

An Interactive Online Education System for the Supplemental Nutrition Program

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Abstract—Public health education is a key component in the variety of services provided by local health departments, particularly for the low-income demographic. In addition to helping the participants to live a healthier lifestyle, nutrition education sessions are a required component of a specific program for low-income mothers and children, entitled the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). However, some women in the Utah County WIC program were not receiving the sessions because the inconvenient class times and scheduling difficulty. With the increasing availability of the internet access by WIC participants, we can increase the availability and effectiveness of the nutrition education by providing courses online via the Utah County's WIC website. We are designing a system consisting of a web interface and a database backend, where health workers can author and publish interactive content, track users' progress, and evaluate the outcome of the courses taken.

Keywords—learning management system; health education; WIC; online courses; nutrition

1. INTRODUCTION

The United States Department of Agriculture funds and administers the Special Supplemental Nutrition Program for Women, Infants, and Children, popularly known WIC. Through the WIC program, food, nutrition counseling, and access to health services are provided to low-income women, infants and children [1,2]. In order to receive federal funding, state and local agencies are required to provide nutrition education sessions to WIC participants to promote healthy behaviors [3]. However, some women in the Utah County WIC program were not receiving the education sessions because the class times available were inconvenient for clients or clients rescheduled an appointment to a date in which the class was no longer offered [4]. In addition, 44% of clients reported missing scheduled appointments because of no access to transportation, a sick child, distance from WIC clinics, or inability to come during the clinic's hours of operation [4,5]. Meanwhile, a preliminary survey showed that approximately 86% of WIC clients in the county have internet access through home, work, school, or public library facilities, thus suggesting online learning as an effective and convenient means to provide nutrition education to WIC clients.

Birkett et al. found that WIC clients preferred online learning for their nutrition education [6]. Similarly, approximately 66% of the Utah County WIC clients indicated that they would be more likely to complete nutrition education classes if they were offered online. In an effort to improve the availability and

effectiveness of health and nutrition education to WIC clients, we are designing a Learning Management System (LMS) to provide interactive online education through the World Wide Web. This LMS will allow the WIC staff to author and deliver customized learning objects to individuals, keep track of users' progress, feedback and goals, and allow staff to evaluate the outcome of clients' learning. By offering health and nutrition courses online, we can dramatically increase the availability of consistent and timely educational content without additional cost.

2. RESEARCH BACKGROUND

In recent years, electronic learning (e-Learning) technologies have been widely used in the corporate environment and in the institutes of higher education replacing face-to-face training or academic courses. It is estimated over 3.9 million students in the United States participated in online courses during the fall 2007 term, a twelve percent increase over the previous year [7]. LMS or Learning Content Management Systems (LCMS) have emerged as a popular platform for developing e-Learning solutions. Many commercial LMS products are available on the market, e.g. Blackboard [8] and Desire2Learn [9], as well as open source solutions, such as Moodle [10] and ATutor [11]. They provide arrays of tools and functions to support teaching and learning. However, most of the functions are designed to support the academic learning environment, e.g. homework collection, assessment and grading, and assessments are used to test users' knowledge or collect their feedback after the courses are completed.

A review of accessible nutrition education programs found that the most successful ones are client centered with feedback mechanisms [12]. We want to make the clients feel safe, comfortable and have them engage in discussion rather than lecture style classes. In this WIC learning environment that we envision, assessment and keeping score are much less important than understanding participants' needs, attitudes and behaviors. It is desired to have the flexibility to ask questions and collect feedback from participants during the course itself in addition to a test or quiz before and after the course. Most of the questions are open-ended which do not necessarily have right or wrong answers. For example, the "Fruits and Vegetables" nutrition course teaches vitamins and minerals in different colors of fruits and vegetables, then immediately asks questions such as "What kinds of fruits and vegetables do you already eat?" and "What colors of fruits and vegetables do you eat a lot of?" These questions are not designed as an assessment, but rather an integral part of an interactive course, which the instructor would ask if the course was taught face-to-face. The answers or responses users provide during the courses need to be stored in the database so the WIC staff member can access responses

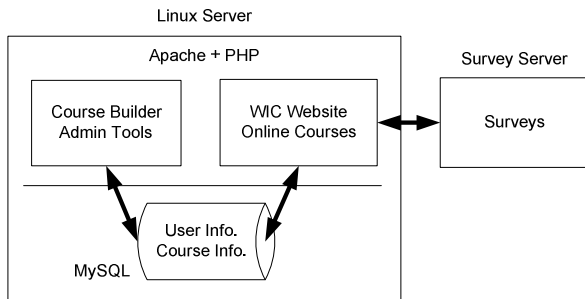


Figure 1. System component diagram.

