Design and Development of a Medical School Curriculum Management System

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ABSTRACT
The objective of this research is to design and develop an online curriculum management system for medical schools. This involves relational database design as well as user process flow design. These two design charts were developed with careful consideration of user requirements. The Entity Relationship Diagram included several related tables: Courses, Sessions, Instructors, Calendars, Events, Objectives, and Keywords. The process flow diagram included process flows for several users: Students, Faculty, Coordinators, and Administrators. The database-driven website model was used to develop the system using MS SQL for storing and querying data, ASP as the web programming language, JavaScript for calendar event movements graphically and data entry checking, and AJAX for seamless page refreshing. Several online forms and pages were developed to accommodate input and output processes. While information gathering and interaction with eventual users is vital to the accurate and appropriate design of the system, it is possible to develop an online curriculum management system for medical schools which satisfies the needs of curriculum management at the Faculty of Medicine and Health Sciences, UAEU and is earnestly used and accepted.

Keywords: Medical school, curriculum, design and development, online management system.

1. INTRODUCTION
Data management systems are valuable tools for better management of medical curricula [1]. CurrMIT is such a tool widely used in the United States of America and Canada [2]. It uses a relational database containing curriculum information and instruction details such as outcome objectives, resources, content, educational method, assessment methods, and educational sites. CurrMIT, however, is not available for medical schools outside the US and Canada. The University of New South Wales, Faculty of Medicine in Australia has also developed a unique curriculum management system called eMed. This system provides integrated tools for managing graduate outcomes, content, activities and evaluation of programs [3]. They justify developing their own system rather than using best-of-breed subsystems available in the market because of their need for full integration and customization. The Faculty of Medicine and Health Sciences (FMHS) at the United Arab Emirates University (UAEU) found itself in the exact same situation and opted to develop its own curriculum management system.

2. BACKGROUND
For several years now the UAEU has been using an eLearning platform (Blackboard) for delivering learning content to students. While Blackboard satisfies the content delivery end of an electronic curriculum and is well suited for university courses, FMHS has a need to manage the curriculum in a different way because its course structures are different from typical university courses.

Most university courses have one instructor exclusively in charge of several students. They meet several times a week at set times for the whole semester spanning around four months. This instructor is responsible for taking attendance, writing and conducting assessments, as well as all other matters pertaining to the course. For the most part, eLearning systems are designed based on this course model.

At FMHS, however, there is an inherently different course model because of the integrated nature of the curriculum in a medical school. Each course at FMHS has many instructors (around 10-20). One of them is the coordinator who takes care of preparing the course timetable, collecting exam questions from the instructors, among other course management duties. Each instructor is responsible for his own lectures in the course which range from only one lecture to around 20 lectures. FMHS also has three distinct types of teaching sessions: Lectures (where typical or didactic teaching is performed), Tutorials (where students discuss topic and teach each other under supervision), and Practicals (typically conducted in the labs). The total number of sessions in the program are around 3,500 sessions of various types.

The medical curriculum at FMHS is six years long with around five courses yearly, each lasting about two months. Unlike typical university courses where the student may take several courses at the same time, at FMHS medical students register for only one course which takes up all their time. At the end of each two year period the students take a comprehensive exam.

3. METHODS
For several months, data gathering and interviews with key personnel took place in order to understand the specific needs of users. A relational database system was designed using a suitable entity relationship diagram (ERD) and process flow diagram (PFD). The system was designed using ASP, JavaScript, AJAX, and MS SQL Server. ASP was used as the programming language that performs all the processing. JavaScript was used for graphical on-screen calendar manipulation and data entry checking, AJAX was used to refresh information on parts of the webpage rather than refreshing the whole webpage, and MS SQL Server was the Relational Database Management System utilized to store all the data regarding the curriculum. Dynamic web pages for input and output were developed to be clear, consistent, and user-friendly. Finally, user control was taken into account giving each user access to allowed information and processes only. Information gathering, needs analysis, development of data entry tools,
actual (automated) data entry, system development, testing, and launching took only 8 months from start to finish. Only one developer, the author, worked on the design and development of this system for half of his time using the needs analysis results as a guide.

