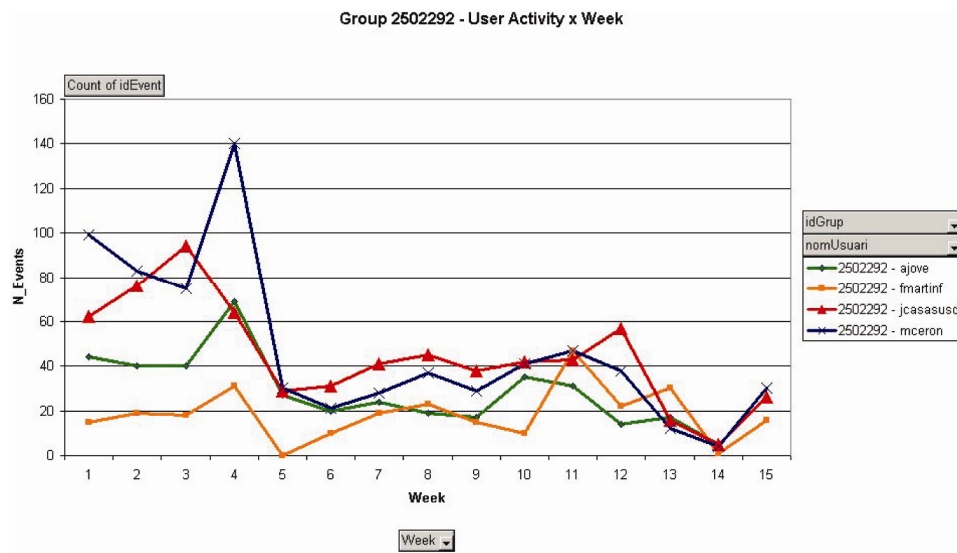


Figure 6 Historical evolution of group’s member activity (see online version for colours)



5.2.4 History information about students’ connection habits

Besides monitoring groups’ and students’ activity by means of weekly reports, we were also interested in obtaining additional information on key aspects about our students’ behaviour regarding connectivity and navigation habits. In short, we were especially interested in having some additional information about students’ activity habits.

SAMOS provides us with the average daily activity (event generation) by time interval. As we can see in the sample screen (Figure 7), there are two maximum-activity peaks, at [10:00–11:00) and [18:00–19:00). We also observed that there was almost no activity from 2 a.m.–7 a.m., and that a lot of activity occurred between 6 p.m. and 1 a.m. (that can be explained by the fact that most of UOC's students are over 25 years old and they combine professional careers with their studies). The knowledge of these activity habits can guide other group members and scholars when publishing course material, starting online debates or arranging synchronous meetings.

Figure 7 Average daily activity (event generation) by time interval (see online version for colours)

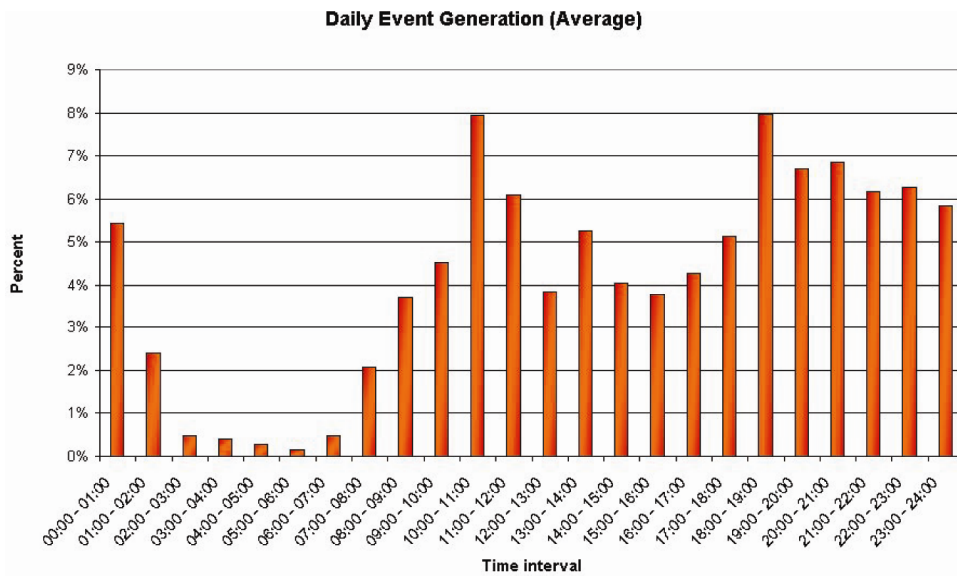
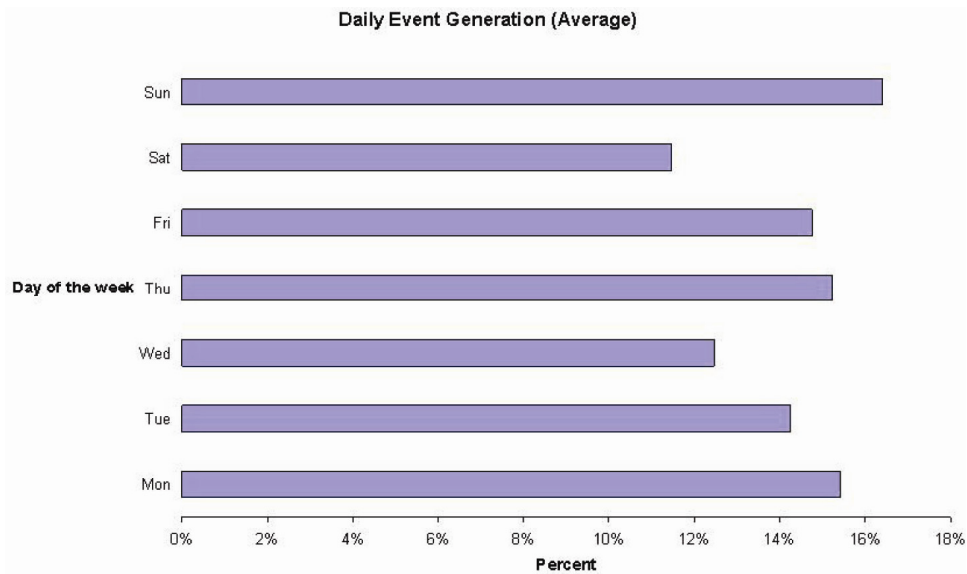


