International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 4 Issue: 10 214 - 222

An M-Learning Application to Enhance Children's Learning Experience

Dr. Chery Seals, Qian Zhang, Dr. Tony Cook

sealscd@auburn.edu, qzz0005@tigermail.auburn.edu, cookja1@auburn.edu

Abstract:- eXtension.org is an interactive learning environment offers reliable educational and information resources on a variety of topics. For Youth, For Life Learning Network community works with eXtension.org to produce youth oriented content for the base of eXtension.org. However, there is no particular software or application designed for children to gather information from extension.org so far. The target user of eXtension.org is the general public, which means it is not child-friendly.

In this project, we developed a child-friendly android version mobile app to draw children's attention in exploring science knowledge from eXtension.org. The app is an educational tool designed to provide learning opportunities to children. It provides several articles to its users in a systematically categorized and prioritized topic. The application is a joint collaboration from eXtension.org and For Youth, For Life (FYFL).

Keywords: *M-learning, Mobile Application, Android App*

*****

1. Introduction

The popularity of mobile phones and wireless devices allows anyone to access Internet anywhere and at any time. It marks the beginning of a new era of learning: mobile learning (M-Learning). M-Learning is a learning that can take place anytime, anywhere with the help of a mobile computer device. The purpose of m-learning is to allow users to access information at the moment it is needed. Mobile devices can be taken to different places and users can access the learning material whenever they have Internet access. Due to the limited screen size of mobile devices, UI design for m-learning asks for basic screens and simple navigation. M-Learning module should only take learners between 3 and 10 minutes due to the small memory size of mobile devices. All these features make m-learning a better learning strategy for children to explore their interest in science [1].

Children are not miniature adults [2], and design principles formulated with adults in mind cannot simply be scaled down – children have their own needs and goals, which cannot necessarily be met by adult tools [3]. A web page with a few pictures, but too many articles is not suitable for children. Children prefer videos and pictures to text. Children are always impatient and will not spend 30 minutes or more to learn things. Thus, features of m-learning make it a best method for children to explore their interest in science and health.

The For Youth, For Life Learning Network consists of learners interested in topics related to science, health, living responsibly and service to others. They made great efforts in producing content for youth in a variety of subject areas for the knowledge base of extension.org. However, extension.org does not have a particular tab designed for children, which means the general website is not children friendly. Thus, it will not attract children's attention in search anything from this website.

In this project, we developed a new android version of the iW2K (I want to know) application for extension.org. iW2K is an application that provides introductory information on various subject areas to children and allows children to search content in their interested area.

2. Literature Review

2.1 E-Learning

E-Learning is a term proposed by Jay Cross in 1998. It can be defined as any learning technology involves use of electronic media in the process of teaching and learning. Since the beginning of the last decade, it has gained attention among academicians and students because of its time and location independence. Compared to traditional classroom learning, which only happens in normal office hours, e-learning allows students to access the learning material whenever they have an electronic device with them.

Many different forms of e-learning systems have been developed for different purposes. A large number of open source e-learning platforms are available for educational institutions. Users can also integrate customized modules to those platforms to meet personalized requirements. Some of the notable e-learning systems are Blackboard, Moodle, Coursera and Udacity.

2.1.1 Blackboard

Blackboard software consists of seven platforms offered as bundled software. This software provides innovative services with a virtual learning environment, real time collaboration, urgent community communication and learning on hands [4][5].

2.1.2 Moodle

Moodle is an open source web based e-learning platform. Its major features include collaborative tools and activities, convenient file management, progress tracking, secure authentication, mass enrollment, multilingual capability, bulk course creation, high interoperability, detailed reporting and logs, design and management of courses, external resources [6].

2.1.3 Massive Open Online Course (MOOC)

A Massive Open Online Course (MOOC) is an online course aimed at unlimited participation and open access via the web. It is based on simple open Internet platforms. Most MOOCs are free and delivered through online videos[7].

