



Android Apps for Education: An International Collaboration

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Abstract

This paper describes the participants, activities, and outcomes of a project which introduced educational Android apps and the software for making them to students and teachers in schools in the United States and Thailand. The basis for the project is the Android application architecture, which separates code (app logic) from resources (textual or media content). This makes it possible to design app templates for learning tools such as flash cards, as well as separate software which allows non-programmers to gather and assemble materials to populate the app templates. The project included templates for flash cards, sequences of multiple choice questions, and apps in which each screen displayed the steps of a problem description, algorithm, or solution in sequential order. The project demonstrated that the software was straightforward to use. The approach was suitable both for school students to gain experience organizing information and for teachers to translate source materials tailored to their needs into high quality apps appropriate for use in the classroom. The project also demonstrated that with modest technical support, the contents could easily be integrated into apps which were then distributed over the Internet.

Keywords: App Template, Android Apps for School

Introduction

The project described in this paper was an outgrowth of the course CSCE A305, Android Programming, in the Department of Computer Science and Engineering at the University of Alaska Anchorage (UAA), offered for the first time during fall semester of 2013. The project was supported by an Innovate grant, entitled “Android Apps for Computer Science Learning in Schools”, awarded by the Office of Research at the University of Alaska Anchorage for spring and fall semesters of 2014. This paper is being written after the completion of project activities through the summer of 2014, and thus, is an interim report on the Innovate grant. International activities and teaching and learning of subjects other than computer science were not part of

the original Innovate grant proposal, so the paper serves the purpose of describing the full scope of the project as it expanded during implementation to address a larger purpose and larger audience as the opportunity arose.

The project, in its current form, encompasses the creation and use of Android apps for educational purposes in or outside of the classroom. Activities have been focused on science, technology, engineering, and mathematical topics in the 7-12 classroom, involving both teachers and students, but this project also integrated the development of apps in the humanities at the college level, namely vocabulary flash cards for introductory Russian courses at UAA. Although this project was initially conceived as an approach to generating interest in



computer programming among school students, it quickly became clear that the tools being developed would be generally applicable, and that both school students and their teachers could use them. Since the principle investigator of the Innovate grant had already engaged in international collaboration with Dr. Supanee Sengsri, a colleague at Naresuan University (NU) in Thailand, it was also a natural step to test the same software and techniques in a different culture and educational system. The approach developed in the project translated directly from the American to the Thai setting, with equal success in both.

Materials and Methods

The project involved a broad range of institutions and individuals. Kirk Scott and Supanee Sengsri coordinated the efforts between the University of Alaska Anchorage and Naresuan University. Ringo Tyson and Brent Gonzales, undergraduate students in the Department of Computer Science and Engineering at UAA were responsible for the development of the Android app code, the software for assembling app content, the technical process of merging content into templates to create apps, and the infrastructure for Web-based distribution of the finished products of the project. At this point, all project materials exist only in the English language. Phuttaporn Sanchindapong, Pichaya Prompraphai, and Supasit Tengkeew, master's degree students in the Department of Educational Technology and Communication at NU, took responsibility for mastering these materials, and taught their use to school teachers in Thailand.

What follows is a list of participating institutions with summary information describing them. The summary information reveals the diversity of the participating institutions and the environments in

which the project was conducted and in which success was achieved.

Participating Universities:

1. The University of Alaska Anchorage: Located in Anchorage, the largest city in Alaska, a metropolitan statistical area with a population of approximately 380,000 in a state with a total population of approximately 730,000 in a land area of approximately 1,700,000 square kilometers. UAA has a full time equivalent student enrollment of approximately 10,000, awarding approximately 500 associate's degrees, 1,000 bachelor's degrees, 300 master's degrees, and 2 Ph.D. degrees per year.

2. Naresuan University: Located in Phitsanulok, Thailand, the capital of Phitsanulok Province in lower northern Thailand, a city with a population of approximately 84,000 in a province with a total population of approximately 850,000 in a land area of approximately 10,800 square kilometers. NU has a full time equivalent student population of approximately 16,000 undergraduate and 3,500 graduate students, awarding approximately 4,700 bachelor's degrees, 800 master's degrees, and 200 doctoral degrees per year.

Participating Schools:

1. Su-Valley Junior/Senior High School, Talkeetna, Alaska: Enrollment approximately 175 students in grades 7-12. Participating teacher (mathematics): Tom Harrison.

2. Wasilla Middle School, Wasilla, Alaska: Enrollment approximately 800 students in grades 6-8. Participating teacher (science, technology, engineering and mathematics [STEM]): Shelly Youngberg.

3. Steller Secondary School, Anchorage, Alaska: Enrollment approximately 280 students in grades

7-12. Participating teacher (mathematics): Marla Sanders.

4. Anuban Lampang School, Lampang, Thailand, 2012 World Class Standard School, 2013 Royal Thai Award Large Primary School: Enrollment approximately 3,300 students in grades pre-kindergarten through 6. Participating teacher (computer teacher and head of the Information Technology Center): Amon Saikumfoo.

