Offline Course Package for a Database Systems Course

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ABSTRACT

Remote learning, which has become popular in recent years, typically uses learning management systems accessible through the Internet. However, learners in secluded areas or developing regions face significant connectivity issues. Thus, there is a need for remote learning courses that do not require a persistent Internet connection to reach these learners. We present an offline course package for a Database Systems course deployed as a client-side only web application. Once students secure a copy of the course package, they can create their profile, access lectures, take quizzes with automated feedback, track their course progress, and launch SQLite to practice SQL programming, even without an internet connection. While there is no communication component in the course package due to its offline nature, it can be a valuable supplement to online courses and has excellent potential to further the democratization of database education.

CCS CONCEPTS

• **Applied computing → Interactive learning environments**; • **Information systems → Data management systems**.

KEYWORDS

database systems, education, learning platform

1 INTRODUCTION

Database Systems is one of the core courses in Information Technology programs worldwide. Traditionally, there are lecture classes where theories are explained and laboratory classes where students get to practice database programming. Recently, remote learning for Database Systems courses has become popular in educational and professional development institutions.

Before the Internet became more accessible, remote learning was conducted in various ways, such as mailing printed course materials to students and delivering lectures through radio and TV programs [8]. However, as computer technologies became more advanced, remote learning has been computer-mediated and typically done over the Internet through Learning Management Systems (LMS). While the Internet has enabled increased access to education, there are still remote areas and developing regions with limited access to the Internet. For instance, the Philippines ranks 68th (out of 120) countries in the 2021 Inclusive Internet Index, which gives an estimate of the extent that the Internet is accessible, affordable, and relevant to the population [2]. To not disadvantage learners in areas with limited Internet connectivity, there is a need to make online courses available offline.

Efforts for offline course access have been mainly focused on Moodle LMS, an open-source LMS, one of the world's most popular LMSs. In 2010, Ijtihadie et al. proposed a prototype for an offline web application using HTML5 that provides an offline interface for students to work offline then retrieve/submit activities from/to their institution's Moodle LMS once they are online[4]. In 2012, Ngom et al. presented a solution to enable Moodle to run in offline mode, allowing learners to perform activities offline and sync their progress to the Moodle server once a connection is restored [6]. In 2017, Hillier proposed MOLEAP, an offline learning management system based on Moodle. The system can be executed by booting a USB or CD ROM drive. It also features an office suite, graphics editor, and multimedia player and the ability to enable two-way communication and updates when connected to the Internet [3].

The official developers of Moodle have also recognized the necessity for an offline LMS as the current version of Moodle (3.11) allows offline access through the Moodle Mobile app [5]. Once students download the entire course site, they can access the course contents in th Moodle Mobile app. When reconnected to the Internet, their assignment submissions and discussion forum posts are synced to the Moodle server.

While the Moodle Mobile app is an excellent option for offline access, it is still limited to Moodle users and mobile users. Additionally, you cannot access SQLite from the course site in Moodle Mobile. In this project, we created a Database Systems course site that allows offline access to the following: (1) lectures, (2) automated homework and exams, and (3) the SQLite DBMS. These three components are some of the targets for automating aspects of a database course presented by Ullman [7] to improve the efficiency of Database Systems teaching. We used JavaScript and HTML5's web storage and offline application capability to create the offline user interface for students. Once a student secures a copy, they can register, set up their profile, study lectures, save lecture notes, take quizzes, access SQLite, and track their progress. They can also download their progress reports and share them with their teachers.

In the next academic year, 2022-2033, we aim to test the course package's utility as supplementary material to the online Database Systems course at the University of the Philippines Open University and then as one of the Massive Open Online Courses we offer.

2 COURSE DETAILS

The course package is CMSC 206 - Database Management Systems, a core course in the Diploma of Computer Science program of the University of the Philippines Open University. It tackles the design and implementation of database management systems, relational database and query optimization, and future trends in database designs[1]. Specifically, the offline course consists of the following topics: (1) Database and DBMS concepts, (2) ER and Relational models, (3) Normal Forms, (4) Relational Algebra, (5) SQL, (6) Triggers and stored procedures, (7) Query processing and optimization, (8) Storage and indexing, (9) Recovery, and (10) Trends in databases. For each topic, there are lecture notes and a quiz that is automatically graded.

3 SYSTEM DETAILS

The course is packaged as a client-side-only web application using HTML5 and JavaScript. The web application can be accessed in any operating system with a web browser that supports HTML5 and JavaScript. Figure 1 presents the system architecture. Once downloaded, students must navigate to the directory of the offline course and open the *login.html* file. From there, students can register and set up their profiles. Student data is stored in the browser's local storage.