2.1.3.1 Coursera

Coursera partners with top universities and organizations worldwide. Teachers from top universities post their courses on coursera. For the students who purchased the course, they can earn specified certification for the course if they finish all the homework and quizzes on time and get a good score for them. If a student has any question on some points, they can post their question online and immediate feedback will be provided.

2.1.3.2 Udacity

Udacity focuses on providing courses based on skills required by industries and most of the courses are free. Nanodegree programs offered on this platform are co-created by industry giants such as Google, Facebook, AT&T, mongoDB, twitter, NVIDIA, Amazon web services and other [4].

2.2 M-Learning

One recent significant change in technology is the popularity of mobile devices and the drastic growth in wireless and mobile networks. Those have brought the beginning of a new era of education—mobile learning (m-learning).

M-Learning is defined as “any sort of learning that happens when the learner is not in a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies” [8]. Just as desktops and laptops are primarily used for e-learning, devices like cell phones and personal digital assistants (PDAs) are used for m-learning. Thanks to the features of mobile devices, in the m-learning model, students can take the mobile device to any place and access the learning materials at anytime. Students learn as if they are in a real classroom while they are outside of school. Students communicate and exchange data with each other and even with their instructors anytime they are equipped with a mobile device. Students also decide their own learning path since they will select from a menu of courses based on their preference. Moreover, students can gather data unique to their current environment and time, including both real and simulated data [9].

Despite these benefits, mobile learning still faces many technical challenges: most mobile devices have limited storage space compared to the huge amount of learning resources per course; due to the limited memory of mobile devices, many complicated operations cannot be performed on the devices; formats such as Adobe Flash are not always supported and PDF or graphics may not display clearly on the screens. However, thanks to the rapid growth of cloud computing, some of these technical challenges can be handled easily, and cloud computing can promote the popularization and development of mobile learning.

Cloud computing provides a secure data storage center to house educational resources in the cloud server. It also provides high computing ability for a variety of applications. Therefore, data-storage and data-processing requirements are not needed for mobile devices and just a normal mobile phone is enough. Moreover, in the environment of cloud computing, all resources involved in mobile learning can be put at the cloud “end”. The cloud “end” means all materials are stored on a server and can be accessed by anyone. All learning activities can be carried out by any mobile device[10].

2.3 Mobile Apps for Children

2.3.1 Design principle for children

Children today are growing up in a world filled with newly evolved technologies, such as the computer and smart phone. Many scientists investigated the relationship between children and software. As science has shown, children are different from adults in cognitive development and physical development. Software designed for adults cannot be directly applied to children. Special design principles should be found for children. Sonia Chiasson and Carl Gutwin [3] have reviewed a variety of studies concerning design principles for children and made several conclusions. Listed here are some of these conclusions:

1. Interface should avoid using text-based instruction since children don't like to read instructions.
2. Software should provide some audio or visual feedback immediately after children have made some action because children are impatient.
3. Mouse interactions should be made as simple as possible. One-click is better then dragging or double clicking [11].
4. Colors can evoke powerful emotions and memories. When bright colors are used and put in contrast with each other, children can see the difference between them.

2.3.2 Privacy requirements for children's application

While design principles for children have been defined, another big concern of children's application—privacy requirement also needs to be investigated. Over the past few years, due to the popularity of mobile devices, many mobile applications were developed. This rapid growth of market has raised problems about user's privacy, especially when users are children and teenagers.

Mobile apps can obtain a lot of personal information, such as geolocation and phone number from mobile devices automatically. Some mobile apps contain in-app advertisement, which needs location information for purpose. However, parents may not want to share this information with unknown third parties and parents may want to limit their children's exposure to ads. Moreover, some mobile apps can connects with some social media and allow users to share information with other unknown users. Some of mobile apps allow users to purchase additional contents via in-app purchase mechanism. However, based on Federal Trade Commission staff's report on mobile apps in 2012, only a few mobiles apps provide information about their data practices to parent prior their download. These data practices include: if they collect any personal information, how they use this information or if there is any in-app purchase or in-app advertisement [12].

