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Analysis of three different models used to acquire three e-learning solutions at the same university

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Key words: *e-learning, electronic assessment, learning management system, e-portfolio, development of systems, proprietary commercial system, home-grown custom system*

Abstract:

The Universtiy of Pretoria has been using an electronic assessment system since 1991 and a learning management system (LMS) since 1998. Both systems required urgent upgrading. In 2003 a further need arose in the Faculty of Health Sciences, for an electronic portfolio system. The Department for Education Innovation has thus implemented three new systems during the past three years: a new electronic assessment system, an upgraded LMS, and an electronic portfolio system. This paper analyzes the advantages and challenges experienced in each of the three different implementation models adopted. Recommendations are suggested, not as guidelines for information technology specialists, but rather for other individuals who are responsible for, or may consider acquiring, a new e-learning system.

1   Introduction

The University of Pretoria (UP) is a residential university in South Africa with more than 50 000 students. The university follows a blended learning approach, in which contact sessions are combined with e-learning solutions, according to the needs of each particular module and its participants. The Department for Education Innovation (EI) is responsible *inter alia* for establishing the necessary e-learning software platforms and training academic staff members to use them in pedagogically sound ways. The department has a close working relationship with the Information Technology Services (ITS) department, which is in charge of setting up the necessary infrastructure and is responsible for the integration of different computer systems on campus.

Due to the fact that the specifications for only one of the three required systems could be met by means of a proprietary commercial system (namely the LMS), the other two systems had to be developed according to the specific needs of the university. Both these customized systems were developed by external software developers according to the specifications of the future internal users thereof. The electronic assessment system was developed as a closed-source proprietary product according to the specifications of the university, but remaining the property of the vendor. On the other hand, the vendor responsible for the development of the electronic portfolio system has no ownership of the product, which means that the system is the property of the university.

This paper reports on the experiences with each of these three implementation models. The advantages and challenges experienced with each model, as well as

recommendations to consider when adopting each option, are presented. The discussion focuses on intellectual property rights, user testing, license issues, post-development support and maintenance, financial concerns, integration with other university systems, further development of the systems and sustainability.

2   Need for new systems

This section presents the background and the need for each of the three systems. The details of the three different models finally adopted are presented in the following section.

2.1   *Computer-based testing*

The university has used an electronic assessment system since 1991 (Le Roux, 1999) to administer electronic objective type questions as one component of the assessment strategy of many courses. The number of tests conducted has grown from 37 000 in 1992 to 160 000 in 2006. UP initially used a programme called Question Mark (DOS version), which was later replaced with Question Mark Designer (Windows version 3.20).

In 2005 the latter programme was still being used successfully, but it was no longer compatible with the latest network structures and operating systems. The natural course of action would have been to upgrade to the web-based version of this programme, but in 2005 this version did not adhere to all the requirements of the university.

The e-assessment team within EI undertook a thorough investigation and comparison of different electronic testing systems used internationally to find a sound, reliable and comprehensive system to satisfy all the needs of the users. In order to do a comparative evaluation of the different testing systems available, a comprehensive criteria list, based on literature and the users' needs, was compiled. A system that adhered to these criteria would be a 'perfect system' for this institution.   The criteria included technical, question management, test management and implementation categories (Pretorius, Mostert, & De Bruyn, 2007).

After this careful investigation, the e-assessment team realised that none of the numerous systems evaluated complied with **all** the criteria identified. This was in line with results reported by Mackenzie (2003:185) who found no assessment system available at the time that "delivers all the features that are likely to be required by tutors wishing to deliver assessments online".

Among the criteria that led to systems' failure to comply, the most important were poor support of the system in South Africa, inadequate variety of question types, limited feedback provided to students on questions and restricted or inadequate reporting functions. The three systems that best met the criteria were identified and evaluated on an official trial basis. Although none of the three systems fully met all the criteria, one South African based developer situated in the same city as the university, was willing to modify their system, that was still in development at the time, to match UP's criteria, which included an extensive reporting function.