At this point in the development of the project, templates exist for three different kinds of apps: flash cards, multiple choice, and what are referred to as solution cards. As indicated above, the motivation of the project was to take advantage of the general programming structure of Android apps—namely, the separation of program logic from contents. Not only does this separation easily support internationalization; in a more general sense, it makes it possible to create standard logic for various

well-understood types of apps, allowing non-programmers to gather and arrange content which can be used to populate the apps. Examples of apps created by project participants using these templates can be downloaded from the project Web site: math.uaa.alaska.edu/~android.

Technical Description: Flash cards

Flash cards are based on the simple idea of physical flash cards: The presentation of a question, or prompt, followed by the presentation of an answer, or response. When the user of the app navigates to a question screen, text and a picture can be displayed and a sound can be played. Similarly, an answer screen can show text and a picture and a sound can be played. The following screen shots illustrate a single pair of cards from a flash card app, the prompt, or question, followed by the response, or answer.

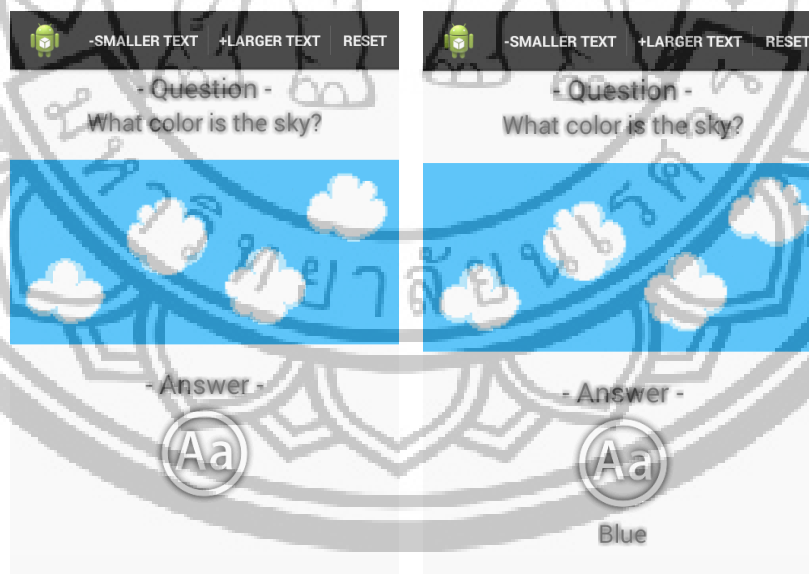


Figure 1 A single pair of cards from a flash card app, the prompt, or question, followed by the response, or answer

The multiple choice app is based on the idea of a multiple choice quiz. A question is presented with up

to 4 possible answers. When the user selects an answer, an indication is given of whether that is the



correct one. The app keeps track of the number or correct and incorrect responses, and the app can be used either in practice mode, or in quiz mode, where the user's score is saved. In its final form, this app will allow the inclusion of a picture and sound with

the prompt and response. The following screen shots illustrate the multiple choice app. The first pair of cards show a prompt and a correct answer. The second pair of cards show a prompt and an incorrect answer.

