E-learning System with Seamless Integration to SMS

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Abstract
This paper introduced an E-learning system which was developed with Microsoft .NET platform. This system was seamlessly integrated with the internal Student Management System. It offered efficient support for online learning as well as the academic administration, such as uploading and sharing e-resources, online class management, monitoring attendance, checking the latest achievement, online submission of assignment, Turnitin integration for plagiarism control, emailing, discussion board, and online chat, etc. The seamless integration with the SMS offered remarkable features which might be hard to see from other commercial solutions.

This E-learning system was conducted as applied research of IT program team. It is very practical and cost-effective, fully scalable and customizable. It could be further enhanced upon business needs.

Keywords
E-learning, SMS, .NET platform, seamless integration

Introduction
As one of the PTEs in New Zealand, we have been offering multi-programmes ranging from English Language Study, Certificate, and Diploma to Bachelor degree and MBA programmes mainly for international students.

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For the last a few years, there has been the increasing need of a suitable E-learning system to support our teaching and learning. We once tried some third party systems or free E-learning portal, but they could only offer very limited facilities and couldn't meet our needs.

We surveyed and compared some real solutions which have been widely used in Universities and Polytechnics and found that all commercial solutions have rich functions and very user-friendly interfaces; some functions are offered but might not be frequently used by most users; they could be integrated with the internal LMS (Learning Management System) at certain level but with seam in term of real time update / synchronization or the sharing of key data; They are very scalable, extendable and flexible but less customizable in terms of user's special request. We also notice that some universities and polytechnics have tried several different E-learning platforms in the past.

Upon the market survey and review of our business needs, we found that:

- Our business was unlikely to purchase expensive commercial product for E-learning support purpose;
- A real practical solution but not a luxury one is what we expected;
- An E-learning system with seamless integration with our SMS (Student Management System) could offer the best facilities and meet our special needs.
- The best way to achieve this is to develop an E-learning system according to our business needs.

The project team was setup in Sep 2009 for this purpose. The project manager was also the SMS project manager who worked on the SMS development for couple of years and had the best knowledge about the SMS structure and all related techniques. The whole IT Programme staffs appreciated this opportunity of applied research, and shared all valuable ideas and participated actively in the whole life cycle of this project. Two talent GDIT interns worked on the development of the system with strong ambition and full commitment.

The intensive development work was finished by the end of Dec 2009. The E-learning system had its trial run in IT Programmes in Semester 1 2010. It was adjusted upon users' feedback and recommended to other programmes in Semester 2 2010. It has been widely used across all the programmes since Semester 3 2010. Now it is offering normal service for all students and teaching staff on daily basis.

Existing Systems

The SMS has been the student management system for the last 5 years. It is a windows based application and runs on the local business network. SMS was originally from AU, but in-house customized to meet our business needs. It manages all students' personal information, academic activity, attendance, course enrolment, all finance transactions, accommodation, and reporting, etc. SMS has a key built-in facility call TDD (trust draw down) which copes with the NZQA's student fee

protection policy. SMS also generates relevant reports to support finance management package.

CEE (Course E-Enrolment) is another simple web application built upon SMS database and working with SMS together which allows students to enroll their courses in the beginning of each semester via internet. It was developed with Microsoft .NET 1.1 platform.

Approaches

System architecture

The E-learning system was designed with serious consideration on system security, stability, reliability, functionalities and performances. It was built with the advanced multi-tier web application architecture illustrated in figure 1.

Database design

The existing SMS has a comprehensive structure with over 200 related tables and over 300 stored procedures. It was further extended to support the new development of the E-learning system.

To minimize the potential influence on SMS' performance and stability, we reviewed the SMS database structure in detail with limited extension. Another E-learning database was created for the new developed system.

We observed a constant increasing of the E-learning database size – it has reached nearly 4GB in just over one year's running, which is mainly because of the huge upload of teaching material and student's online submission of assignments. On the other hand, the SMS database is still at about 600MB with 5 years data. Without the separation, the rapid growing of the DB size might affect the performance of the SMS.