2.2 Learning management system

UP has successfully used a proprietary commercial system, WebCT Campus Edition (CE) as its learning management system (LMS) since 1998. Starting with 252 modules and 1 277 students with access to WebCT in 1999, the use of the system grew to 1700 modules and 26 000 students with access to courses on WebCT in July 2004. E-learning was embedded into the teaching methodologies of many courses within the institution to such an extent that the LMS became mission critical. However, the increasing instability of the system made it clear that WebCT CE was not scalable or robust enough to accommodate the growing use and demands of users. This led to an investigation by EI and ITS to explore various options for a more stable and robust LMS. Table 1 provides a list of possible solutions and the aspects which were considered during the investigation conducted in 2004.

Table 1: List of LMS solutions and the aspects which were considered (Le Roux, 2004)

LMS Solution	Aspects considered

1. Use WebCT CE for another two years (by which time Open Source solutions might be more mature and viable)	• Architecture and scalability:
	  o WebCT CE does not fit UP architecture and cannot be integrated into current and new systems.
	  o Flat file structure does not accommodate exponential growth of use of WebCT.
	  o WebCT CE cannot scale across servers.
	• Security:
	  o No audit trails available of who was responsible for changed marks.
	  o Student assistants could gain access to marks.
	• Functionality:
	  o Champions on campus request functionalities that cannot be met by WebCT CE, since it is not an open system.

2. Move to Blackboard	Reaction from South African distributors led to the conviction that Blackboard (at that time) had not yet been deployed at any institution in SA and was not supported locally.
3. Use an open source solution	• Open source can suffer from a lack of interoperability due to the fact that open source does not necessarily mean that open standards have been used. • UP cannot provide sufficient support to implement and develop an immature product as an enterprise system. • The impact on academic staff members and students using the current system will necessitate an elaborate change management strategy.

4. Implement a locally developed system	• There are a number South African developed LMSs available:
	  o Varsite (University of the North West)
	  o KEWL (Open Source development of University of the Western Cape and the

LMS Solution	Aspects considered
	University of South Africa) o Construct (Member of Riverbend Group of companies, eDegree, Learning Strategies and Learning Advantage) o None of these are market leaders. UP is seen as the leader in e-learning in SA, one of the reasons being that it uses an LMS-leader in the world.
5. Migrate to WebCT Vista	• Architecture fully extensible and based on industry open standards: o Standards-based architecture that includes Sun Microsystems' Enterprise Java Bean technology, fully compliant with Java 2 Platform Enterprise Edition (J2EE) and uses an Oracle 9i database. o Standard API's allow for seamless integration with other campus technologies, such as portals, Student Online Services, library systems and financial systems. Also supports LDAP and Kerberos authentication that allows for single sign-on to the e-learning environment. o The Enterprise Integration Framework saves labour costs when transferring student data, and improves user services. o Software Development Kit allows for incorporation of external e-learning content and tools and integration with other campus systems. • Security o Comprehensive role-based access to content. o Grade book auditing captures user, time and date information for all changes made. • Configuration o Centralized implementation with local control: multiple institutions are supported by a single installation, each entity operates autonomously. o Multiple autonomous educational entities are possible. • Functionality o Student information tracking across courses o Gradable discussions o Streamlined groups management

2.3 Electronic Student Academic Portfolio (e-SAP)

The School of Medicine in the Faculty of Health Sciences follows an integrated, problem-orientated, community-based curriculum that is presented in blocks of time. The involvement in the community results in students being distributed across hospitals in the Gauteng and Mpumalanga provinces. Most of the elements within the

blocks result in grades, but certain aspects of the curriculum, such as the 'golden threads' are problematic to assess throughout the curriculum. These golden threads are themes that are woven into the rest of the curriculum and address topics such as professional communication, bio-ethics, teamwork, problem-solving and critical thinking. Other elements of the curriculum resulted in large quantities of assignments which accumulated in offices and storerooms. In 2003 the school decided to implement an electronic portfolio system that could capture the assessment of these elements to obtain a profile of a student's progress throughout their 6-year study programme.