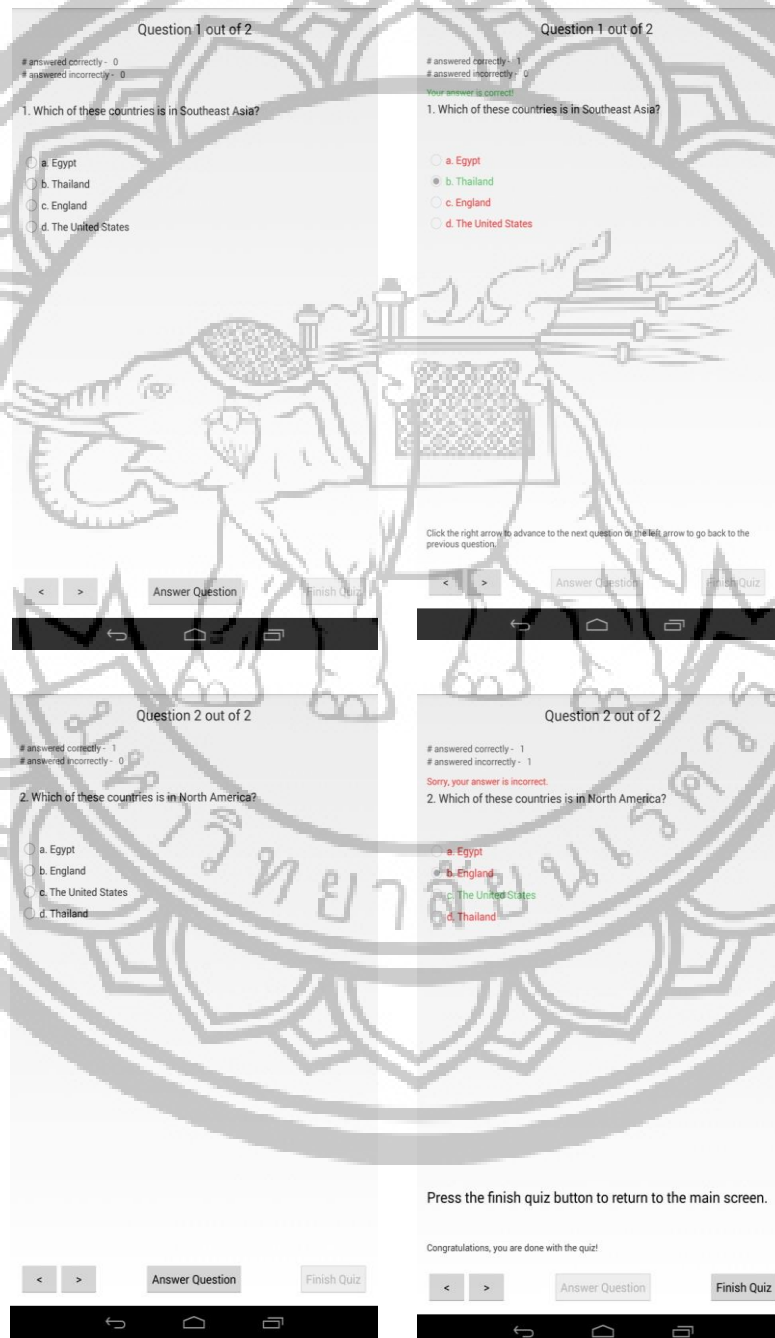


Figure 2 The second pair of cards show a prompt and an incorrect answer.

The solution card app is based on the idea of the contents of a solution manual. A problem or task is stated, and a step-by-step presentation of the solution is given. Each individual card is for a single problem, and each time the user clicks, the next step in the solution is presented. A complete set of cards can contain the solutions for many different

individual problems. In its final form, this app will allow the inclusion of a picture and sound with the prompt and with the set of responses. The following screen shots illustrate the solution card app.

The following four cards show the initial prompt and the first 3 ingredients of a cheesecake recipe.

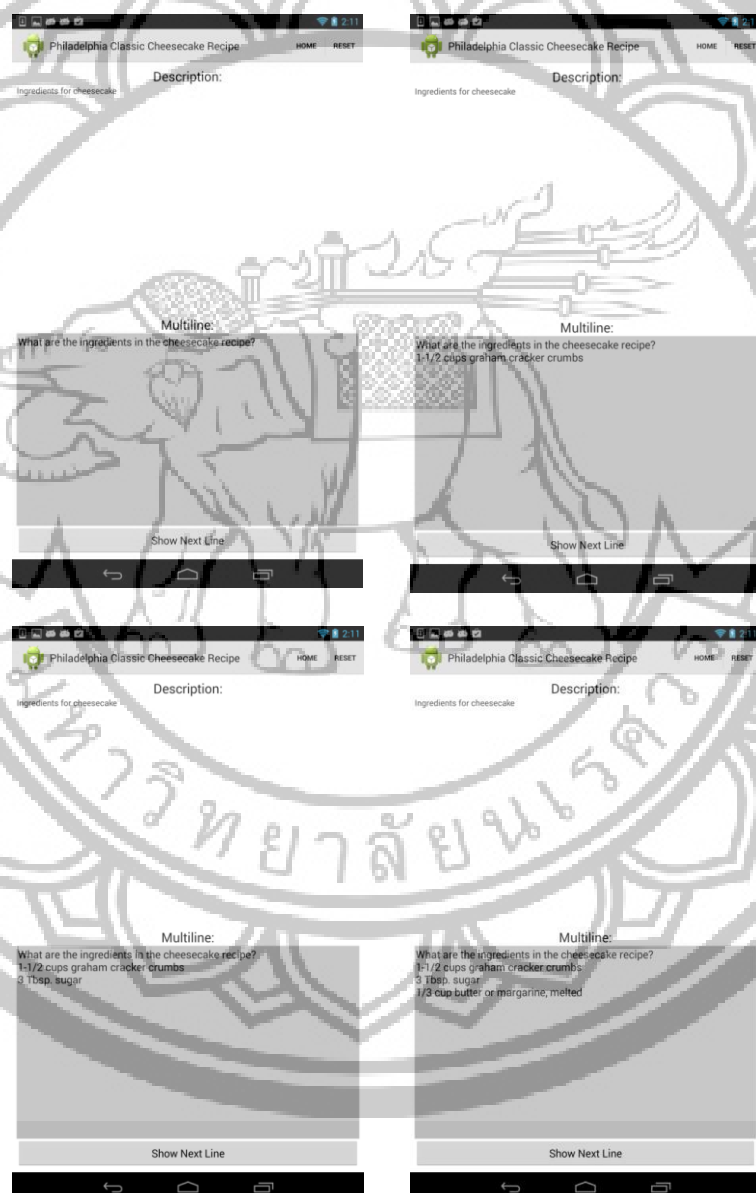


Figure 3 The four cards show the initial prompt and the first 3 ingredients of a cheesecake recipe



The following two cards show the initial prompt for the steps in the cheesecake recipe and the card as

it would appear after “Show Next Line” had been pressed four times, to show all of the steps.