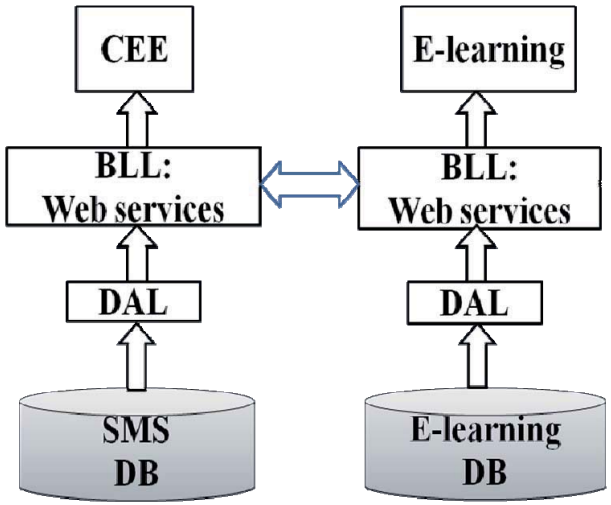

Figure 1: E-learning system multi-tier architecture

The E-learning database size will not always increase at such a high speed. The massive data upload only happens in the early stage; and most of the teaching material could be reused in the future and they don't need to be reloaded again into the database.

The database extension of SMS to E-learning is illustrated in the figure 2.

