

FlipFinance

ECE1778: Creative Applications for Mobile Devices

Final Report

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1. Introduction

1.1 What

Our project, FlipFinance, is an experiential financial literacy education framework that helps students improve their personal money management knowledge and skills outside the classroom and provides teachers with class management tools to facilitate virtual learning environments.

Using the FlipFinance app, students learn financial concepts and skills by reading lesson texts and presentation slides, watching videos, practicing financial concepts through quizzes, and solving problems with the aid of financial tools. The financial concepts in FlipFinance is an example of a grade 12 financial securities course, following the standards outlined by the Ministry of Education in Ontario. The app also provides a forum for discussion, so students can create a knowledge building community together and stay connected with teachers.

Teachers use the FlipFinance web portal to upload course content, and quizzes. The web portal also allows teachers to monitor student progress and quiz performance. Quiz performance data can be used to enhance in-class lessons by focusing on areas students find difficult.

1.2 Why

From research studies across countries, financial education in youths is emphasized because most young adults lack the ability to manage their income effectively, to choose the right banking services, and struggle with debts such as student loans and credit card bills.

A major issue for students in a traditional teacher-centered classroom is that not all students are engaged with or interested in classroom activities. Furthermore, financial literacy education requires application of the knowledge for it to be effective. Instructors also have difficulty teaching course contents in its entirety and would like other approaches to efficiently teach and engage students.

FlipFinance provides students with a new environment of learning that is outside the teacher-centred classroom environment and teachers with a tool to facilitate teaching. Based on research of learning progress, cognitive knowledge building process is diverse for every student, so it is FlipFinance's goal to provide a different way to engage students.

2. Overall Design

Figure 1 below shows the block diagram for FlipFinance. The major components are the web software, and the app software. Instructors upload and view data to and from the web database while the app retrieves the data from the web database to view content. Details of these software blocks are explained in the next sections.