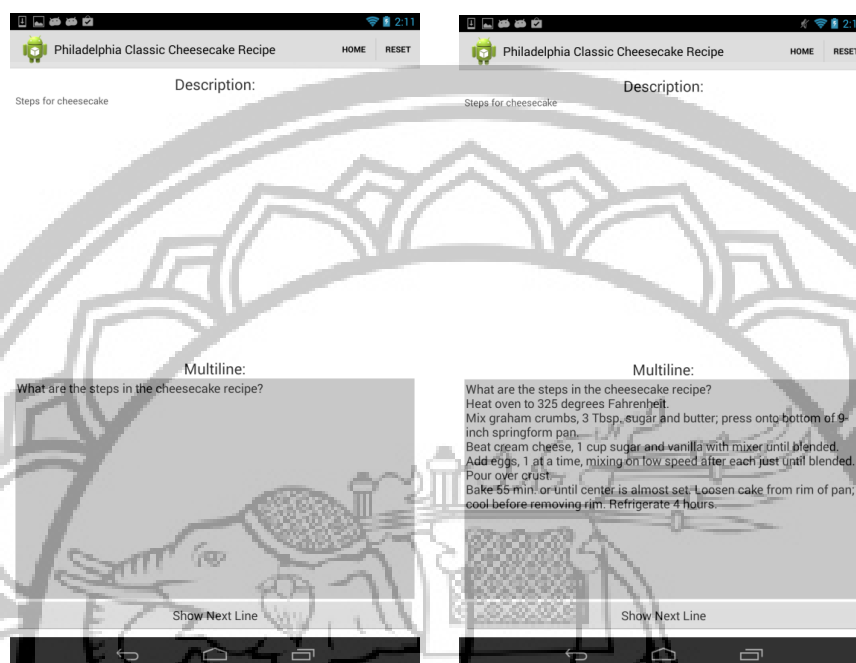


Figure 4 The two cards show the initial prompt for the steps in the cheesecake recipe

The Software for Content Development

Having created app logic, the templates for flash cards, multiple choice, and solution cards, the next step in the project was to create “maker” programs, which provide a user-friendly interface for gathering and creating app content. At this stage of development there is a maker program for each kind of app, FlashCardMaker (FCM), MultipleChoiceMaker (MCM), and SolutionCardMaker (SCM). These programs were written in the Java language and can be downloaded from the project Web site (math.uaa.alaska.edu/~android). Any system which has the Java runtime environment (JRE) installed on it will support these programs.

The programs, not surprisingly, are organized around the concept of a card. In essence, each screen of in any of these apps is conceptually a card. Just as

MS PowerPoint, for example, allows you to edit a presentation one overhead at a time, the maker programs are designed to allow the user to edit a card set one card at a time. Because all three makers are based on the same concept, they share very similar interfaces which include basic functions like adding text, pictures, or sound to a card, adding or deleting cards from a set, and navigating between cards in a set.

It is important to note that at this stage, the programs enforce certain restrictions on the kinds of sound and picture files which can be included. PNG files and MP3 files will be accepted. Android will accept other file types, but they introduce potential problems of size and compatibility. PNG files are preferred for pictures for two reasons: They can be compressed without loss of resolution—and they tend to be small in size. JPG files can be quite large, and

unknowingly, a user might include a file which exceeds the limit for an Android app. There are fewer technical problems with sound files, but MP3 is extremely common and sound files of other types can easily be converted to that type. Although restrictive, limiting file type makes the programs “rock bottom” simple for users. It should also be noted that at this time, multi-media or movie files are not supported because they, by definition, will tend to be large and

likely to exceed size limits. Future versions of the maker programs may be revised to include different file types with appropriate support to make sure that size limits aren’t exceeded.

Technical Description: three maker programs

What follows are screen shots of the three maker programs. The interfaces shown here should be self-explanatory.