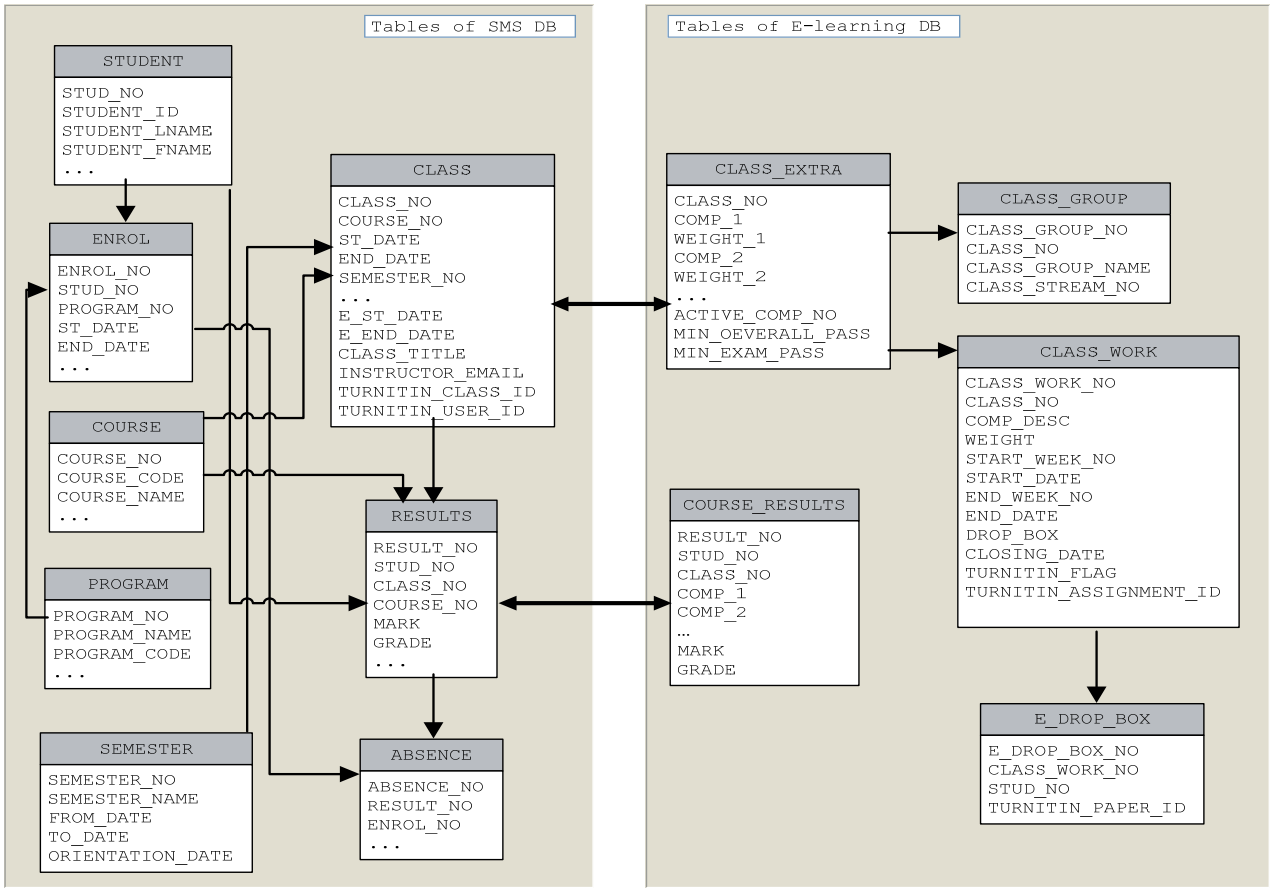

Figure 2: Database extension of SMS to E-learning. The left panel shows the partial structure of SMS database, the right panel shows the one for E-learning database. **Class** is an existing table in SMS database; it is extended with several new columns (E_ST_DATE, E_END_DATE, CLASS_TITLE, INSTRUCTOR_EMAIL, TURNITIN_CLASS_ID, and TURNITIN_USER_ID). In E-learning database, **CLASS_EXTRA** and **COURSE_RESULTS** further extended **CLASS** and **RESULTS** respectively. E-learning database also has several other tables but not listed here.

DLL and BLL

As figure 1 illustrated, all data access from web application to database is via DAL (Data Access Layer) and BLL (Business Logic Layer, the web services). The communication between the two databases is also via the same channel. This guarantees the system has a centralized logic control and all data access is with permission and authentication.

The separation of the database added some extra difficulties for the system development as its facilities actually relies on both SMS and E-learning databases. It was implemented by using the DAL - BLL access mechanism. It is transparent to all end users. The performance is guaranteed by a careful design of the structure.

Lots of stored procedures were built in the two databases which were further called by DAL and BLL to provide various facilities.

Development platform

Microsoft .NET framework - The E-learning system was developed with Microsoft .NET 2.0. The existing CEE system was also upgraded from .NET 1.1 to .NET 2.0.

LLBLGEN - We used another third party tool called LLBLGEN to generate the required DAL. The licensed LLBLGEN which we have could only support up to .NET 2.0, which is why we couldn't use the latest .NET 3.5 for the development work at that time.

DEVEXPRESS - We also used Devexpress in web interface design. It provided lots of web controls which simplified the user interface design. It enabled us to build user friendly web application in the similar way as in windows applications.

Firebird is the database engine used in our system, which is an open source database but with superior performance.

Screenshot of the E-learning system

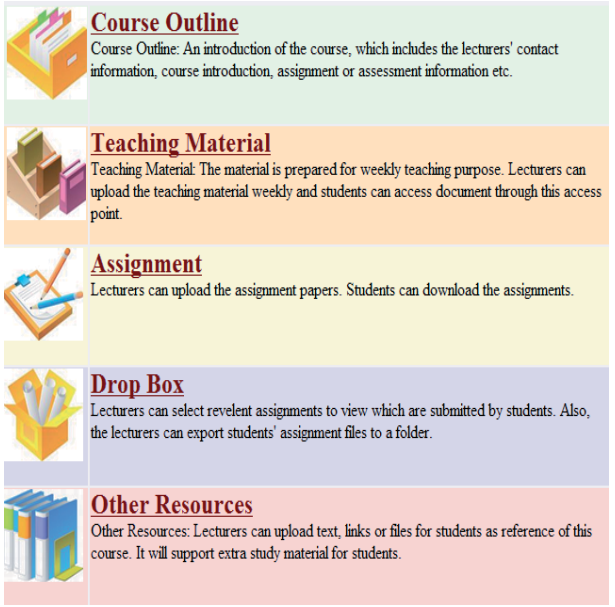

Figure 3: Course document categories. Each lecturer could upload course outline, (weekly) teaching material, assignment or other resources for student to access. Student could submit their assignment in e-drop box if instructed.