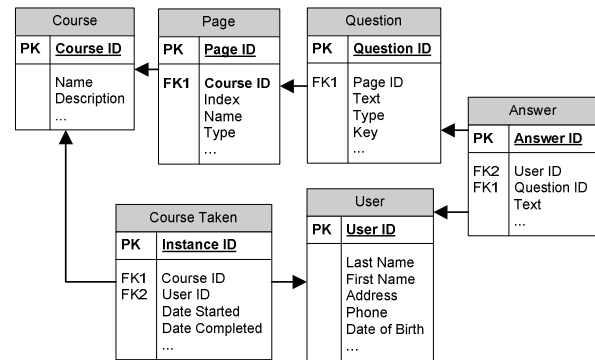


Figure 2. Simplified database schema diagram.

as a follow-up tool with clients, with the goal to promote a healthier lifestyle. As the existing LMS solutions do not fully support our design ideology, we chose to develop a simple LMS to address our particular needs.

Online courses have recently been offered by some WIC programs. For example, the Texas Department of State Health Services has a number of courses for pregnant mothers and parents of infants [13]; however, none of the available programs use a LMS system to store comprehensive user information and course feedback in a database. Few studies have been done to evaluate the use of online nutrition courses. Bensley et al [14] conducted such a study in a WIC setting and showed a positive effect of online classes specifically in improving a client's readiness to change their behavior related to child feeding issues. Our system can be used to collect data and study the impact of an online nutrition education program on improving knowledge and the effectiveness of the courses. Qualtrics [15] software is integrated to conduct pre- and post-course surveys.

3. SYSTEM IMPLEMENTATION

Like many LMS, our system consists of a web interface and a database backend, which is designed to fulfill the following main requirements:

- 1) Identifiable users; the web site will provide secure log-in functionality.
- 2) Ability to track users' courses in progress and courses completed, and generate reports.
- 3) Ability to have interactive content, e.g. multiple-choice or open ended questions, within the courses and store users' answers in the database.
- 4) User interface for (non-technical) health workers to author interactive content without having to understand the database management or how to set up connections (binding) in the course web pages to display the questions or store the answers.
- 5) Ability to evaluate the outcome after the user completes a course, so the staff can determine how much the user has learned from the course material, and how the course content can be improved. This is done through the pre- and post-course surveys.
- 6) Ability to provide customized dynamic content for each user based on her profile or courses taken, e.g. suggesting courses based on previously taken courses or children's ages.

The system is implemented on top of the Linux, Apache web server, MySQL database, and PHP programming language (LAMP) open source software infrastructure as shown in Figure 1. There are multiple benefits by using the open source LAMP solution. First, it eliminates the software acquisition cost. Second, it is a widely adopted standard with a large development community and availability of tools which makes it easier to develop our system. Finally, these open source packages are supported on multiple hardware platforms or even on virtual server which could also potentially lower the hardware cost. The web interface mainly consists of the course builder and the administrative tools. The course builder allows the course designer to organize a series of HTML pages and associate them with a set of questions stored in the database. As a user takes the course, questions will be generated dynamically within the course pages using PHP, and the client's response will be stored in the database. The admin tools include functions such as managing the database, and generating reports for individual user and for the course.

Database Schema

In order to provide the flexibility of having questions on pages within the courses, and storing the user's response in the database, the database schema is designed to include objects of course, page, and question as shown in a simplified data object relation diagram, Figure 2. Each course consists of a set of pages; a page can include any number of questions; each user will have a unique instance of the answers to the questions. Each object contains detailed information of the course, page, or question which is not fully listed in the diagram. WIC clients will be given a User ID after they register on the web site, and a record will be created for each client in the user table. When a user starts a course, an instance of "Course Taken" will be created and linked to the User ID to track the progress, completion and history, which allows WIC to monitor the clients' personal progress and enable the web site to generate customized content based on the personal history. The database also contains user profiles and other management information, which is also not shown in the diagram.