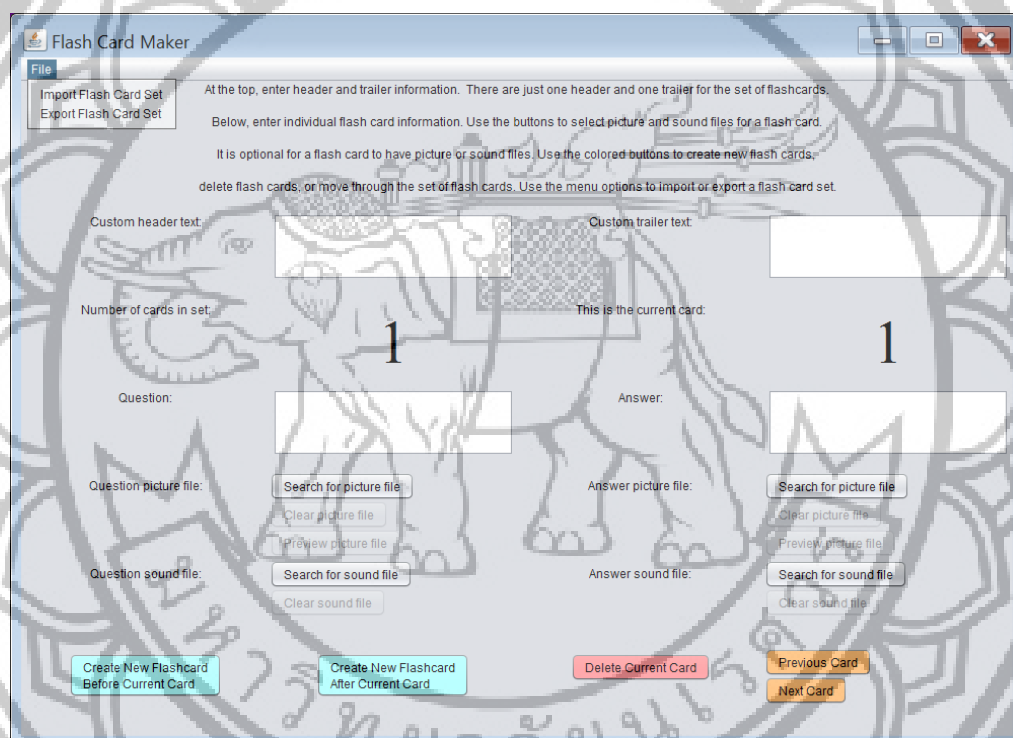


Figure 5 Flash Card Maker



Figure 6 Multiple Choice Quiz Maker

Figure 7 Solution Card Maker

The Project Web Site

All of the products of the project, both those created for use by the participants, and those created

by the participants, have been saved on a Web site.

A screen shot of the main page is shown below:

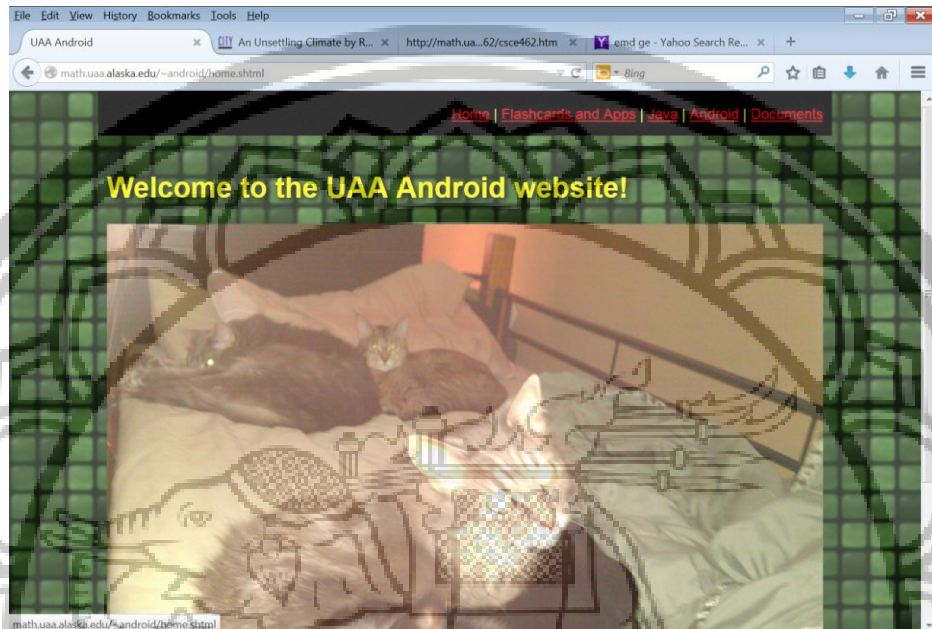


Figure 8 The Project Web Site

The following screen shot shows the Flashcards and Apps sub-page. This page and its subpages

contain the apps created using the content created by the project participants.

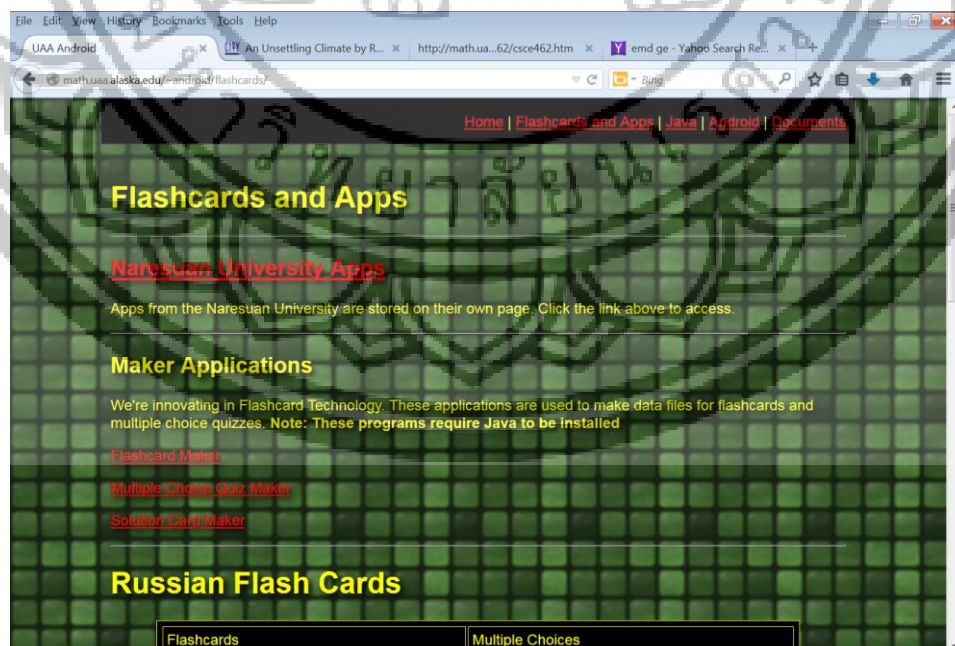


Figure 9 The Flashcards and Apps sub-page



The following screen shot shows the Naresuan University Apps sub-page. Project participants created flash card, multiple choice, and solution card apps.