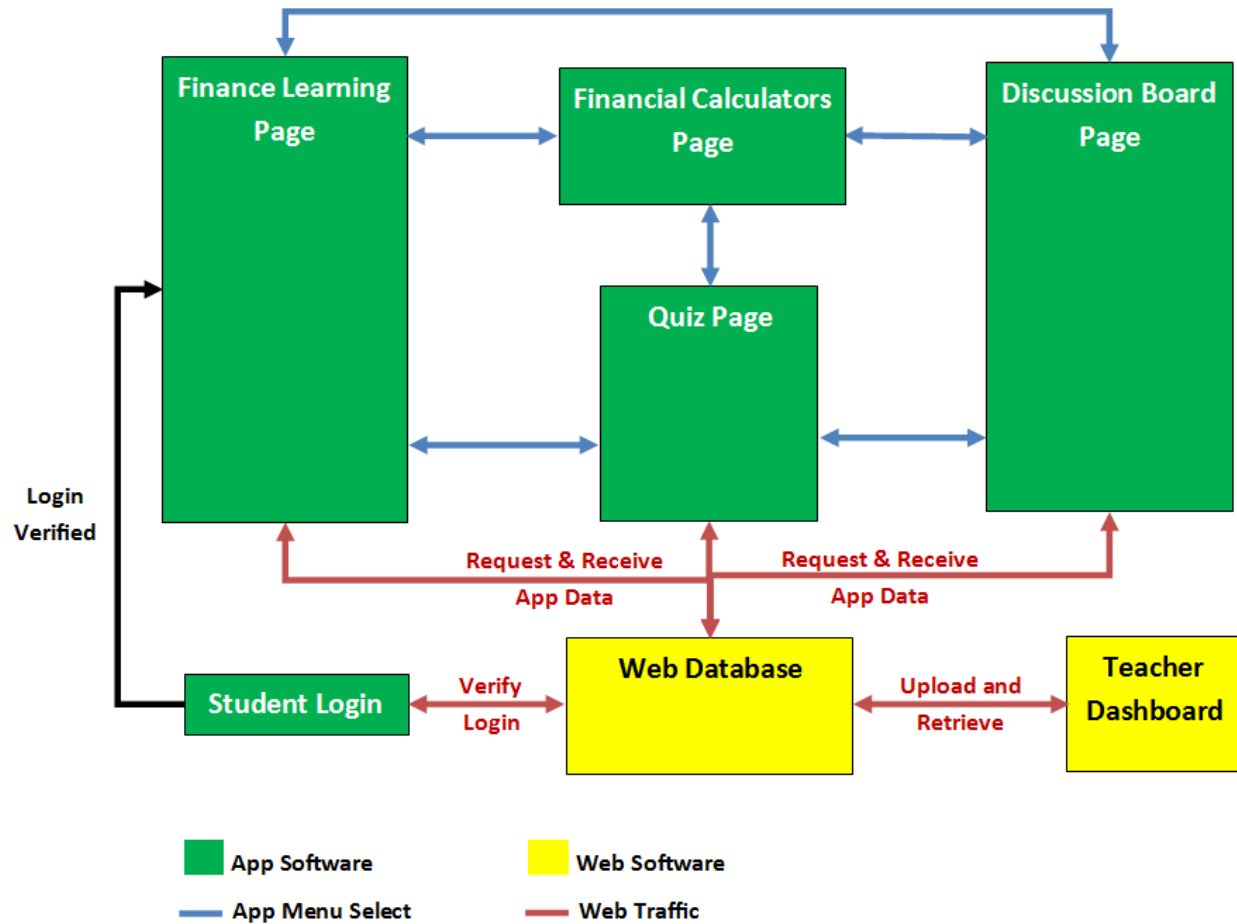


Figure 1: Block diagram for FlipFinance

2.1 Web Server

The web database of the project uses PostgreSQL. The main web framework is called Django, a high-level Python framework that encourages rapid development and clean, pragmatic design. We use Django's automatic admin interface, which reads metadata from the models we defined, such as Units, Lessons, etc., to provide a quick, model-centric interface where administrators like teachers can manage contents on the database server. Additionally, the teacher web portal provides a simple interface for uploading files to Amazon Simple Storage Service (Amazon S3). On the teacher's dashboard, a combination of two frontend JavaScript toolkits, Bootstrap and Chart.js, provide the design for our user interface on the website.

On top of the Django framework, we use Django's REST framework to provide web services for our FlipFinance mobile application to consume. REST is a powerful and flexible toolkit for building web APIs. The RESTful APIs are the glue between the FlipFinance mobile application and the backend PostgreSQL database server.

In our web development, we use these existing frameworks which take care of the hassle of web development. This hastened our web development and allowed us to focus on developing the application logic. Our web application is deployed on a cloud application platform named Heroku. Heroku lets us focus more on the application code, not on managing servers, deployment, ongoing operations, or scaling. Saving time on web development, we are able to prototype more ideas from the specialist.

2.2 Application on Mobile Platform

The student login verifies the identity of the student by sending a request to the web server through the login web API. Upon successful verification, the student can access financial learning contents retrieved from the web server via GET request. Through the menu, students can access quizzes, financial tools as well as the discussion board, which also retrieve content from the web server via GET request. During any of the quizzes, students can also use financial tools directly from the quiz interface. The answers to the quizzes and the messages on the discussion board are sent to the web server via POST request.

3. Functionalities

The following sections describe the different features that FlipFinance provides.

3.1 Teacher: FlipFinance Web Portal

3.1.1 Upload Lesson Contents and Quizzes

Teachers can add units and lessons that belong to a certain unit with contents such as video or presentation URL. Figure 2 and 3 below illustrates the web portal interface for uploading lesson contents and quizzes respectively.

FlipFinance Teacher Portal

Home > Lessons > Units > Unit 1: Introduction to Investment

Change unit

Title:

Order:

LESSONS

Lesson: 1.1 Money Matters

Order:

Title:

Description:

B *I* U ABC x, x' | [List Icons] | Paragraph | Font Family | 4 (14pt)

[List Icons] | [Link Icon] | [Image Icon] | [Omega Icon] | [Undo Icon] | [Redo Icon]

What is your financial goal? Watch the video and learn why and how you should start thinking about your own personal money management now.

Path: p » span

Video url: Currently: https://youtu.be/w_mU8VX1Arc
Change:

Figure 2: Web Interface for teachers to upload lessons

Change question

Unit: Unit 2: Time Value of Money ✎ +

Order:

Question text:

CHOICES

CHOICE TEXT	CORRECT
<input type="text" value="\$3267.25"/>	<input type="checkbox"/>
<input type="text" value="\$6125.22"/>	<input checked="" type="checkbox"/>
<input type="text" value="\$5350.00"/>	<input type="checkbox"/>
<input type="text" value="\$2175.00"/>	<input type="checkbox"/>

Figure 3: Web interface for teachers to upload quiz questions

3.1.2 Dashboard - Overview

Teachers can view students' performance and progress on the dashboard on the website as seen in Figure 4. Teachers can use this data to create an in-class teaching plan accordingly.