After registration, students are automatically logged on and can start exploring the course site. Figure 2 shows Topic 1 of the course site. Students can also save their questions or notes in the text box provided for every topic. To complete the course, they must take all quizzes and the final exam, which are automatically graded and given feedback. Question types in the quizzes and final exam are limited to multiple-choice and true-or-false questions. When students close their browser, they can return to where they left off. Additionally, students can download a progress report in PDF format for the course as seen in Figure 3. Finally, Windows users can launch SQLite by clicking the link on the Resources page. The link directs the student to the SQLite binary. The entire course package is available on github[1].

4 DISCUSSION

The course package addresses the need for an offline course package. While potentially useful, it is still pending evaluation. There are also open issues that need to be discussed, such as the following.

Viewing of Source Codes. Since everything is written in JavaScript and stored on the client-side, students may view the source codes and find the answers to the quizzes. To deter this, we obfuscated JavaScript codes that contain the quiz questions. Academic integrity is an open issue in online learning, and while we may improve technologies used to stop students from cheating, students who want to cheat may still find ways.

Course Materials Licensing. If the course will be available to the general public, the source codes and the course materials must have the proper licenses such as General Public License and Creative Commons.
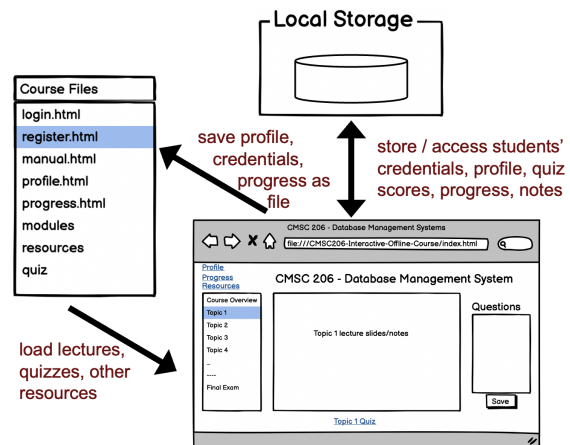
[1]https://github.com/joshzes/CMSC206-Interactive-Offline-Course

Figure 1: System Architecture

Figure 2: Screenshot of Course Page

Figure 3: Progress Report

Class Communications. The system provides no means for communication with the teacher or other learners. The students and teachers must independently organize a means of communication

such as text messaging or group calls if communication through the Internet is not possible.

Extending to Other Courses. Based on the system's features, upon customization, it can be used in other courses, whether Computer-Science related or not.

5 EVALUATION

We intend to use the offline class as supplementary material in the actual online CMSC 206 class in the first semester of the academic year 2022-2023. Before deployment, we aim to get feedback from fellow Database Systems educators on how we could improve the system to maximize the students' learning experience. From actual students, we aim to get feedback on the course package's technical features, usability as a system, and usefulness as a learning material for the Database Systems class.

6 FUTURE WORK

After evaluation in an actual class, we also plan to distribute the course package as an offline Massive Open Online Course (MOOC), to reach more learners. A draft implementation plan for this is shown on Figure 4. This plan, however, requires revision in the course material, to make it more appropriate as a MOOC.

Figure 4: Offline MOOC Implementation Plan
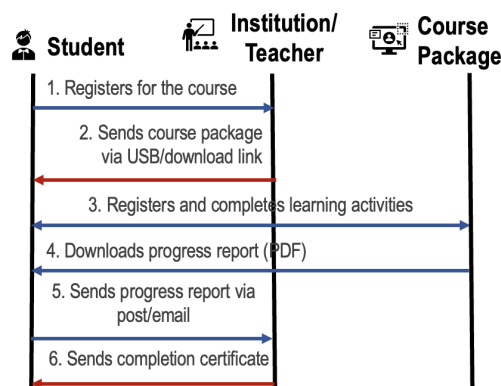
7 CONCLUSION

While remote learning via the Internet has improved access to education, some learners are still disadvantaged by limited Internet connectivity. Thus, there is a need for courses that students may access offline. However, efforts to deploy offline courses have been centered on working around the Moodle LMS, limiting access to Moodle users. We present a complete course package for a Database Systems course that can be accessed even without an Internet connection, in any operating system or device with a browser that supports JavaScript and HTML5. As a result, students can perform course activities such as studying lectures, writing notes, taking quizzes, and practicing programming offline. While still pending evaluation in the real world, it can be an important resource in online classes and may contribute further to the democratization of database education.

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