The envisaged e-portfolio system (e-SAP) was required to comply with various specifications: It should be able to create a collection of compulsory, curriculum-associated activities for which no tests or exams are scheduled. Each medical student should have a personal profile within the system that is accessible by means of their student number. These profiles may only be accessed by authorised staff members. The system should allow for the creation and population of groups, submission of assignments, online assessment of these assignments with the use of rubrics, and the online publication of the results of these assessments. The aim of the e-SAP system was to create a learning history for each medical student to display their professional growth.

WebCT Campus Edition could not accommodate these needs in 2003 as the student data within courses in the LMS were 'cleaned out' after each semester or year, in order to allow the next group of students to use the course. The use of rubrics for assessment and the automatic integration of the marks into the grade book were also not possible.

No other system could be found that would comply with all the specifications and needs set out by the school. It was therefore decided to develop a customized, 'home-grown', web-based system to accommodate their needs.

3   Model for acquiring each system

Di Mayo (2007) provides criteria for governments to use when sourcing software. These criteria include the peculiarity of requirements, peculiarity of the operating system platform, product market maturity, service market maturity, sourcing attitude of the IT department, availability of skills from the IT department and trusted external service providers, potential for cooperation, and risks involved. Di Mayo (2007) recommends the selection of a commercial or open source solution if the such a solution satisfies the requirements of the majority of the users. If unique requirements exist, it is better to develop a custom-built solution.

3.1   Computer-based testing

Based on the evaluation report of the different CBT (computer-based testing) systems available at the time, the university contracted the developer who was willing to tailor their e-assessment system to meet UP's criteria. The developer was willing to give a low quotation for the development of the system due to the fact that the university would provide expert input into the development in the system. The electronic assessment system was developed as a ***closed-source proprietary product*** as the property of the vendor, but according to the specifications of the University of Pretoria.

3.2 Learning management system

After weighing all the options listed in Table 1, the final decision was made to upgrade to the *proprietary commercial system* WebCT Vista and to deploy it across the university in 2005/2006, as it addresses all the requirements of the institution. The university decided to purchase the WebCT Vista three year Annual Subscription License with an annual maintenance contract with Premium Support (24/7). The license and price are based on tiers of student full time equivalent enrolment for the entire institution. The license provides for usage of the system by all UP students, faculty, administrators and other employees whose responsibilities require access.

3.3 Electronic Student Academic Portfolio (e-SAP)

The University of Pretoria decided to *develop* the e-SAP *system in-house* with the help of a trusted outside programming company. The development was a team effort which involved the following core groups:
* The Faculty of Health Sciences as the client;
* EI who provided expertise with regard to educational aspects and the use of technology in education;
* IT which was responsible for the project management, system integration, development and maintenance;
* An outside developer employed by IT who provided the programming expertise.

The developer had no ownership of the product and the system remained the property of the University of Pretoria. Funds for the project were provided by the university.

4 Advantages and disadvantages of each model

4.1 Closed-source proprietary model

The *closed-source proprietary* model adopted for the development of the e-assessment system, with an outside developer guided by CBT experts at the University, yielded the following advantages:

* Both parties benefited from the collaboration:
    o The developer benefited due to the expert input from the university, guiding them in developing a testing system that they could sell nationally and internationally to educational and corporate institutions.
    o UP benefited as the users could implement their 'perfect system' based on research, good practice and the needs of the lecturers.
    o UP paid a reduced development cost due to our expert input into the product.
* The development took into account information technology structures, security measures and administrative structures of the University of Pretoria.
* The fact that both parties are in the same city enabled communication and close collaboration during the development and testing phases.
* The close proximity also ensured a fast response time for changes, problem-solving and support.