Figure 8 shows the average daily activity (event generation) per day of the week. As can be derived from the sample chart, students generate a lot of activity on Sundays, and tend to lower their activity level on Wednesdays and, especially, on Saturdays. Even so, the workload seems to be quite uniformly distributed throughout the week, which demonstrates good regular habits. The combination of this information with the previous information provided by SAMOS (daily activity by time interval) can be helpful not only when arranging synchronous meetings, but also when UOC's computer department has to plan server updates or back-up processes (both tasks should be done as transparently as possible for the intranet users).

Figure 8 Average daily activity (event generation) by day of the week (see online version for colours)



5.2.5 Summary reports about classes and course performance

Our e-LMS provides two kinds of summary reports for both tutors and course manager-professors, one at class aggregation level and the other at course aggregation level; a course comprises several classes and groups. Such reports offer information about the following variables:

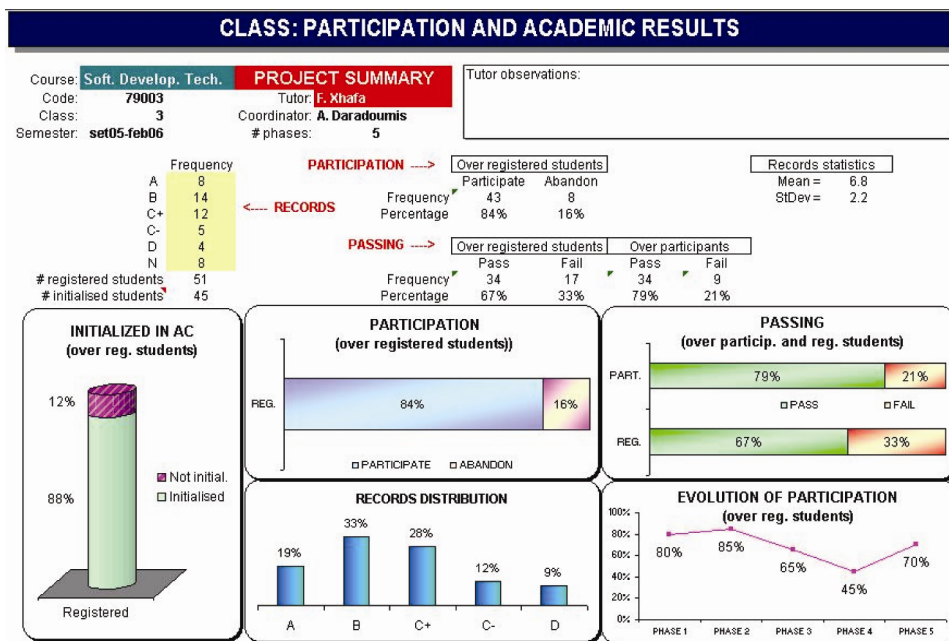
- **Initialised (timely incoming) students.** It refers to the students that start their academic activity as soon as the course begins. This information is significant, since a problem that is frequently encountered in online courses is that some students tend to start their activity with a significant delay—two or three weeks after the course has begun. Therefore, it is important to identify these students, since this delay makes their integration into the academic activity a difficult task. In fact, this late entry eventually tends to increase the abandonment rate. Obviously, a correlation exists between the initialised students rate and participation rate as well. In fact, on UOC many courses we have found a significant positive correlation (at a 0.05 significance level) between the initialised students' rate and the participation rate.
- **Student participation in the course project.** It is considered that a student participates in the course project when he/she makes active contributions—according to the assigned tasks—towards the development of the different project phases. The report shows both final participation and the evolution of participation at each phase. Our experience has shown that students with a low participation rate tend to abandon their group work and the course. In this sense, our system helps to anticipate possible abandonment situations and let both tutors and course manager-professors intervene with suitable adjustments and supporting policies in order to prevent or, at least, reduce these

abandonment cases. Moreover, the system can easily identify and highlight those project phases where students tend to encounter special difficulties, and thus require specific tutor’s support.