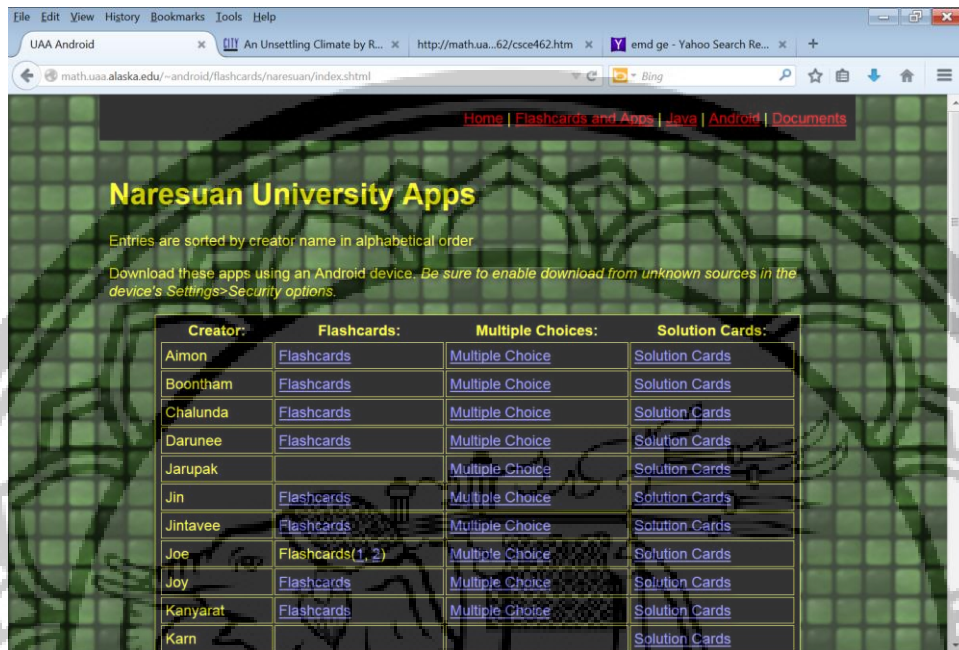


Figure 10 The Naresuan University Apps sub-page

The following screen shot shows the Java Learning Resources sub-page. Each of the links on this page leads to a set of resources on the topic shown, including a PowerPoint presentation, Word document files of exercises and solutions, and example source code.

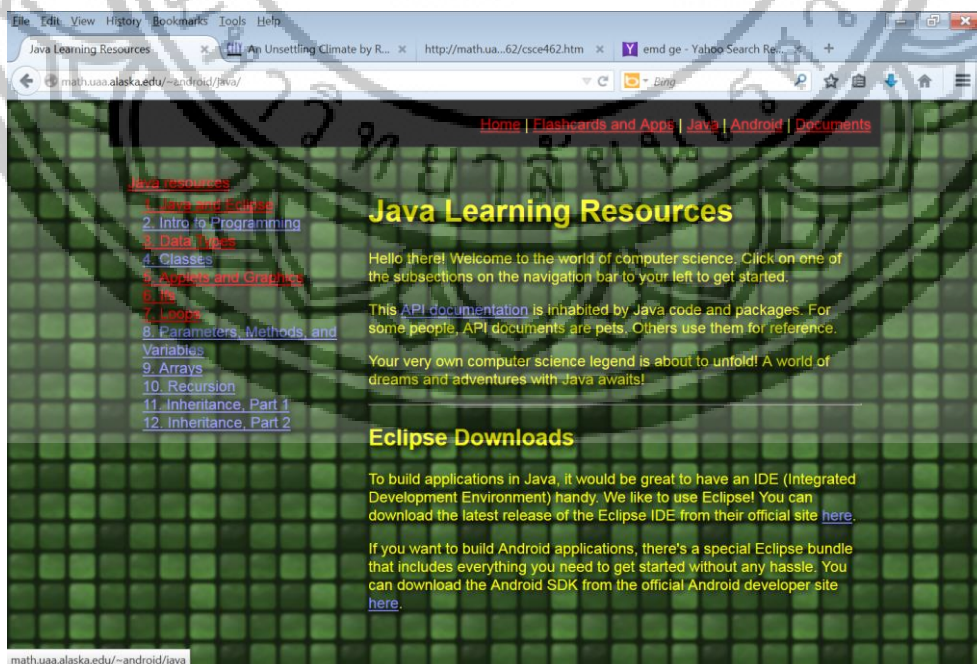


Figure 11 The Java Learning Resources sub-page

The following screen shot shows the Android Learning Resources sub-page. Each of the links on this page leads to a set of resources on the topic shown, including a PowerPoint presentation, Word document files of exercises and solutions, and example source code.

