COMPARING NATIVE AND CROSS-PLATFORM DEVELOPMENT TABLET ENVIRONMENTS BASED ON AN APPLICATION FOR AUTISM.

by

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ABSTRACT

Software development on tablet devices is very important. The leading tablet devices on the market are Google’s Android tablet and Apple’s iPad tablet. We will be comparing both native environment development and cross-platform development through the design and implementation of a tablet application for Autistic children. Autistic children show drastic improvement in school with the assistance of tablet applications. Utilizing both the iPad and Android tablet’s features like animations, touch sensors, button interaction and sound output all help to hold the attention of Autistic children.
1 Introduction

Tablets have been around since at least 1985, when a company named Pencept joined with another, CIC, to create the first PC pen computer products that implemented handwriting recognition technology [19]. Apple then redefined the tablet industry with its release of the iPad in April of 2010 [20]. The Xoom, the first Android tablet released, hit the market on February 2011 [21]. Apple relayed that there are currently 700,000 applications available with 250,000 of them specifically designed for the iPad. In 2010, Android’s own application market place accumulated 1 billion user downloads of their applications, to 2012 where they are now up to about 25 billion application downloads. Similarly, Apple released a statement about 7 months prior when they had achieved their 25 billion applications downloads benchmark [22]. Autistic children show drastic progression when utilizing the educational applications offered on both the iPad and Android application markets.

Nearly one in every 110 American children is diagnosed with autism. This non-curable, complex neurobiological disorder comes with several lifelong symptoms [8]; however, with early intervention these symptoms can be either minimized or treated to the point of making them significantly more manageable later in life. Some of these symptoms include, but are not limited to, difficulties in social interaction, verbal and non-verbal communication problems, sensitivity of the five senses, and behavioral issues that include unresponsiveness. This list of symptoms is a vast collection of obstacles faced by those suffering from autism [2], but the use of technology can help. The utilization of tablets during the stages of early intervention is a new and supported method of help.
The iPad, created by Apple, and the Android tablet, created by Google, are giving those with autism a voice. The tablets hosts a wide range of applications used to teach and aid those suffering from this neurobiological disorder [4].

We propose to redevelop the Do2Learn application “What’s the Order” [6]. Do2Learn’s application is an autism education game that teaches linear and relative time. It has extensive options on its start menu for setting up different scenarios for individual learning experiences. This application employs videos, animations, voiceovers, a reward system, and game play assistance. We intend to redevelop “What’s the Order” and port it on to the Android and iPad tablets utilizing native application environments and a cross-platform framework, and compare the results.

2 Background

2.1 Multi-Platform Application Development

With Today’s elevated standards of technology, companies are forced to utilize iOS, Android, Mobile and Web devices or else suffer a loss of competitiveness within the marketplace. It is plausible for a company to choose just one device and disregard development for the others but this path leads to the loss of accessibility among their clientele. A company could also choose to develop for multiple devices but this would require programming in different languages using different compilers for each of the devices. This method is costly and time consuming. A third avenue is for a company to develop their application on a multi-platform environment with a single code base. This would allow for one programming language to bring the application to all relevant
devices without having to individually code them. For this research, one code base would be used to implement the application on both the iOS and Android tablets. Benefits like lower development and maintenance costs, increased productivity, quicker transition to application market, and reduced training or learning for the one development platform are all side effects realized by cross-platform development environments. While using a single code base is convenient and allows for rapid prototyping, can be web oriented, and offers shorter development time, negatives for this method also exist. Complications like the increasing complexity, costs increases for added development features, bugs in software, flexibility limitations, and a large learning curve for implementing the new framework [18]. This method is still in its infancy stage struggling with several limitations, like increase complexity, costs, software bugs, flexibility limitations and learning curve, not seen by the other solutions and should not be seen as an error proof solution to multi platform programming [14].