Among 200 Android app and 200 Apple app related to kids, FTC staff found that 230 apps contain ads, but only 35 of the apps tell users they contain in-app advertising and 24 apps tell users that they do not contain advertisement while 10 of these apps did contain ads. FTC staff also found 88 of the apps allow connection with social media while only 36 of the apps disclosed that they linked to social media. Moreover, FTC staff found that among these 400 apps, 66 of the apps allow users to purchase additional content via in-app purchase mechanism.

From the articles we reviewed, we learned that developing a mobile app could enhance learning and while creating apps for child, we need to follow certain design principle to make it child-friendly. Based on this review of literature we have discovered that it is very helpful for applications to have a mobile version as a companion to a web-based application. Also with Android being the most prevalently used mobile OS, we will work toward the development of an Android App for iW2K.

3. Method

3.1 The Problem

eXtension is an interactive learning environment connecting knowledge consumers with knowledge providers. It offers reliable answers based upon sound research and creative solutions to today's complex challenges.

The For Youth For Life Learning Network is a network of learners interested in a variety of subjects related to science, health, living responsibly, and service to others. It strives to explore ways to engage youth with technology and to produce youth oriented content in wide-ranging scientific topics for the knowledge base of extension.org. However, there is no particular software or application designed for children to gather information from extension.org so far. The target users of eXtension.org are the general public. It is not specifically for children, so the UI design is not friendly for children to use. It only has three words linking to the youth section lying on the end of the home page of extension.org.

Children are always impatient in finding hidden items. They would not enjoy exploring all the details in the website to find the desired link on the bottom of the page. The UI design of eXtension.org will not draw children's attention to scientific knowledge and at present the webpage is just a listing of topics of interest.

3.2 Proposed Solution

To solve the above problem of making the science information more appealing and increase ease of access, we proposed to build a child-friendly mobile app that defaults to youth content pages in the extension environment. By saying child-friendly, we plan to make the app simple and easy to navigate. The app should avoid using too much text. Instead, more pictures and large buttons will be used to attract children's attention. The app should contain links to main categories of interest (i.e. 4-H sections, which are 'Science', 'Heath', 'Responsibly', and 'Serve'). Each of the sections should have subcategories, which will connect to an article related to that category. This way, the app presents youth orientated knowledge to children even if they do not have a specific interest. The app should allow children to search for their interested areas and also browse contents. Therefore, the app should have a search button to allow text

 ISSN: 2321-8169
214 - 222

or voice input to search through the article database of extension.org.

By 2015, Android dominated the smartphone OS market with an 82.8% share[13], while iOS contributed a 13.9% share. Taking into account the fact that building an android app only requires a computer supporting android development environment, and publishing an android app costs less money and less time, we decided with client for this version to first design an application for android system and an iOS companion app later.

4. Project

4.1 Requirements

After several conversations with the client from extension.org (Dr. Cook), the following requirements are gathered:

1. This application should have four categories ('science', 'health', 'responsibility' and 'serve'). In each category, there should be several subcategories containing corresponding articles for users to read.
2. This application should have a search function, which allows users to search for topics they are interested in.
3. The search function should support both text and voice input. A search result page should contain a scrollable result list of articles.
4. This application should maintain users' interest by giving them the ability to share an article to social media.
5. This application should be accessible from a mobile device.

4.2 Comparison of Previous Versions

The first development version 0.1 prototype of iW2K was built as a responsive webpage and iPhone companion app. This was iterated through 10 versions of web software and analyzed as a good representative of the project, but there was need to have a more professional user interface and also support for Android hardware (see Figure 1 for iW2K web version).