4. RESULTS

Needs analysis for the users of this system, who are administrators, medical educators, course coordinators, teaching faculty, and medical students, produced the following needs list:
1. All users need to:
   a. View the course’s general information.
   b. View the detailed session information.
   c. View the course timetable.
   d. Identify instructor time conflicts in the timetable.
2. Students need to:
   a. View their attendance record.
   b. View their grades record.
   c. Evaluate courses and teachers.
3. Faculty need to:
   a. View session titles and summaries in which they teach.
   b. View their personalized teaching calendar.
   c. View a help file for the system.
   d. Modify their own session summaries and objectives.
4. Course Coordinators need to:
   a. Modify the course’s general information, session summaries, and timetable.
   b. Modify the instructors of sessions.
   c. Easily identify sessions that are not timetabled.
   d. Modify the timetable in a user-friendly, graphical fashion.
5. Course Administrators need to:
   a. Have same access as course coordinators.
   b. Have the ability to print out the course’s general information and timetable.
   c. Enter and modify student attendance.
6. Medical Educators and College Administrators need to:
   a. Have same access as course administrators.
   b. View statistics regarding the system’s use.
   c. View statistics regarding faculty teaching load.
   d. View statistics regarding departmental teaching load.
   e. Have the ability to search the curriculum for keywords and locate the place and amount of teaching of specific subjects graphically.

A suitable ERD was developed using the results of the needs analysis and relational database theory (partially shown in Figure 1). A suitable PFD was also developed and is partially shown in Figure 2.
5. DISCUSSION

Significant components of an electronic medical curriculum taken from the needs analysis of our medical college and a general idea of how other medical colleges operate could be as follows:

1. Overall course guidelines and objectives
2. Session information containing session title, instructor(s), teaching method, theme, summary, objectives, keywords, resources, assignments, and location.
3. Timetable of sessions
4. Personalized view of faculty teaching timetables
5. Attendance management
6. Student evaluation of course and instructors
7. Grade management
8. Map objectives at all levels with CanMeds objectives
9. Question banks and exam management
10. Logbook management (for clerkships)
11. Rotation management (for clerkships)

The first five items have been satisfied in our system. Previously developed evaluation and grades systems are fully integrated with our system. The last four items are currently being developed.

Because of the key fact that in our medical curriculum many teachers teach in one course, both central and distributed management of the curriculum are important. In every part of the curriculum just mentioned there are components that need to be viewed and managed centrally by administrators and there are components that need to be viewed and managed by individual teachers, students, or staff.

Making available customized views for each user type is crucial to the success of the system in achieving its intended goals. These views must be made available with the correct level of information and the appropriate access rights depending on who the user is. For example, students and teachers should be able to view session summaries and course timetables. In addition, teachers should be able to modify session summaries for their own sessions only and view their personalized teaching timetable in all courses. The personalized teaching timetable is the most popular feature among faculty and in itself an overwhelming reason to use the system. Significantly important features for course coordinators include the ability to graphically move sessions within timeslots, the ability to easily identify sessions which are not timetabled, and the ability to identify session with teacher conflicts.

The rapid development of this system using half of a man-power for 8 months is only possible due to high knowledge of and involvement in the curriculum, as the developer is also a user of the system as a teaching faculty member, course coordinator, and medical educator. In addition, past experience in developing such systems and keeping the design and tools used for development as simple as possible contributed significantly to the rapid development and deployment of this system.

On the other hand, the development of other curriculum management systems such as CurrMIT and eMed required at least a year of a handful of developers. Granted, these systems probably are more feature-rich than our system but our system is specifically designed to satisfy all the requirements found in the needs analysis and nothing else, and therefore it works well for us. In the future there may be a need to enhance the system with additional features which is easily possible due to the simplicity of the design and the availability of software developers using the tools used for development.

The next step is to allow for a period of use and then analyze the curricular data. There have been several such analyses on curricular data obtained from CurrMIT such as identifying what students are expected to learn, how they learn, and how they are assessed [4]. Another study showed that despite some difficulties, the resulting ease and accuracy of reports generation is extremely beneficial to course directors and curriculum oversight [5].

6. CONCLUSION

It is possible to design and develop an online curriculum management system for medical schools which satisfies the needs of curriculum management at the Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, UAE. Information gathering and interaction with eventual users is vital to the accurate and correct design of the system. Applying the appropriate IT tool in the appropriate way is also critical to the success of the system. For example, using Javascript and AJAX, it was possible to develop a user-friendly calendar which allows for moving sessions within timeslots using drag and drop.

7. ACKNOWLEDGEMENT

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8. REFERENCES