Student Quiz Scores

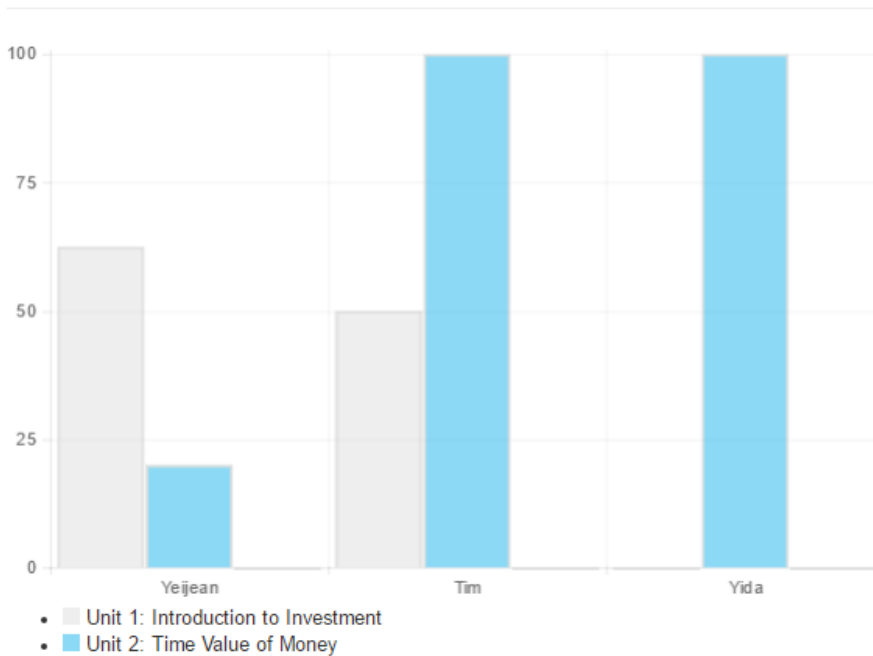


Figure 4: Quiz scores on the teacher's web dashboard

3.1.3 Dashboard - Analytics

Teachers can use the quiz analytics tool, as shown in Figure 5, to identify focus questions to take up in class.

Quiz Analytics

Unit 1: Introduction to Investment

People's income depends on their education, career choices, economic conditions and the investments they make



- ■ Incorrect
- ■ Correct

Fixed expenses are more important than variable expenses when tracking the amount of money you spend



- ■ Incorrect
- ■ Correct

Figure 5: Quiz analytics on the teacher's web dashboard

3.2 Student: FlipFinance Mobile Application

3.2.1 Login

Students are required to sign-in to FlipFinance as shown in Figure 6 below.

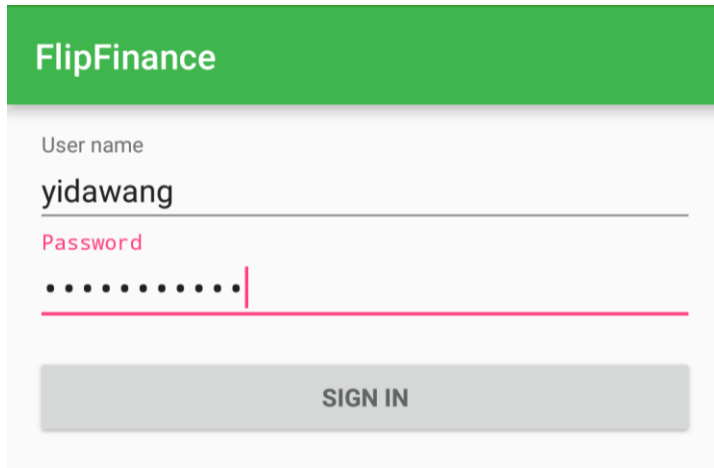


Figure 6: Login interface for FlipFinance

3.2.2 Main Menu

Students can access Units, Quizzes, Financial Tools and the Discussion Board from the main menu. Student can also sign out from the application. The main menu is illustrated in Figure 7.