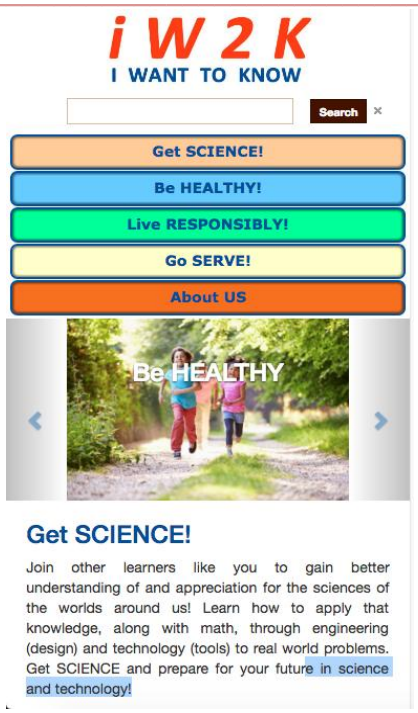
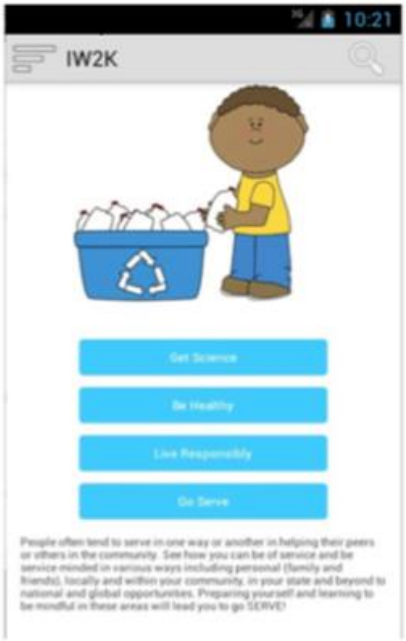


Figure 1

There were two second generation prototype versions of the iW2K app (Figure 2) created with both fulfilling some of the specified requirements. We preformed an analysis of the two versions through functionality comparison and the difference is listed in Table 1. We will create an improve version of the iW2K android app system based on those findings.

Homepage of Version 0.2

 ISSN: 2321-8169
214 - 222



Homepage of Version 0.3

Figure 2

Table 1 Comparison of V 0.2 and V 0.3

Version 0.2	Version 0.3
App has four categories ('science', 'health', 'responsibility' and 'serve'). In each category, there are several subcategories containing corresponding articles for users to read.	App finished the UI design for the main category and the corresponding subcategories. However, only one subcategory connects to the actual related article.
App has a search bar on top of the home page and subcategory page. It allows users to search for topics they are interested in.	App has the search icon on top of the home page and subcategory page and the icon bring users to a search page.
The search function supports text input. A search result page contains a scrollable result list of articles.	Search function allows text input, but doesn't search anything. The search result page always shows 'No Result Found'.
App allows sharing an article to social media.	App does not allow sharing articles to social media.

4.3 New Requirements

After investigating the two previous versions and discussing with the client (Dr. Cook), we agreed to develop a system that supports the previous five requirements and adopt the design of v0.2. We will add a few more functions to it:

1. App should have a setting button to allow users to choose the background pictures. If users choose 'cartoon', the app will change the background pictures to cartoon pictures. If users choose 'real', the app will have the same pictures as version 0.2.
2. App should utilize search through extension.org's search tools.

4.4 Flow Diagram

The application flow of the diagram is designed to keep the child's attention. It begins with the Home page where a user can click on a category, search with voice or text or change settings. If that user clicks on a category, that category is broken down into subcategories. Eventually, the user will focus down to a single article by going though categories or searching. This flow is depicted in Figure 3.

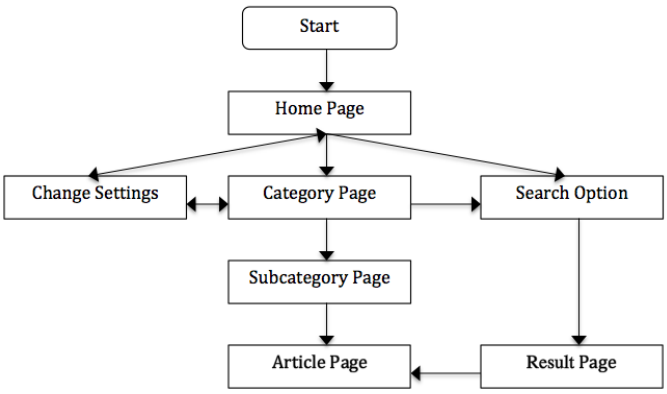


Figure 3

4.5 Tools and Technologies

For the development of our application, we used Android Studio as the IDE. This application was tested with Genymotion as the emulator and iW2K v1.0 will run on the Android SDK versions v18 - v23.