- Distribution of student records/marks (in frequencies and percentages). This kind of information can be useful when comparing academic results among different classes and for detecting courses with extremely high or extremely low academic results.
- Percentages of passing students (both over registered students and over participative ones). It is important to know the students’ passing rate over the entire population (registered students) of the class, as well as the passing index over the set of students who have actively worked during the project development (participative students). This index can be fundamental when trying to detect level differences among classes and even among courses with the same credit load.

For instance, in Figure 9 we show an example of a class summary report where we can easily observe the information associated with the variables we mentioned above.

Figure 9 Summary information about class participation and academic results (see online version for colours)



6 Final discussion and concluding remarks

There are several ideas that we would like to point out in this final part of the article, these being the main questions we have tackled here. We have tried to make some contribution to the general CRM framework of non-profit making organisations and, in particular, to the CRM applications used in the e-learning arena.

We are all aware of what CRM is. We find lots of academic papers that offer their vision of this management model during the last decade. Most of them could be aggregated into a small set of perspectives (i.e. CRM as a process, strategy, philosophy, etc.). However, no matter what the perspective is, it is reasonable to agree with the essential purpose of any CRM perspective: a process for managing the relationships with the firm's customers that, based on the application of capabilities for knowledge generation, aims to maximise the value offered to every one of them.

In this article, we have highlighted the importance of amplifying the scope of CRM application, from the more restrictive arena of businesses to the non-profit making organisations. Consequently, the concept of 'customer' must not be constrained by the business context, but it has to be open to the non-profit making context. Specifically, we have focused on analysing the potential that CRM has to be applied in e-learning domains. In this respect, higher educational institutions are advised to make use of CRM systems in order to better know their 'customers' (i.e. the students) and address specific actions, with dynamicity, to improve the value provided to every one of them, so to increase the students' performance. Besides, we defend the use of CRM systems in this context, not only to maximise the value offered by the e-learning institution to the students – thus focused on managing the institution-student relationships – but also to favour collaborative relationships with and among scholars' and students' working groups. In other words, we point out that it is interesting to apply CRM in the e-learning contexts by broadening its focus from customer/student to a group of primary stakeholders compounded by the students and scholars of the institution.

One of the key questions that should be considered in any CRM process aiming to obtain successful results is that of monitoring and evaluating the customers' performance in order to know the right ways to address, if necessary, accurate actions to improve it. This is especially interesting when CRM is applied to the e-learning domain. The main contribution of this article is the development of an e-CRM application, called SAMOS, which facilitates the automatic generation of monitoring reports derived from data contained in the e-learning environment log files and databases. We have presented its main constituent elements, as well as an illustration of how it performs.

In particular, SAMOS provides scholars and students with relevant information about students' academic activity and performance inside the e-learning environment at different aggregated levels. On the one hand, students are able to use monitoring reports to know the state of their group activity, to scaffold their colleagues, to adopt policies and take decisions regarding future work. On the other hand, monitoring reports are used by educators to track the learners' online behaviour and group activity at specific milestones, gather feedback from the learners and scaffold groups with a low degree of activity, intervening whenever necessary. Finally, these reports also allow course manager-professors to specify the main criteria to analyse and assess course effectiveness. All these questions are very necessary to improve the value offered by the institution to their primary stakeholders.

Both the SAMOS system and the automation of information generation have gone through an in-depth evaluation and verification process by all the agents (students and scholars, in our case tutors and course manager-professors) involved in the learning process. This has not only proved its effectiveness and usefulness in all cases but it also constitutes a significant contribution to the enhancement of the functionality of e-learning environments by adding a new role – e-monitoring.

Likewise, it would also be interesting to relate the gathered information by SAMOS on the students' behaviour to their socio-demographic profiles (e.g. gender, age, occupation, etc.), taking advantage of the information they provided when applied to the University. Thus, it could test whether or not the socio-demographic (variables) profile determines their connection habits when a student. This information should be of considerable help to scholars in order to be able to develop customised supervision of every one of their students.

Moreover, the model presented here can be easily tailored to the necessities of other e-learning environments, universities and other higher education institutions that desire to manage adequately their relationships with and among students and scholars.

Finally, our future research aims at using monitoring reports in order to offer adaptation to the university online courses in two senses:

- 1 the educational material that is most suitable for the needs of each particular student or group
- 2 the educational goals to be attained.

So, it will be plausible to adapt the learning design to the changing characteristics of the learning teams; e.g. a team has to slow down its activity during some project phases due to the time restrictions of its members. This will allow students to gain some flexibility while pursuing the learning goals of a particular subject, without affecting the main scope and quality of the course.

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