2.1.1 Multi-Platform Development Environment

Appcelerator’s Titanium Platform sdk allows programmers to code applications using a single JavaScript code base for developing iOS, Android and mobile web apps [15]. It offers support for iOS, Adroid and HTML5. Appcelerator also offers the Titanium Studio, which is an Eclipse-based IDE, integrated development environment, that can be used to build, test, package, and publish, desktop and web applications. This solution comes with four versions, the basic model available for free download and the premium models available for an unlisted fee. Even with the added benefits of the premium model, the basic model is fully functioning and has everything a developer needs just short of offering the support service found in the premium version. Appcelerator, while giving a
free solution in the form of developer tools and support services comes with unique
“libraries, syntax, and development approaches” applicable only to its own environment
[16]. This unique framework requires a lot of time to become proficient in utilizing its
functionality, time that would be commanded by the “trial and error” life cycle.

Motorola’s RhoMobile Rhodes, a popular multi-platform development environment,
offers an open source, single code base of a Ruby on Rails framework with a model-
view-controller setup [9]. Their slogan of, “one codebase, every smartphone,” offers
insight into to how their single codebase can encompass all of the most popular devices
on today’s market without the costs and time restraints put on single platform
development. RhoMobile, unlike Appcelerator, uses a programming language that
allows programmers that already are familiar with Ruby to jump the learning curve of
developing on this platform. This framework, joined with the use of the Git distributed
version control system, DVCS, gives developers the tools needed in an effective and
efficient manner and the support needed to secure the application’s code. This bundle is
made more user friendly with its new installation executable file on Windows [16].

A different way of achieving cross-platform development that circumvents the limitations
posed by a single code based framework, is to develop a web application using
JavaScript, CSS, or HTML. This strategy altogether bypasses the native application
development process capitalizing on the universality of web applications.

2.2 Autism Background

Autism is a spectrum of strengths, weaknesses, and intelligence levels. While these
table applications aren’t a cure to Autism, it doesn’t disqualify the device as being a
revolutionary medium for education in the classroom. Laura Holmquist quoted to Fox News that through the integrating of the iPad device into her son’s, Hudson Holmquist, life, they were able to get his violent hourly meltdowns under control and help increase the effectiveness of communication between them [5]. A Harvard Medical assistant professor and Autism expert, Dr. Martha Herbert, fully backs the implementation of the iPad for Autism. Dr. Herbert relates how the iPad gives control to Autistic individuals who can’t control or sift through the vast amounts of information being hurled at them daily [5].

Those suffering from Autism are constantly being alienated because of their differences. Having to use bulky communication devices just does that much more to draw unwanted attention to their daily struggles. By taking the tablets out of the classrooms and onto the streets, those with Autism can use the many functionalities for daily life, helping them to become more independent in everyday life. In addition, to meeting the social needs of Autistic individuals these tablets, while expensive for recreational use, is cheap in comparison to the bulky communication devices normally prescribed to help those with Autism [12].

### 3 iPad Autism Applications

There is a notable disparity between the amount of autism applications offered on the iPad verses the Android tablet. The iPad is overwhelmingly the tablet of choice among those looking to employ the benefits of tablet applications as a teaching medium. The specific iPad applications that are designed to help autistic symptoms are focused mostly on sensory stimuli, language and communication improvement, and the
reduction of social deficiencies, functional shortages and stress levels. These
categories cover a wide range of the symptoms that make autism a daily struggle.

Applications, like the iAssist Communicator for the iPad, allow Autistic individuals to
touch corresponding pictures and words to help them communicate what they are
thinking [3]. An app called iMean is essentially a large keyboard that displays texts and
utilizes word prediction for Autistic people to communicate without being confined by a
picture based word bank [3]. Autistic people tend to have trouble making eye contact,
so the app Look in My Eyes: Steam Train uses the animation of a train to help teach
eye contact [3]. For children in school dealing with autism the app School Skills has a
database of expected and unexpected social skills pertaining to interactions one might
encounter in different classrooms, the lunchroom, playing with friends as well as
interpreting feelings like anger, responsibility and disappointment. Some people
suffering from autism have difficulty reading social cues like smiling, so the app Smile at
Me uses a reward system to promote the learning of smiling cues [3]. The list of
applications tailored to the needs of those with Autism is expanding exponentially.
Through this avenue of technology those suffering from Autism now have an outlet that
allows them to express themselves in areas they couldn’t before.