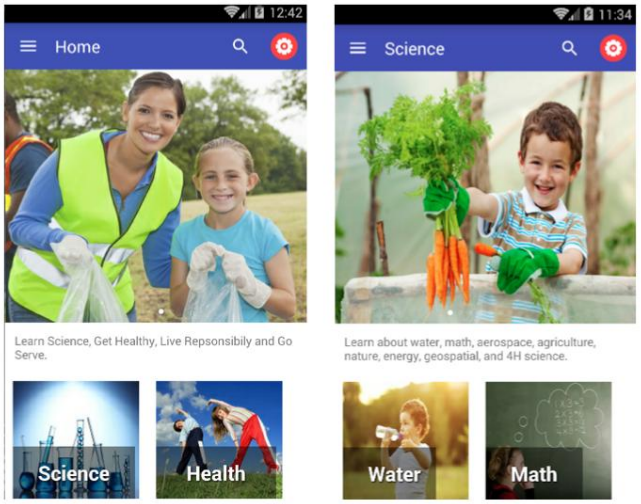
4.6 App Implementation

Our app utilized version 0.2's UI design, but rebuilt all of the code functionality from scratch. Version 0.2's app created a navigation drawer layout activity for the home page and a separate activity for each category page. If a user wants to jump to another category page from current category page, he needs to click on the back arrow on the upper left corner to go back to the home page at first, and then click on the sidebar or the image on the home page to go to the requested category page. This does not fully take advantage of navigation drawer layout.

Navigation drawer now is made as a standard by Google and numerous functions are supported. Navigation drawer layout, by default, works with multiple fragments. The main advantage is the improved performance. It not only allows users to switch among different fragments in

 ISSN: 2321-8169
214 - 222

only one step, but also, it enables code reusability. Like in version 0.2, using one activity for each category, each activity will have the repeated code for the toolbar in the top of the screen. However, in our app, when using navigation drawer with multiple fragments, we only need one set of code for toolbar in the main activity. Figure 4 shows the homepage and subcategory page of our app.

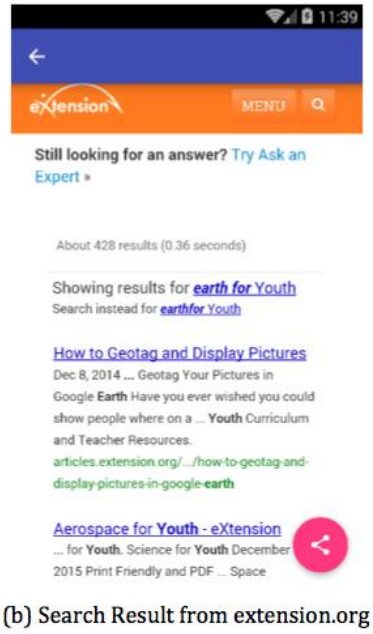


(a) Home Page (b) Subcategory Page

Figure 4

In addition to the navigation drawer in the category page, we also made changes in the result pages. In version 0.2, when users are in 'Science' and 'Health' category page and they click on image of any subcategory, they will be directed into a subcategory page containing a list of search result related to that subcategory. After discussed with Dr. Cook, we agreed that the subcategory page should have a particular article related to that subcategory, instead of a result list. Figure 5(a) shows an example article page for category 'Health'.