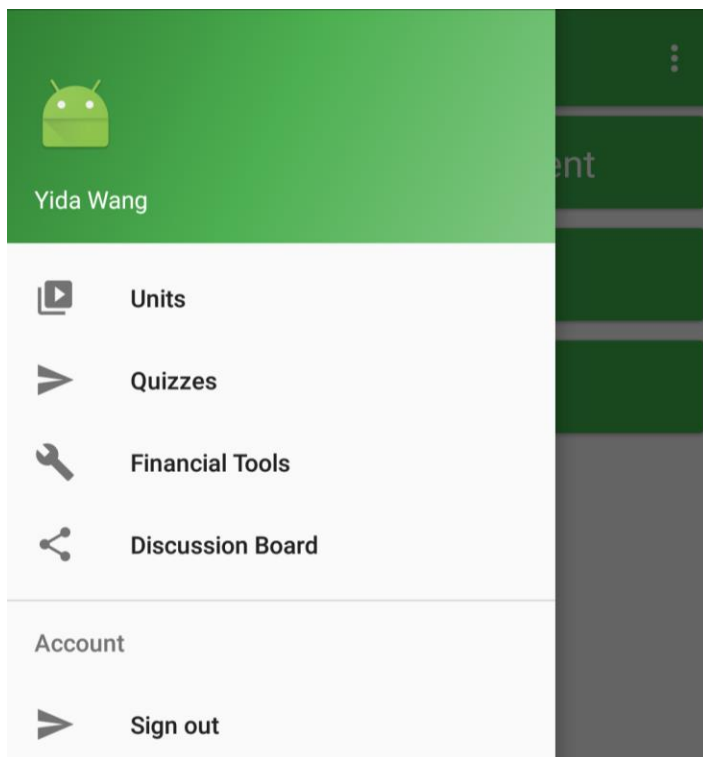


Figure 7: Main menu interface for FlipFinance. Students can navigate to different pages with the menu

3.2.3 Units and Lessons

Students can select Units, which are a group of Lessons uploaded by teachers as shown in Figure 8 and 9.

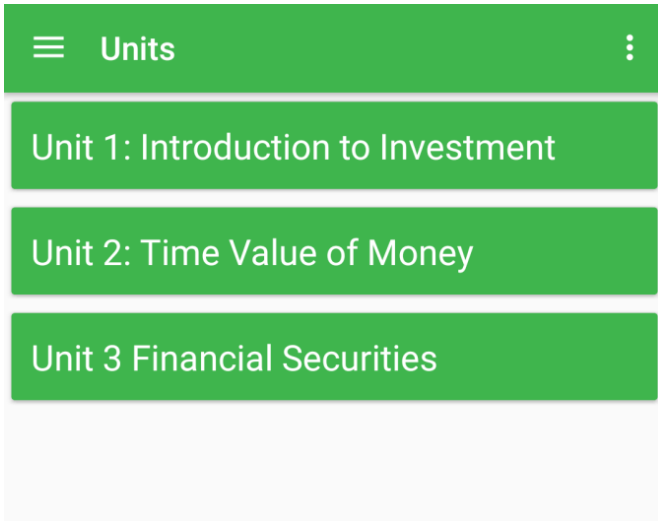


Figure 8: Selection of Units on FlipFinance

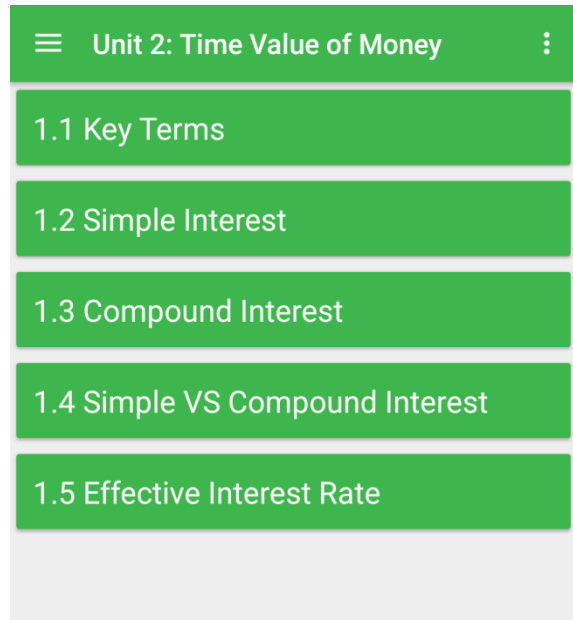


Figure 9: Selection of Lessons for "Unit 2: Time Value of Money" in FlipFinance

3.2.4 Lesson Contents

After selecting a lesson, students can read rich-text lesson contents as seen in Figure 10 and watch videos or presentations as shown in Figure 11.

1.5 Effective Interest Rate

The **effective rate of interest** is the equivalent rate of simple interest earned over a period of one year for an interest rate which is compounded twice or more over the year. The annual simple interest rate will be greater than the annual compounding interest rate to earn the same amount of interest.