3.1 Proloquo2Go

Out of the top-rated applications for autism on the iPad, one called Proloquo2Go is
rated first [1]. Proloquo2Go is a communication application with a wide spectrum of
features tailored to provide solutions to the many difficulties these children face when
communicating. This application has a text-to-speech option along with a library of up-
to-date symbols that represent vocabulary. Proloquo2Go, though revolutionary and undoubtedly a helpful resource for those with autism, is priced at $189.99, making it a costly option for many people struggling to cover all of the other costs associated with autism.

3.2 Grace

The second top-rated application, Grace, is a more affordable communication solution [1]. Grace allows the user to build sentences by selecting images from its database that depict the subjects they wish to communicate. The unique feature of this application lies in its drive to build a relationship between the talker or typist and the listener or reader. The child with autism will communicate what they want through pictures and words that the recipient will understand, creating an open social interaction along with aided communication. This application is on the Apple market for $37.99.

3.3 iCommunicate

The iCommunicate application, ranked third among iPad autism applications, is utilized as a teaching aid more than just a communication aid [1]. iCommunicate allows users to create custom flash cards with their own images. These custom-designed flash cards can then be selected in different combinations to result in the desired sentence; it also allows the user to create custom audio input for communication and teaching in any language. Coming with a library of a 100-plus options to start with and user friendly operation, the iCommunicate application goes a step further in helping teach children with autism and is only $29.99 in the market.
3.4 AutismExpress

AutismExpress is an app designed to help struggling children learn how to express themselves emotionally [1]. It comes with a preloaded library of the most used and common emotions, which are depicted by smiley faces, frowning faces and other cartoon-like facial expressions. These depictions are used to help the children overcome their low functioning social and communication skills, allowing them to better understand and interact with those around them and to better understand and handle the emotions they experience. This application is not only effective but also free, allowing access to more people.

4 Android Autism Applications

Recently, the Android market has grown to be a more comparable size with the iPad’s autism application market. Top rated applications, like the AAC Speech Communicator application was developed for all ages of autism that are struggling with communication [7]. The application helps teach communication methods and skills, focusing closely on those with reading difficulties. As a huge contrast to the top rated iPad app, the AAC Speech Communicator is free.

4.1 AutismSpeech DiegoSays

AutismSpeech DiegoSays, is the second highest ranked app in the list of top autism Android applications [7]. AutismSpeech is another communication assistor. This app utilizes pictures and voice functionalities to help give those with autism a voice.
4.2 DTT Colors Full

Autism/DTT Colors Full, the third most prominent amongst the android apps, was developed by Dr. Gary Brown [7]. Dr. Brown’s app uses the method of Discrete Trial Training, DTT, to teach the fundamentals of colors to autistic children. DTT works by breaking down a whole skill into its parts. The discrete trials break down a skill, teaching step-by-step the understanding and emulation of that skill, and then proceeds to slowly and methodically build the skill back up into its whole state [17].

4.3 Alexicom AAC

Alexicom AAC for Android, is an app whose functionality allows the user to input their own images [7]. In addition, this app offers word prediction, text-to-speech, 1,200+ pre-packaged pages, over 7,000 images, 20 natural voices in over 7 languages, and a cloud back up service for between device sharing for a $40 per month fee.

5 Do2Learn’s Application User Interface

Do2Learn’s “What’s the Order?” has a start screen interface that allows the instructor to select options for customizing each individual game for their autistic students or children. The application focuses on linear and relative time and, within those, several subcategory options including basic and advanced play. In linear time, once the player’s name has been entered, and the instructions, accessed by pressing the corresponding button located in the top right quadrant, has been read, the instructor can select as many actions as they want. Then they need to choose if they want the game to continue on repeat, if they want practice rounds before each game, how many rounds they want
per game, if they want a reward screen to come up after the player is successful in the game, if they want instructional, conversational text to appear on the top of the screen during the game, and if they want a video of the actions selected to be played before each game round; see Figure 1. The Instructions button links to a fully detailed instructional page to help users navigate through the application; see Figure 2.
The relative time option, as well as the linear time option, offers basic and advanced playing modes, both with continued options available with the Advanced Options button; see Figure 3. The Advanced Options button takes you to a separate screen where you are given control over how you want the game dynamics set up; see Figure 4.
Once all options in the game’s start menu are selected and the instructor presses the Play Game button, the player is taken to the game screen. If the video option was selected, the player is immediately shown a video of someone completing one of the previously selected actions; see Figure 5.