(a) Article Page



(b) Search Result from extension.org

Figure 5

Another big change we made is in the result page for search button. As we aim to build a child friendly app for extension.org. We want our search result contains articles from extension.org with the keywords 'youth'. Version 0.2's search function utilized Google's search engine with the keywords 'extension', 'science', and user's input. In this case, most of the search result is irrelevant to extension's article. In our app, we improved it by directly using extension's search engine. Figure 5(b) shows the search result from extension.org.

(a) Buttons to change pictures

 ISSN: 2321-8169
214 - 222

(b) Home page with 'Cartoon' selected

Figure 6

The last change we incorporated is to make the app have two different sets of background pictures. One set used more realistic photos; another used more cartoon-based pictures. Figure 6(a) shows where to select the different settings. On the upper right corner of the screen, there is a red button. Click on that button, users can find two collapsed items: 'Cartoon' and 'Real'. Clicking on any of these buttons, the pictures in the app will be changed to the required set of pictures. Figure 6(b) shows the home page when 'Cartoon' is selected.

5. Results and Analysis

We conducted several functional and usability test to assess the performance of iW2K app. Functional test identifies hidden issues. We tested every functions of the software to make sure it is working smoothly. Usability test identifies how children would like to use the app and how they would like to rate the app on a scale of 1-5. We designed an experiment, pre-survey and post-survey to evaluate the performance.

5.1 Functional Testing

5.1.2 Automated Testing

Google provides easy ways to test the android apps. With just a few clicks, we can set up a Junit test that runs on the local JVM or an instrumented test that runs on a device. For our app, we utilized Espresso frameworks to exercise user interface in our instrumented test.

The Espresso testing framework, provided by the Android Testing Support Library, provides APIs for writing UI tests to simulate user interactions within a single target app. Espresso tests can run on devices running Android 2.2 (API level 8) and higher. A key benefit of using Espresso is that it provides automatic synchronization of test actions with the UI of the app we are testing.The Espresso testing framework is an instrumentation-based API and works with the AndroidJunitRunner test runner.

Our test cases are designed in such a way that each button in the app is clicked once and the expected result was compared with the actual result. The test is passed when there is a match. To insure the quality of our app, we created five test classes. One of the class tests functions in the Home page, the other classes test functions in four categories pages respectively. Each test class contains several test methods and each method checks if a specified view works as we intended. These views included all the ImageButtons of the app, MenuItems on the navigation drawer, the Search item in the toolbar, Settings item in the toolbar and the PressBack button in the toolbar (Figure 7 give an illustration of these views). The app passed all the tests (58 tests) and proved it is working well.