The effective annual interest rate, r_e , is calculated using:

The diagram shows the formula $r = \left(1 + \frac{i}{n}\right)^n - 1$ written in red on a white background with a green border. A blue line connects the text "stated interest rate" to the variable i . Another blue line connects the text "effective interest rate" to the variable r . A third blue line connects the text "number of compounding periods" to the variable n in the denominator. A fourth blue line connects the text "number of compounding periods" to the variable n in the exponent. At the bottom right, there is a small link: [wiki: How to Calculate Effective Interest](#).

$$r = \left(1 + \frac{i}{n}\right)^n - 1$$

stated interest rate

effective interest rate

number of compounding periods

[wiki: How to Calculate Effective Interest](#)

Figure 10: Rich-text lesson content for "Effective Interest Rate"

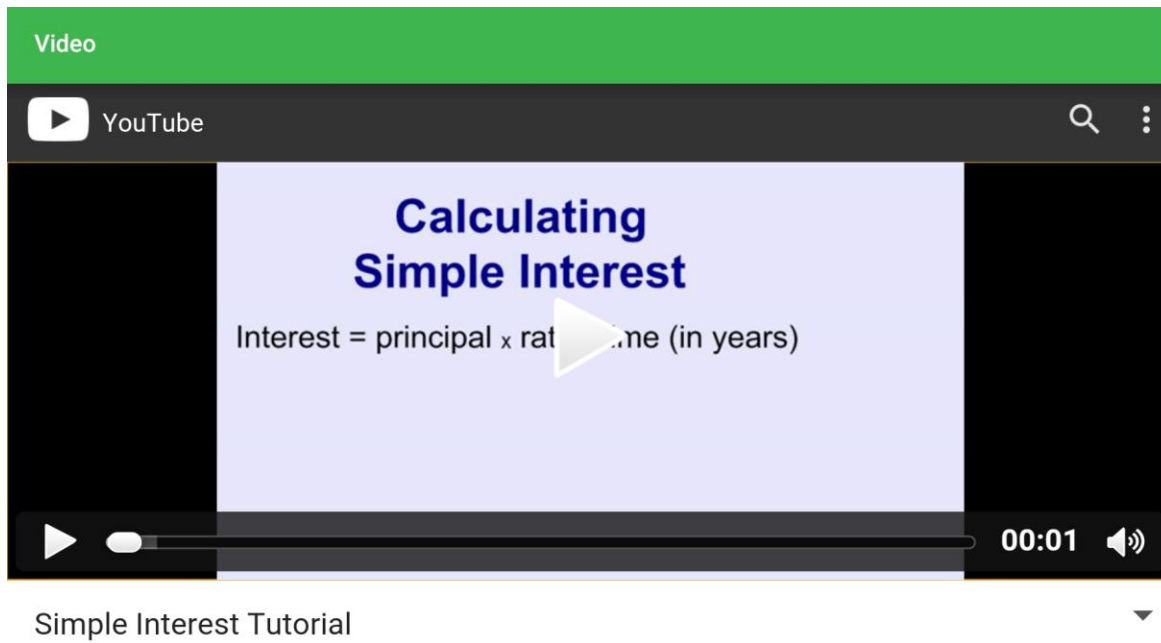


Figure 11: Video content for lesson in "Calculating Simple Interest"

3.2.5 Quizzes and Financial Tools

Students can take quizzes, and also access Financial Tools to solve harder problems. On the last question of a quiz, students can submit their answers. The quiz interface is shown in Figure 12.

There are three financial tools in FlipFinance. The first is the Savings calculator, shown in Figure 13, and it is used to solve problems of compound interest with annuities. The second is the Loan Calculator, shown in Figure 14, and it is used to solve the payment amount needed to return a loan. The third tool shown in Figure 15 is the Balance Sheet tool, which is used to demonstrate basic accounting where assets equal liabilities and equity. Students can add and delete items into each of these categories to check if their balance sheet is balanced.