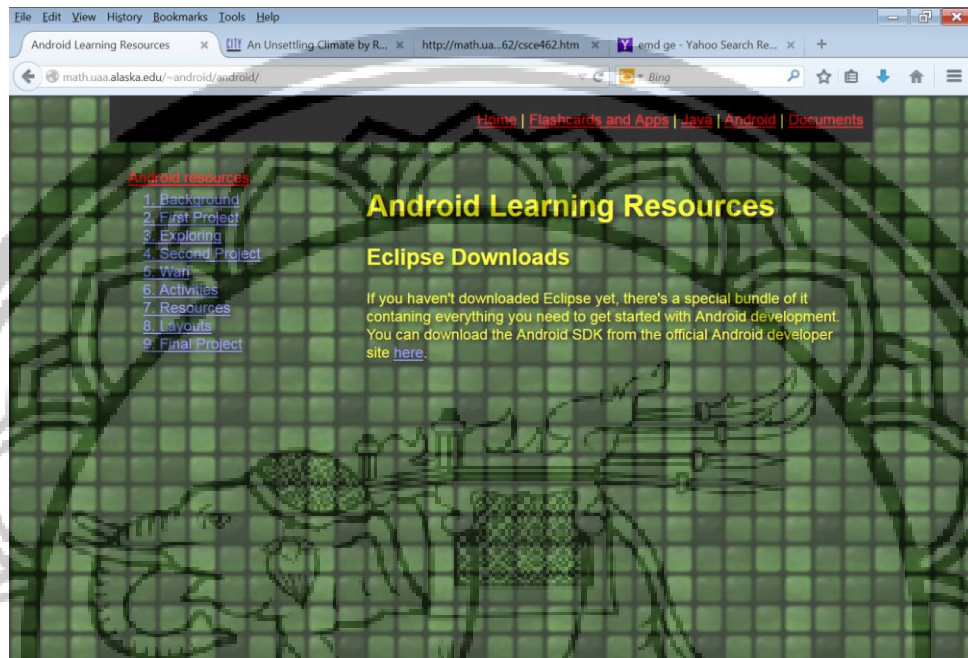


Figure 12 The Android Learning Resources sub-page

The following screen shot shows the Documents and Forms sub-page. This includes instructions for using the maker programs and instructions for downloading and installing apps from the Web site.

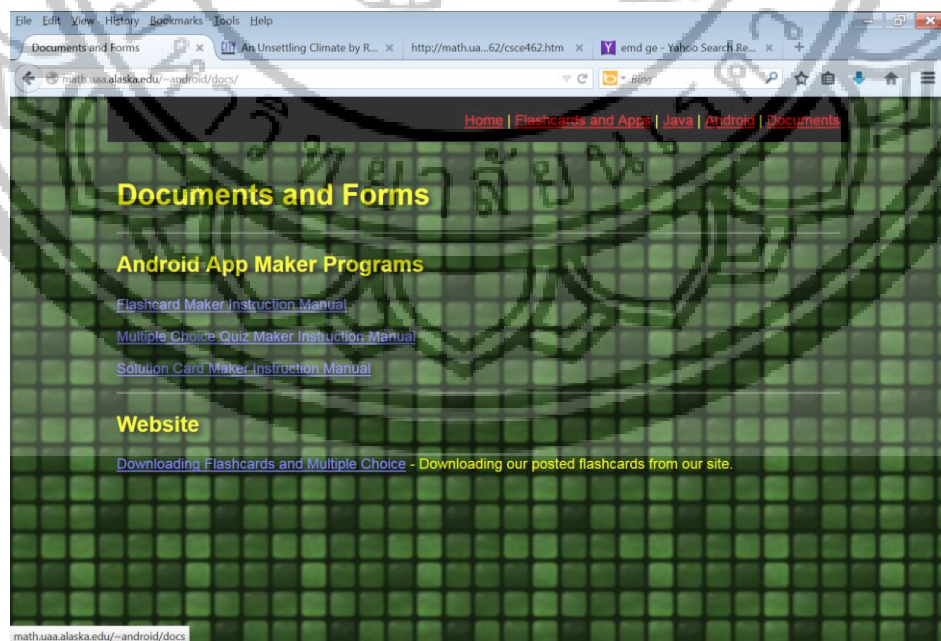


Figure 13 The Documents and Forms sub-page



Project Activities

The contents of the project Web site reflect the related activities undertaken so far. A concise list follows:

Spring of 2014:

1. As part of a separate faculty development grant, the UAA student workers created Russian vocabulary flash card apps for the second course in the Russian language at UAA. Although separately sponsored, this activity provided initial experience in app creation, which was put to use in the rest of the project.

2. Six 11th and 12th grade students in the calculus class at Su-Valley High School created a flash card app as part of their preparation for taking the AP Calculus Test.

3. Working together in class groups of 25–30 students, classes in the 7th and 8th grades created seven flash card apps in the area of science, technology, engineering, and mathematics.

Summer of 2014:

1. 25 students in grades 7–12 from Steller Secondary School spent two weeks in attendance at UAA learning Java programming. Each of the Java programming units included a pre-test and a post-test in the form of a multiple choice app. The multiple choice app gathered statistics on student performance. Although the Steller students did not create apps themselves, they served as “guinea pigs”, establishing the utility of the project apps in an educational setting.