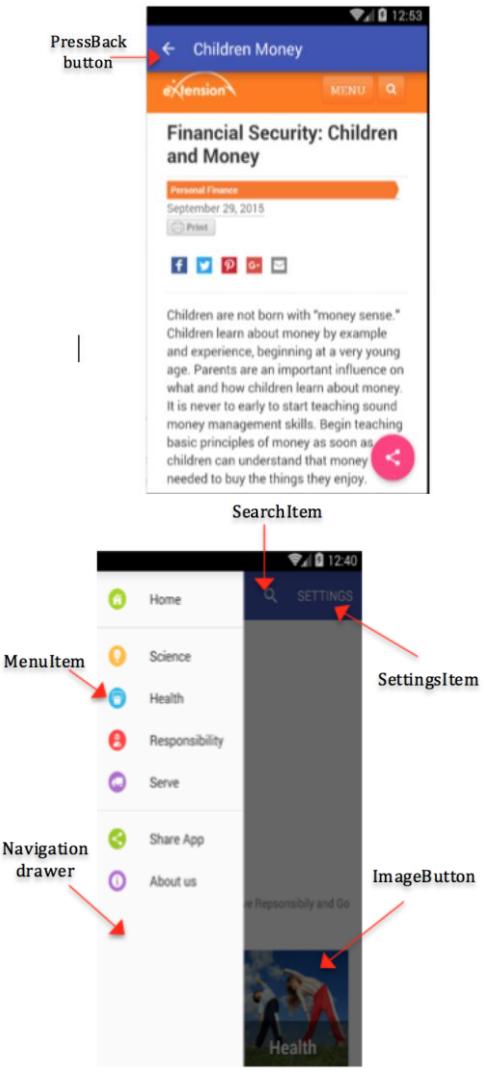


Figure 7

5.1.2 Manual Testing

Besides of the automated testing, we also performed manual testing. To give an example of manual testing, we will describe the process for manual functional testing of the search function. We tested the search function by searching using the toolbar, then verifying whether the results returned the expected contents (i.e. a list of related articles from eXtension.org). We tested searching an empty string, searching the keywords 'science' and searching any keywords children chose. Other manual tests were also performed based on the task list. All the tests provided expected results and usability testing will discussed further in section 5.2.

5.2 Usability Test

5.2.1 Test Procedures

The iW2K app was tested with teenagers from Dr. Seals' Summer Camp. They were first asked to take a pre-survey. The pre-survey asked about general information of users, such as their age, gender and what operating system their mobile phone is. It asked users' preference on certain features, such as voice search vs. text search. It also contained open-ended questions such as "What are your two favorite apps". Moreover, we also asked about their experience in online learning and learning applications on mobile devices.

After the pre-test, we generated a task list for users to test the functionality and usability of the software. A task list is a guide to help users through usability testing and it covers all the functions of the software. It asked users to navigate to, and read an article of interest from a subject that child choose and try some features of our app: sharing an article via social media and changing the background picture of the app. As we do not have enough Android mobile devices on hand, we used an emulator for the test. We tested our app on the embedded emulator of Android Studio 2.1. The mobile device is Google Nexus 5 with API 23.

After users completed the whole list of tasks, we asked them to finish the post survey. The main concern of the post-survey was the overall performance of the application. We asked the users questions such as whether the app is easy to use and would they like to use it again and recommend it to others. We also asked them to list the most positive and negative aspects of the app.

5.2.2 Data Collection and Analysis

Pre-survey results shows totally 18 participants tested this app. 16.67% of them were from 10-17 and 83.33% were from 18-20. They were all undergraduate students in Auburn University. Half of them were females and the other half is male. 77.78% of participants preferred accessing a product through mobile application while 22.22% preferred using a browser. Most of them never had any development experience before.

The results of the post-survey presented the participant's perception of the iW2K app from the usability point of view. Average response to all the usability questions indicated a positive response to the application from the usability point of view. Data was collected on a scale of 1-5 scale, 'strongly disagree' being the lowest and 'strongly agree' being the highest. The average rating for each question in the survey was nearly 4(Figure 8, Figure 9). Their response to the app was better than expected. All of them agreed that the app can enhance learning by providing information quickly, and they would recommend this app to others.