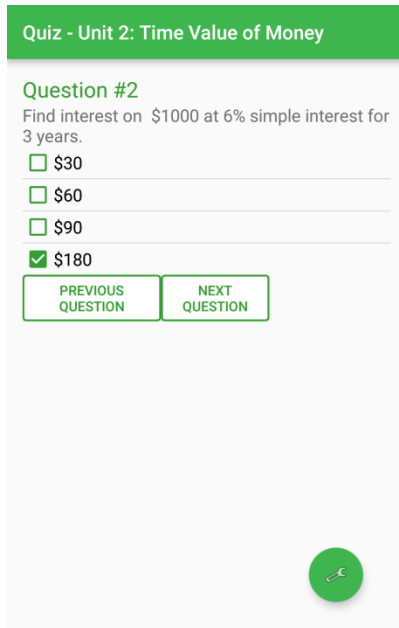


Figure 12: Quiz Interface for FlipFinance

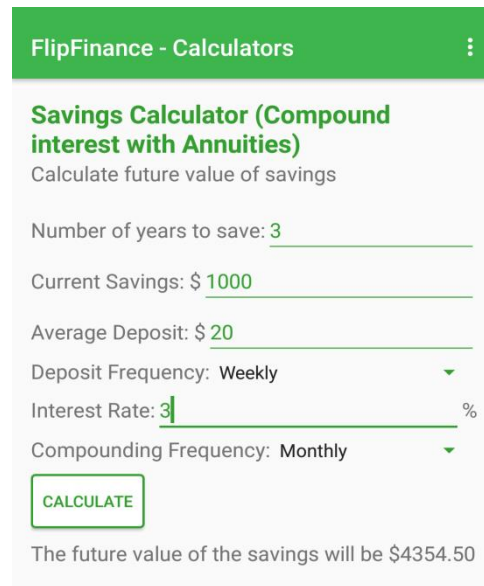


Figure 13: Saving Calculator Interface

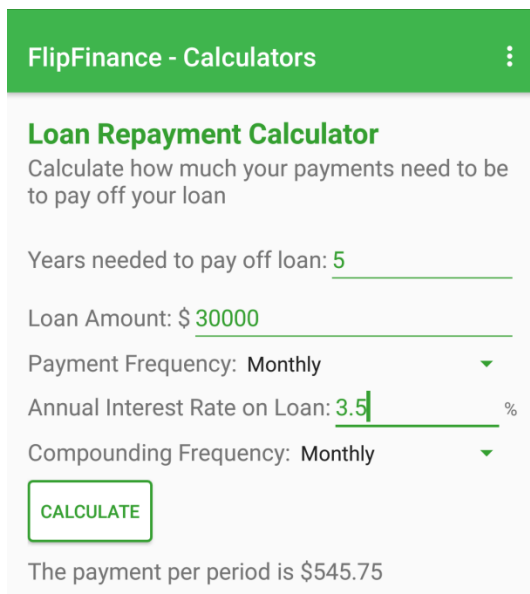


Figure 14: Loan Repayment Calculator Interface

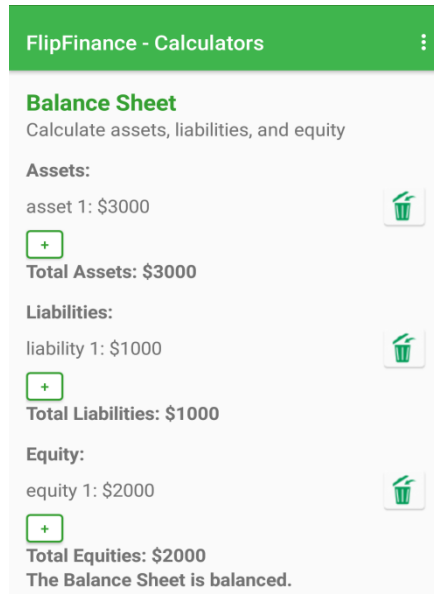


Figure 15: Balance Sheet tool Interface. Users can add and delete items into the categories

3.2.6 Discussion Board

Students or teachers can view all threads on the main board of the discussion board shown in Figure 16. Tapping a thread in the main board, users can read each thread individually as shown in Figure 17. Figure 18 illustrates how users can add a new thread by pressing “Post New

Message” on the main board. Figure 19 shows how users can reply to an existing thread by tapping “Post a Reply” when viewing an individual thread.



The screenshot shows the main board of the FlipFinance Discussion Board. It features a green header with the text "FlipFinance - Discussion Board". Below the header is a table with two columns: "Subject" and "Posted By". The table lists ten messages with their respective subjects and authors. At the bottom of the table is a button labeled "POST NEW MESSAGE".

Subject	Posted By
I am.smart	By: Tim Sham 2016-03-29 08:46:22
what is the n for quarterly compounding?	By: Yida Wang 2016-03-28 23:08:16
interest rate	By: Yida Wang 2016-03-28 17:13:30
eyygv	By: Yida Wang 2016-03-28 14:36:17
new	By: Yida Wang 2016-03-28 13:31:39
rtui	By: Yeijean Lee 2016-03-25 19:03:07
uuu	By: Yida Wang 2016-03-24 18:29:37
test	By: Yida Wang 2016-03-24 17:56:50
tesr	By: Yida Wang 2016-03-19 15:51:29
greetings from the live demo	By: Tim Sham 2016-03-15 10:01:35