2. UAA hosts the Summer Engineering Academies for middle and high school aged students, sponsored by BP. Although separately funded from the Innovate research project, the UAA students taught two sections of the academies and integrated Innovate materials into those sections. One week

consisted of high school students learning Java similar to the Steller students. Another week consisted of middle school students who learned basic Java and also created flash card apps on the topic of their choice. 25 apps were created. These have not yet been added to the project Web site.

3. The climax of the project activities in the summer occurred in July when elementary school teachers at AnubanLampang School spent 3 days being trained in using the maker programs by the students from Naresuan University and created flash card, multiple choice, and solution card apps. Altogether, 35 different teachers participated, and they made a total of 97 different apps.

Results

Preliminary Project Results

The project results thus far can be relatively easily summarized in a few, brief points:

1. The three different types of apps are functional, easy to use, and of educational value in the elementary, secondary, college classroom setting.

2. The maker programs are also functional and easy to use, suitable both for students creating their own apps, and for teachers creating apps for their students.

3. The three different kinds of apps, flash card, multiple choice, and solution card are equally applicable in both the United States and Thailand.

4. At all levels and in both countries involved in the project participants exhibited enthusiasm and interest in creating apps. The underlying premise of the project was that apps on portable devices hold an intrinsic interest for current users of technology, all the more so, the younger the user; and that this intrinsic interest would translate into motivation to learn when educational materials were packaged in



this way. Informally, all of the project activities thus far have borne out this premise.

Project Continuation

The project will continue under Innovate funding through fall semester of 2014. There is no lack of additional activities that can be undertaken. Three major expansions or extensions of the project are planned:

1. The maker programs will be integrated into the project Web site. In other words, rather than downloading the maker programs, users will create content files and submit them for inclusion in an app through a single Web interface.
2. For those teachers and students who do not have portable devices, but do have access to a desktop or a lab with many desktops, Java programs will be written which display the content of apps on the desktop in the same way as it is displayed by apps on a portable device.
3. All interfaces will be translated into the Thai language, so that there are two versions of every part of the project. Future Thai participants will be able to use the materials without relying on students from Naresuan University as the interpreter. It should be possible for both English and Thai speakers to use the software and Web site without special instruction.

Discussion

In addition to these major additional directions for the project, there will be multiple changes and improvements in the software and components of the project. Working with the Thai teachers and university students was extremely valuable to the project. Rather than something being “lost in translation” something very great was gained for two reasons. One way in which the project benefited from

having international participation was not anticipated: Project participants in the U.S. could easily overcome any minor glitches in the software interface or instructions. This was not the case for people whose native language was not English. This meant that for them, problems could not be overlooked. From a software development point of view, was unexpected and quite useful. In essence, there were end users who, because they were unable to ignore problems with the software, were able to tell the developers that there were problems, what they were, and what had to be changed in order to fix them.

The second way in which the project benefited from the activities in Thailand was more expected. In the U.S., American teachers had had their students work with the software. In Thailand, the people working with the software were teachers themselves. In other words, they were experienced professionals who had particular educational goals in mind when creating the apps. As such, they were able to articulate both practical and more conceptual improvements that could be made in the software and the apps that were developed.

Conclusions

The project has been successful so far, and additional activities will occur during the fall of 2014. There is the possibility of working with teachers and students at Steller School, using the maker programs to create apps. It is possible that Su-Valley and Wasilla Middle School will again want to participate. It is also possible that some other Alaska school may want to participate. At the end of fall semester, over winter break, there will again be a visit to Thailand by one or more of the American participants. At that time, hopefully, the improved



and translated project materials can be presented to teachers at Anuban Lampang School and any other interested parties who the Thai participants can involve in the project.

Recommendations

What follows is representative of the suggestions assembled by the Thai university students who trained the teachers at Anuban Lampang School, indicating problems that the trainees encountered which should be fixed. This list is a subset of the changes and improvements that will be made in the coming months to the maker programs and the apps derived from them:

1. The trainees were not able to see the “big picture” of the app they were creating. Some sort of global preview function would be desirable.
2. The trainees were confused about the number of cards in set and the number of the current card. This needs to be displayed in a more intuitive way.
3. The trainees did not find the current user interface particularly attractive or easy to use. This could be improved.
4. The trainees want the ability to preview the sound they have included on a card. Cards in the maker program should not be static. In general, it should be possible for a user to preview a card exactly as it will appear or function in a finished app.
5. The trainees would like to add a cover picture to a set of flash cards.
6. The software currently supports only .png files. It would be good if it supported other picture file types.
7. It would be great improvement if the capability to copy and paste into content areas in the maker program was supported by the mouse, not just by keystroke combinations.

8. The supported font size is too small. In general, it should be possible to select different font sizes, just like in other graphical applications.

9. There are currently unexplained errors in the display of some Thai text.

10. It should be possible to add both sounds and pictures to both prompt and response cards for all three types of app, FCM, MCM and SCM.

11. The resulting apps should be configured to display properly on small, cell phone screens, not just tablets.

12. For those apps that keep user's scores, the trainees want a convenient way to access the scores.

13. The applications should support special symbols, e.g. math and science symbols. Some sort of support for equation editing would be desirable.

14. File saving should support “Save As” so that multiple copies of work can be saved separately and unambiguously.

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