The following challenges presented themselves as the development and implementation progressed:

- The scope of the project was misjudged by both parties.
- In some instances the developer expected UP to accept lesser features, due to the fact that the institution paid such a low development price.
- The close collaboration sometimes resulted in high conflict.
- Dependency on a relatively small firm with only one or two programmers to work on such an extensive project caused a setback when the first programmer resigned from the development company.
- Loss of intellectual property rights by the University of Pretoria has implications for future development and marketing, as only a small referral fee will be paid to the institution.
- The university is still required to pay license and maintenance fees.

4.2   Proprietary commercial system

By buying a **proprietary commercial system,** UP enjoyed the following advantages:

- The vendor is a large international company with a professional approach.
- A detailed project plan for implementation was developed in collaboration with WebCT management.
- Professional expertise with the implementation was provided to assist UP's IT staff.
- Although the implementation necessitated IT support, the system was not dependent on limited IT capacity for development.
- It was not necessary to have a strong development team, as development is done by the international company responsible for the system.
- The Premium Support contract bought by UP promised excellent support available 24/7.
- Trust in the product was already established as UP had been using it for many years. This contributed to the successful implementation of change management and training strategies.

The following challenges were experienced with the acquisition of the proprietary commercial system:

- Additional hardware had to be acquired at a high cost.
- The license and maintenance fees are high, especially as the currency of South Africa does not have a strong exchange rate against the US dollar.
- Extra costs were incurred as a database administrator had to be employed.
- UP is dependent on the international community for further development of the system. Although requests can be made to the company for future enhancements, the decision with regard to the implementation of these functionalities remains the choice of the vendor.
- UP is vulnerable to the strategy and vision of the company as mergers may occur at any moment. The merger of WebCT and Blackboard was announced just weeks after the institution acquired the new Vista 4 product. The merger had a large impact on the implementation of the system, as the support promised did not live up to expectations.

- The educational approach / terminology of the system may not comply with the educational approach / terminology used within the institution or in different countries.
- The use of a Java applet to provide certain functionalities within the system placed much higher demands on the infrastructure, especially the bandwidth of the institution.

4.3 In-house developed system

The development of an *in-house developed* (home-grown) system proved to have the following advantages:

- The needs of the users were addressed in detail.
- The development took into account information technology structures, security measures and administrative structures of the University of Pretoria.
- The intellectual property rights of the University of Pretoria are protected.
- The payment of license fees is not necessary.
- The development and use thereof stimulated thinking about new ways of assessment, which led to the emergence of innovative ideas.

The development of the e-SAP system was challenged by the following factors:

- It proved difficult to explain the nature of such development to 'novice' users of technology.
- It was difficult to align the IT and educational perspectives.
- The scope of the project was misjudged by both parties, as many needs had to be accommodated in one system.
- Regular new requirements from users after the first implementation resulted in high financial expenditure as every small change requested had financial implications.
- The elaborate business rules of the system complicated the implementation of changes and resulted in many hours of extensive testing of the whole system every time the changes needed to be deployed.
- The intense work load of the end-user testing group (faculty members) limited the scope for and actual testing of the system.
- It was not easy to maintain the interest and buy-in from faculty members who were not involved in the development of the product.
- Three programmers were initially allocated to the project by the development company. One of them resigned during the early stages of development, and the others emigrated near the end of phase 2.
- Maintenance of the system and further development of the system will incur very high costs.
- The bandwidth available in South Africa proved to be such a big obstacle to the upload and assessment of assignments, that some academic staff moved away from using the system.

5 Recommendations

Although there are numerous aspects to consider when deciding on the most appropriate e-learning system to implement, this paper summarizes only those which we have learned from our experience. These are not meant as guidelines for

information technology specialists, but rather other individuals who are responsible for, or may consider acquiring, a new e-learning system.