Course Builder

The course builder is a PHP based web interface which interacts with the database to create and manage the course, page, question and other objects. Detail information and attributes associated with each object can also be entered and edited through this interface. Using provided HTML templates, the course designers author the static portion of the course content as HTML pages which get linked to the page object; embedded PHP scripts query the database to find any questions associated with a given page and dynamically insert HTML

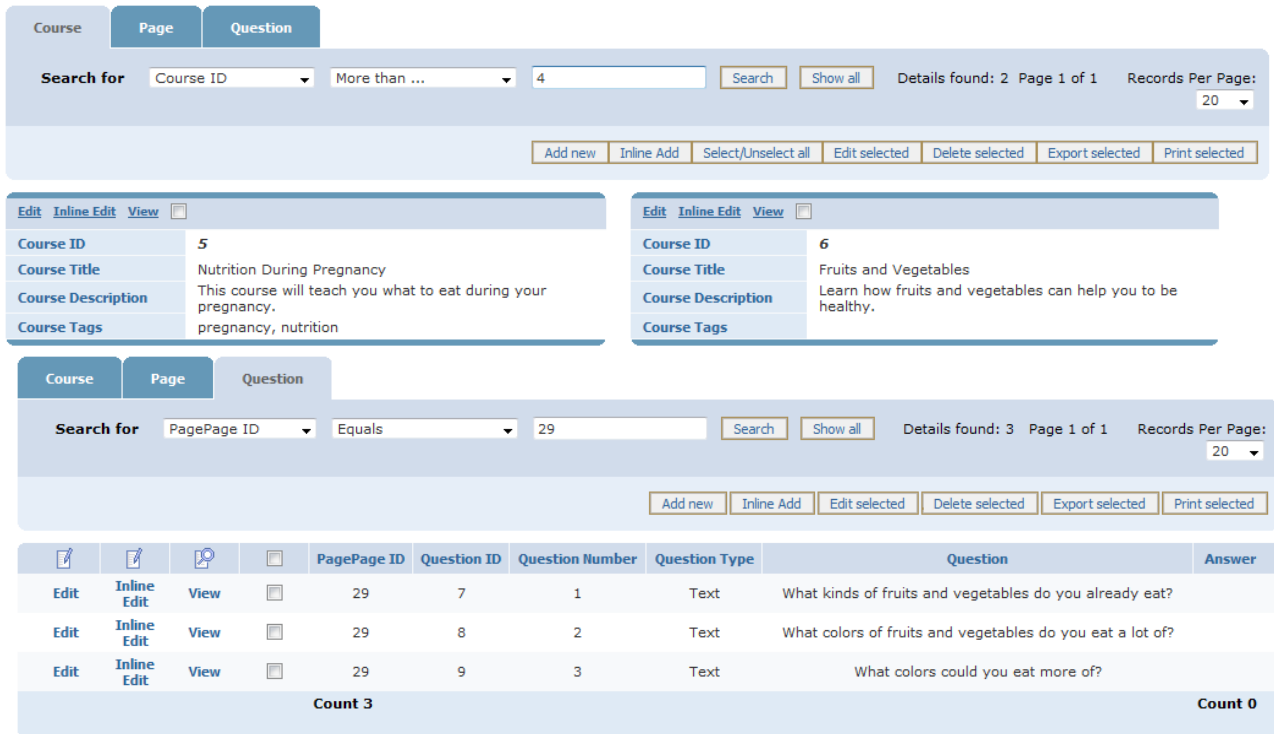


Figure 3. Example of course builder web interface. Top: the course tab shows a list of selected courses. Bottom: the question tab shows a list of questions associated with a page defined in the page table as Page ID 29.

listing the questions and binding the answer inputs back to the database. The web interface also has built-in search capability allowing the designer to find a subset of courses, pages, or questions based on their attributes. For example, figure 3 shows two screen shots of the web interface within a web browser. The top figure displays the course view which lists a selected set of courses; the bottom one shows the question view which lists all the questions associated with a page defined in the page table as Page ID 29.