POST NEW MESSAGE

Figure 16: The Main board of the discussion board

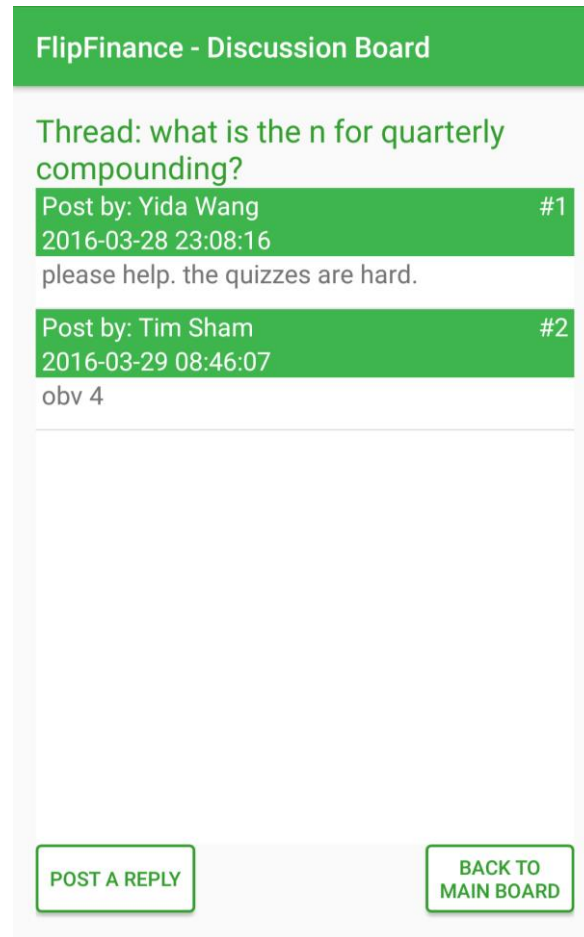


Figure 17: An individual thread for the discussion board

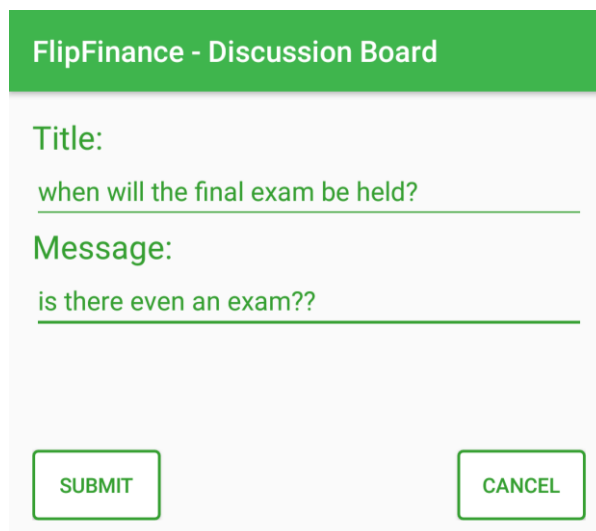


Figure 18: Interface for a new thread on the discussion board

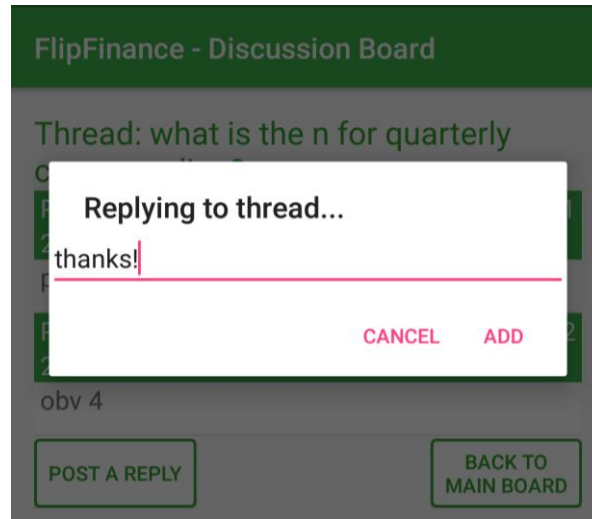


Figure 19: Interface for replying to a thread in the discussion board

3.3 What Did Not Work?

When a new thread or reply to an existing thread is submitted, other users should receive a notification to facilitate the communication. We used Google Cloud Messaging to implement the notification. Each device is registered to Google's server when the application is started. When our own web server receives a new thread or a new reply, it communicates with Google's server, and then the server sends the downstream message to each targeted device. Our solution worked in the first week. However, one day before the final demonstration, the notification stopped working and we are not completely sure why. We suspect the registration token on each device needs to be refreshed once in a while and we are not handling it properly. Sometimes, relying on a third party service is a risk because its behaviour is not well known.

4. Key Learnings

4.1 Specialist

It was Yeijean's first experience in a serious engineering project and her exposure to the complexity of programming and software has been formative. Her greatest takeaway is the improvement in quality of presentations over the four opportunities. She also learned how to work with software engineers as a team. The representative traits of programmers are highly goal-oriented, independent, and efficient. For example, Yida and Tim would plan the proposed functionalities on each spiral with few questions and discussion. Often the minimal and infrequent communications made Yeijean worried and frustrated. Yet, to her surprise when spirals were due, features would be completed for the app and web portal. From her experience, she recommends future specialists to know their team members' work style, trust their specialties, and communicate clearly on what they want from programmers.