One of the most important factors in either acquiring a proprietary commercial system or an open source system, or in creating a custom-built system is the availability of skills, both in the institution and the outside vendor/service provider. This proved to be a key element to the success or failure of all three systems implemented by the University of Pretoria. This concurs with Di Mayo (2007) who advises that technical skills, as well as skills for development, integration and project management should be available. A strong and dedicated IT support structure is vital in assuring both the successful implementation and maintenance of any computer system.

In addition to the availability of enough people with the necessary skills to conduct the development, it is also important that trusting relationships be established between the different parties.

Custom-built systems

Consultation with a large number of the most appropriate key stakeholders at the most appropriate time is of the utmost importance in determining the scope of any custom-built system. If this is not managed meticulously, it will result in many changes that need to be implemented to the system at a later stage, usually at high cost. It may even result in changes being implemented which were requested by individuals, whose needs do not necessarily reflect those of the broader community.

It is important to determine the possible risks that may influence the development and/or implementation of any product. Di Mayo (2007) warns that with all approaches one should attend to the specific technical, organizational, security and legal risks of the product.

The broader information technology environment (outside the institution where the system will be implemented) must be considered carefully. The external infrastructure, for example the way end-user computers are set up, may negatively influence the performance of the system. The frustration users experience with these uncontrollable elements may result in the non-use of the product.

Another very important technical aspect that has to be determined from the outset of a custom-made product is how and by whom the system will be maintained and upgraded. The experience with the e-SAP system is a painful reminder of this fact – it incurred high maintenance costs to the extent that it eventually reached a point at which it could no longer be upgraded in a cost-effective manner.

Decisions with regard to the intellectual property of any system must be determined early in any negotiations. The financial advantage of having the intellectual property must be carefully considered. Our experience revealed that if an outside developer holds the rights to a system, which they may sell a later stage, they will be much more dedicated to the development of the system than if they do not have ownership of the final product.

A system should avoid complicated business rules as far as possible. The restrictions built into a system may confine the use of the system by users if they cannot apply it

as they may wish or need to. During a discussion after the development of the e-SAP system, the developer offered his opinion that one should start out with a simpler system to which new functionalities could be added, rather than starting out with a very elaborate system that delays implementation. Such a strategy would ease the testing demands on staff members, as they would not need to re-test intricate interconnected functionalities time and again.

Proprietary commercial systems

Di Mayo (2007) advises that a commercial or open source system may be a more reasonable choice if the majority of user needs may be met by one system. It is imperative that all costs be kept in mind. There may be additional cost implications with regard to hardware, software and availability of skills within the organization, in addition to license and maintenance fees.

The experience of higher loads on the infrastructure, especially the bandwidth, brought about by the implementation of WebCT Vista 4, is in accordance with Di Mayo's (2007) statement that "subsequent versions of a commercial software product tend to place increasing requirements on the hardware platform".

Di Mayo (2007) further cautions about the possibility of 'vendor lock-in' by both "large powerhouse vendors" and small local vendors "that behave like a de facto monopolist". This warning must be carefully considered when taking decisions about the type of license one intends to acquire for a commercial system. The experience with the development of the electronic assessment system, in which the developer tried to manipulate the University of Pretoria, illustrates this point practically. The unfortunate truth from our experience is that vendor lock-in will occur in all the models − only just to a different degree.

The choice of the correct system or model to implement always involves some risks. Every model has its advantages and challenges which should be carefully considered when making a decision of this nature. The University of Pretoria has become one of the largest institutions in Africa and in South Africa to provide e-learning solutions to students and lecturers. Other universities in the developing world may benefit in the future when selecting a systems implementation model for various components of e-learning, by learning from the challenges we had to overcome. Experience at the University of Pretoria has proved that, whatever model is selected, no matter how much meticulous planning is done beforehand, there always seems to be some unique and unexpected surprises and variables which will influence the outcome.

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