Online Courses

The WIC web site lists all the available courses by category. As a user logs in, the client will also get a list of recommended courses based on the client's personal profile, pregnancy status, children's ages, and courses the client has previously taken. Figure 4 shows an example of a user's home page after logging in. The client's user identifier (ID) will also persist through the session until the client logs out. As the client takes a course, progress and history will be saved in the database. More importantly, the client's answers and responses during the course will also be saved based on the client's user ID and question ID. Figure 5 shows an example page in the "Fruits and Vegetables" course where the user is asked open-ended questions regarding her personal dietary intake behavior, and the client's answers will be stored in the database. The questions on the page are generated dynamically through embedded PHP script which makes SQL queries to the database to search the questions associated with the Page ID. For example, the questions in figure 5 correspond to the course builder search result at the bottom of figure 3.

After a user is done with the questions on a page and clicks to go to the next page, an embedded PHP script will take the user's answer to each question and insert a new record in the answer table in the database. Each instance in the answer table is linked to a particular User ID and a Question ID. This provides the WIC staff with the flexibility to design client-centered interactive content and the ability to store users' feedback during the course, which is one of the primary requirements of the project.

The user also has an opportunity to participate in a survey prior to initiating the course content and immediately after the course is completed to help evaluate the course content and its effectiveness. Some LMS have survey functionality built in. We chose to leverage functionality of the Qualtrics [15] survey software which is easily customized and integrated with the WIC courses.

Administrative Tools

A set of tools are provided via the web interface to allow system administrators to manage user information and give instructors and course designers the proper privilege levels to access various parts of the system. Standard and customized reports of user and course activities can be generated via SQL queries to the database. For example, we can easily list a user's responses to all the questions in a given course. Personalized certificates of course completion can also be printed to include the user's comments and goals provided during the courses.

4. CONCLUSION AND FUTURE WORK

Online education courses are being developed on topics related to women's, infants' and children's nutrition and health. This simple LMS provides a framework for the WIC staff to

Your Home

WIC News

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View the program live on your computer, view it later on your computer or come and see the live broadcast in SLC.

Cost: \$20; 2 CPEUs, Level 1
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Home > My Classes

Suggested Online Classes

- Feeding Your Baby
- What is Breast Milk All About?
- Solid Foods

New Online Classes

- Kitchen Food Safety
- Healthy Snacks

Click [Here](#) to See My Class History

Women Classes	Infants Classes	Children Classes
Pregnancy	About Infants	About Children
About Breastfeeding	Infant Nutrition	Parenting
Exercise for Women	Parenting	Children's Safety


 search

Figure 4. Example of a user's personal home page with customized content.

author client-centered interactive online courses and collect users' feedback and responses during the course work. The information collected will assist the WIC staff to better understand the participant's dietary intake behavior and attitudes about nutrition and health without meeting face-to-face; hence, this enables the staff to provide personalized follow-up and to monitor the participant's progress towards a healthier life style.

Additionally, quantitative and qualitative data will be collected to evaluate the outcome and effectiveness of the online courses. Quantitative data will include the pre- and post-course surveys developed by dietetic researchers and professionals. Qualitative data will be collected through focus groups with participants of the online courses.

We plan to integrate the unique features that we developed in our system into an open source LMS, e.g. Moodle [11], to provide a more complete solution including features such as survey, chat, forum, and other integrated communication tools. Our long term objective is to create a full featured learning system not targeted for corporate or academic environment but designed for public health education programs such as WIC.

5. ACKNOWLEDGMENT

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- [10] <http://moodle.org>

The screenshot shows a web page for a course. At the top left is the logo for Women, Infants & Children, Utah County. At the top right are links for 'Topics A-Z' and 'Español'. Below the logo is a 'Your Home' button. To the right is a search bar with the word 'search' inside. The main content area has a blue box with the title 'Fruits & Vegetables: What You Need To Know'. Below this is a section titled 'Check Yourself' with three questions, each followed by a text input field: 'What kinds of fruits and vegetables do you already eat?', 'What colors of fruits and vegetables do you eat a lot of?', and 'What colors could you eat more of?'. To the right of the questions is a small photo of two young boys. At the bottom right of the page is a blue arrow button labeled 'Next'. On the left side of the page, there is a vertical navigation menu with 'Your Taking Women Class' and a 'Women's Nutrition' icon. Below that is a dark blue bar with the text 'SECTION 1: Introduction'.

Figure 5. Example of a course page with questions and answers bound to the database.

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