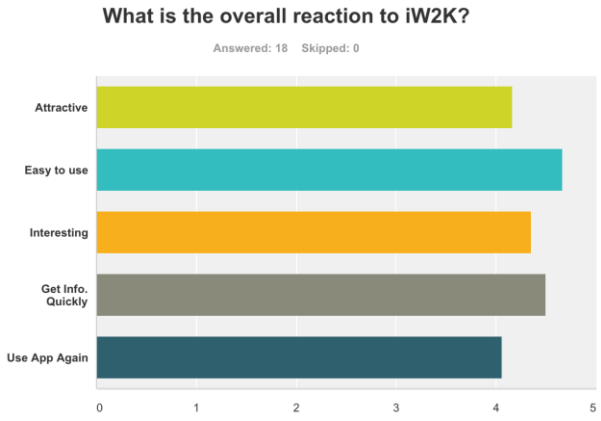


Figure 8

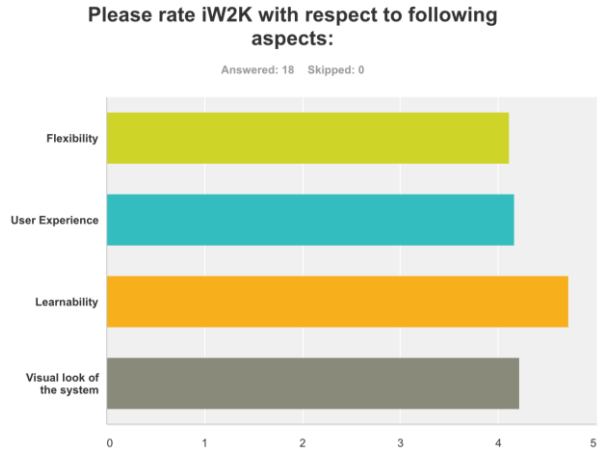


Figure 9

5.2.3 Participants Comments

Some of the participants made specific comments in regards to the app in the post-survey questionnaire. Below are some of the positive and negative aspects made by participants.

5.2.3.1 Positive Aspects

Anonymous Participant: 'Different tab for young and old'

Anonymous Participant: 'pictures'

Anonymous Participant: ' The ability to switch the visuals from the cartoon to default can make the app appeals to different age groups.'

5.3.2 Negative Aspects

Anonymous Participant: 'Some of the animations could be smoothed out. The thumbnail images in the 'default' app view seem stretched.'

Anonymous Participant: ' make the icons look better.'

Usability testing proved that the iW2K app was easy to use and the picture change settings can attract teenager's attention.

6. Future Work and Conclusions

In this project, we implemented an Android version iW2K app as an educational application for providing learning opportunities to children. The content is already provided by eXtension.org, but the website is not child-friend. It is hard for children to find the youth oriented content from the website. Our app utilized a direct hierarchical organization with categories to allow easy access to the content and also allow users using a text or audio search to find articles of their interest.When the users find an interesting article, they can share the article using email, message or other social medias. The app also provides a setting change button to allow users change themes, which make the app attractive to different level of users.

The future work of this project could be on the follow aspects:

1. While our app is designed for K-12 children, our usability test utilized a population of teenagers in a summer camp where the students are incoming freshmen at Auburn University. Thus, the next step would be testing the app with K-12 children that are affiliated with eXtension or a local K-12 school.
2. Moreover, we tested the app using an emulator. To have more accurate results, we should download the app and tested it on an actual mobile device.
3. Currently, the app is implemented on Google Nexus5, which is a 5'' device. For the next step, we would try to make the app support multi-screen and be more responsive.

References

[1] http://info.shiftelearning.com/blog/difference-between-elearning-and-mlearning
[2] Druin A. "A Placed Called Childhood". ACM Interactions, v.3, 1996, 17-22.
[3] Chiasson S. and Gutwin C., "Carl Gutwin, Design Principles for Children's Technology", Technical Report HCI-TR-2005-02, Computer Science Department, University of Saskatchewan, 2005.
[4] Samir R.T. and Hiren D. J., "E-Learning Systems: A Review."2015 IEEE Seventh International Conference on Technology for Education (T4E). IEEE, 2015.
[5] https://en.wikipedia.org/wiki/Blackboard_Inc.
[6] http://moodle.com
[7] http://moocs.com
[8] Malley C.O., "Guidelines for learning/teaching/tutoring in a mobile environment", 2005.
[9] Radovan V., "The developments in mobile learning and its application in the higher education including libraries." Information and Communication Technology, Electronics and Microelectronics (MIPRO), 2015 38th International Convention on. IEEE, 2015.
[10] Li J., "Study on the Development of Mobile Learning Promoted by Cloud Computing", In Proceedings of the 2nd International Conference on Information engineering and Computer Science (ICIECS). 2010,1.
[11] Druin A., Bederson B., Hourcade J.P., Sherman L., Revelle G., Platner M., and Weng S., "Designing a Digital Library for Young Children", Proc. ACM JCDL 2001, 398-405.
[12] https://www.ftc.gov/sites/default/files/documents/reports/mobile-apps-kids-current-privacy-disclosures-are-disappointing/120216mobile_apps_kids.pdf
[13] http://www.idc.com/prodserv/smartphone-os-market-share.jsp