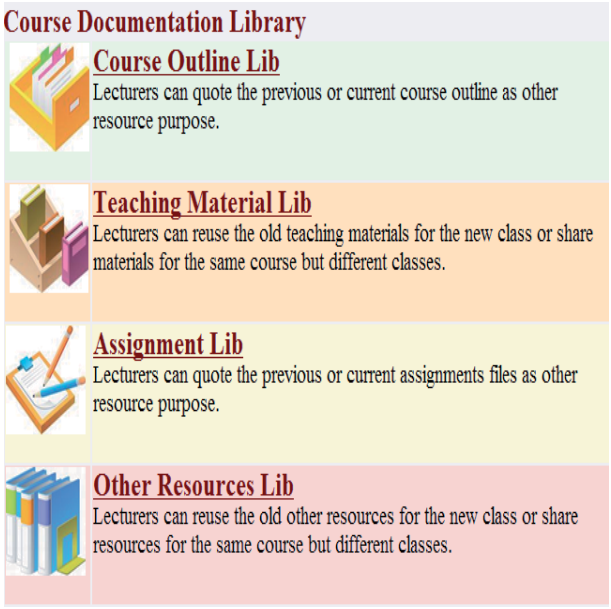

Figure 4: Course documentation library. Lecturer could access all existing e-material in the E-learning system for the same course and relist them as support resources if appropriate.

Figure 5: Course setting. On acceptance of the teaching work, the lecturer could setup the coursework and assessment methodology. Lecturer could choose to use e-drop box and request the E-learning system to access Turnitin to generate report for student's submission (for plagiarism control purpose).

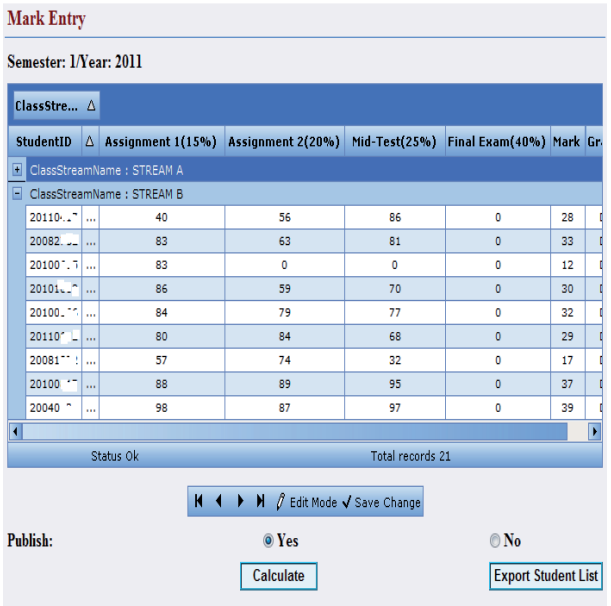

Figure 6: Mark entry. The lecturer could use this worksheet-like interface to enter course work / final exam results for the whole class. The E-learning could then calculate the overall marks and map to the grade accordingly. After the calculation, another button will be available for data import into SMS. This control is provided from DEVEXPRESS.

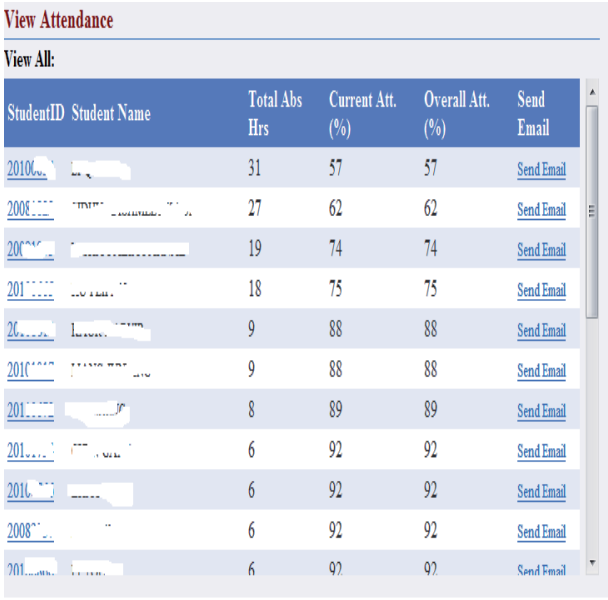

Figure 7: Attendance. Each lecturer could monitor the class attendance and send attendance warning letter to individual student by a simple click. The email will be sent to both the student's institute email box and personal email box and cc the programme admin staff automatically.