4.2 Programmers

Expectations and goals of the project were not clearly defined until Spiral 2 due to lack of specifications between specialist and programmers. For example, our project lacked focus on exactly how and what financial concepts it would teach students. It was important to discuss and continuously manage expectations with the specialist on what the app and web interfaces were going to accomplish within the scope of the timeline in order to work efficiently.

Software development workflow was inefficient at times due to miscommunication on API definitions, causing some re-work and some APIs not being used. It should not happen in organized software development. We needed meetings to set clear expectations of API definitions and how to use them before programming started.

5. Contributions by Group Members

5.1 Specialist: Yeijean Lee

Yeijean's main contributions were providing the core teaching contents of personal money management, the financial calculators relevant to goal of the app with intuitions and mock-ups, and the solicited feedbacks from students in grade 11 and 12 business courses and teachers in business department. In addition, she provided rationale of why and how suggested functions are important and relevant to the goal of teaching financial literacy, which helped programmers prioritize the spiral tasks.

5.2 Programmer: Timothy Sham

Tim's main responsibility was to implement the major features of the mobile application, such as quizzes, financial tools and the discussion board. He also redesigned the UI in the final spiral and gave the mobile application unified theme. Aside from programming, he was responsible for providing the general structure and refinement of the final presentation and project documents.

5.3 Programmer: Yida Wang

Yida did a swift job in setting up the web frameworks and database for the project within a week, while the amount of work could sometimes take a month. He also set up the REST GET/POST requests on the mobile application that consumes the web services. He was responsible for exposing the APIs on the web server based on the needs of the mobile application. Additionally, Yida designed the teacher's dashboard.

6. Specialist Context

As a high school business teacher and a researcher in Curriculum Studies of Teaching and Learning at OISE, my interest of designing FlipFinance is to enhance financial literacy knowledge and skills amongst grade 9 to 12 students in Ontario schools. Financial literacy is defined as “having the knowledge of financial concepts, skills and confidence to make responsible financial decisions” (Task Force on Financial Literacy, p.4) and considered as an essential life skill for all Canadians in order to improve the financial well-being of individuals and society (Financial Consumer Agency of Canada, 2012). There is a considerable body of research and initiatives on financial education to make relevant and effective in school systems. However, the impact and effectiveness of current pedagogical approach on the financial behaviour of children and youth is uncertain.

In Ontario Business Educators Association meetings, the need for an alternative way of teaching students personal finance is highlighted by concerns. The major concerns include lack of connections between students’ real life and topics taught, inadequate assessment tools to identify students’ learning progress, and limited class time to complete learning objectives guided in curriculum documents. FlipFinance address these issues by:

1. providing carefully selected topics relevant to lifecycle of teenage and young adults
2. supporting students with challenging questions identified through analytic functions of quiz assessments on teacher’s web portal, and
3. utilizing outside of class time to teach key concepts through recorded lectures and in-class time for small group activities or individual help.

A key instructional method used to maintain both the formal lesson and tutorial structure as described above is a “flipped classroom” model (Baker; 2000, Lage et al.; 2000). The flipped classroom employs asynchronous video lectures and practice problems as homework, and group based activities and one-on-one tutoring in the classroom.

FlipFinance is an extension of my professional and academic goal to provide students with differentiated and engaging learning resources to become independent financial decision makers. And I am going to use this app in actual courses that I start teaching from September, 2016. This app will enable educators experiment on the affordances of mobile computing technologies in teaching personal finance for high school students. By examining users’ experiences of utilizing this app, I hope the findings elucidate further research in financial literacy education, particularly the effectiveness of implementing mobile software application in formal education.

7. Future Work

Additional app features that would supplement student learning are:

1. Private messages to instructors
2. Quiz results view

Private messages will help students with less confidence be more inclined to engage with instructors through private messages. By being able to view quiz results on the app, students can gain a sense of accomplishment, making the app more engaging.

Additional web features that would facilitate teaching are:

1. Student registration by class group
2. Categorized quiz analytics
3. Quiz data spreadsheet export

Grouping students by class and the ability to view quiz analytics per group will help the teacher organize in-class lessons targeting areas of difficulty. Quiz data spreadsheet export will also aid the teacher in bookkeeping evaluations for students.

8. Memorandum

The project source code is attached to this document's submission package.

The webpage for FlipFinance is:

<http://flipfinance.herokuapp.com/admin/>

Username: admin

Password: password123

We also ask that our final presentation video **not to** be public on YouTube.