Achievements

This E-learning system was seamlessly integrated with the internal SMS and has been providing the following services for teaching staff, students as well as admin staff.

Authentication – All students use their unique ESSID (E-Student Service ID, integrated in Active Directory) to login to the E-learning system as well as their

institute email box. All staff use SMS account to access both SMS and the E-learning system.

Personal portal – On successful login, the E-learning will identify each user, grant access privilege and display personal portal with all accessible facilities. For example, each lecturer will be able to access his / her teaching courses, update teaching stuff and manages the classes; student will be able to access course materials which he / she enrolled for and meet his / her classmates in online chat room for any discussion.

Teaching stuff management - On allocation of teaching work, the teaching staff could setup the course in detail, including assessment methodology, course work, and weightings for each course work. They could also evaluate all the historical teaching stuffs in the E-learning system of the same course, select them for reuse if they are still relevant, rather than upload them again into the system.

Class roll - On the approval of student's course enrolment, the student name automatically appears on the class student list and he /she could access all relevant course materials allocated by the lecturer.

Drop box – Students could submit their assignments via the e-drop box. Upon lecturer's setting, the e-system will access the Turnitin site and generate individual report for each student's submission, which is a great tool for plagiarism control.

Discussion board - The lecturer could setup any relevant topic on the discussion board and all students in the class could join the discussion.

Online chat - All the students and the lecturer of any specific course could join online chat (class based virtual chat room).

Announcement - There are three different levels of announcements – the course lecturer could post announcement for his / her class students; the program admin could post announcement for all students in the same programme; the institute admin could post announcement for all students.

Evidence of achievements – Students' course work results are recorded in the E-learning system. All students could check their individual achievement and manage their progress during the study period to achieve their goal in the course end.

Course final results – The E-learning system will calculate all students' overall marks and grades in the end of the course according to the standard grading system. The results could be automatically imported into SMS for further process. Formal documents will be generated and submitted to Academic Board Meeting for review and approval.

This auto calculation and import dramatically reduced each lecturer's work load in the end of each semester. It also minimized the manual mistakes which could occur during the final result preparation.

With formal approval by Academic Board, each student could view their final achievement of each course and enroll new course(s) for next semester.

Attendance management - With weekly attendance data entry, the lecturer or admin staff could easily

monitor each student's attendance and send warning letter via email to any students with attendance issue.

Emailing – There is the emailing facility in the E-learning system. Students could email their classmates, the lecturer could email his / her class students, and admin could email the lecturers or any class students. Emails for students are sent to both their institute email box and their personal email box.

Each student has one individual institute email account during their study period with our institute. But we noticed from years of practice that students access their personal email boxes regularly. They only check the institute email boxes occasionally and could miss some important messages or announcements from the institute if we only send email to their institute email boxes. So in our E-learning system, all emails are sent to both their personal and institute email boxes.

Further work

Media support – Teaching class will be streamed and uploaded to the E-learning system for students to review or catch-up purpose.

Further enhancement – The E-learning system will be further enhanced with new facilities upon user's requirements. We will appreciate any valuable comment and suggestions and continue with further development.

Conclusions and Recommendations

The seamless integration of the E-learning system with SMS brings great benefits for daily teaching and learning activity and management work.

The in-house developed E-learning system is proved cost-effective, fully customizable, scalable, and extendable.

This applied research from IT academic staff team paved the way for the further development of our business in terms of sharing online resources to support the off-campus teaching and learning activity and overseas business partners.

Considering the existing resources of experienced IT staff and good IT interns, developing the practical IT solution for business needs might be one of the options for other education providers.

Acknowledgements

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IT Programme team actively participated in the system requirement analysis and scope clarification. They also offered valuable feedback in trial run period.

Wei Cui, Jianhui Chen and Vivian Sun are the main developers of the system. Gurpreet Singh also contributed to some module development work.

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