Once the video runs, the player is directed back to the game screen where they are looking at an array of boxes and images for the action selected in the start menu and seen in the video. In Figure 6, the action ‘put on sock’ was selected under linear time. Here, the player is shown two images and asked to place them in order of what image happened first and then what image happened second. In Figure 7, the same ‘put on sock’ action was selected but under relative time. In a game with relative time selected, the player is given the middle image and asked to select what image comes earlier and which one comes later than the middle image.
If the player incorrectly guesses the images order, a voice clip plays telling them that is incorrect and to try again. The player is also given a help option, located on the top right.
corner. Once selected, a white-gloved hand appears and points to the correct answer of the part the student is currently trying to solve; see Figure 8. It then disappears and allows the student to continue trying on his or her own. When they guess correctly they receive a point, which manifests as a bubble in the bottom panel of the screen. If the rewards screen was selected in the start menu, upon correctly finishing the game rounds, a short animation of a wizard with a ‘good job’ sign pops up; see Figure 9.
Once the player completes all rounds the instructor can select the Back button, located on the top left of the screen, and navigate to the main start menu again. From here, the instructor can select the View Report button, located in the top left corner of the main start menu, and see an over view of data collected from the student playing the game; see Figure 10.

[6] – Figure 10

6 Proposal

We propose to redevelop an application, which was originally a web app from Do2learn.com, a site dedicated to helping those with Autism. Do2Learn’s application is called “What’s the Order” [6]. Our version focuses on integrating the benefits of a tablet with the proven autism games for teaching linear and relative time, concepts not easily absorbed by those struggling with autism. Research has established that the rods and cones found in the eyes of autistic children show irregularities, most likely due to
chemical imbalances and deficiencies, in comparison to their non-autistic counterparts. This difference manifests itself into color sensitivity. 85% of those tested reported seeing colors at a “greater intensity” than those tested without autism [13]. “What’s the Order’s” user interface displays neutral colors that are shown to calm and not agitate those with autism [11]. This allows the user interface to promote visual learning with no negative visual effects. The app’s set up screen allows for high customization, which gives teachers or parents the ability to focus on the best method of teaching and best kinds of stimulation for each individual person with autism. Research shows that using animation and touch features help to engage those with autism far better than alternative methods [10]. In addition, top rated applications on both the iPad and Android markets seem to lack realistic images. Instead they teach through use of cartoon-esque imagery. “What’s the Order” utilizes real life images to help not only teach the concepts but teach the concepts in a practical, real life related context. “What’s the Order” does not have the same disconnect that other top rated applications have between their cartoon-styled pictures and the real world corresponding equivalents. In order to help a wider spectrum of autistic learners, implementing realistic libraries of images within the applications teaching games would help these students better connect with the world around them.

This research takes the idea of “What’s the Order” and ports it on to both the Android and iPad tablets. The purpose of this application is to teach young children with moderate to severe autism how to tell time in both a relative and linear capacity. The ported, tablet application’s user interface will be loosely modeled after it’s web application predecessor but adds color neutrality, touch functionality, and layout size
adjustments. The color difference is adopted due to research indicating that neutral, non-bright colors help autistic students focus better than bright reds and yellows that appear almost florescent to them [13]. By porting the concept over from a web application to a tablet application, adding touch functionality becomes a necessity. The tablet’s user interfaces run off of touch function where as web application’s run off of mouse gestures. Additionally, when developing for a web application, layout orientation and dimension constraints are more flexible than developing for a tablet interface that is constricted by the smaller screen resolution. This research produces functional prototypes for the Android and iPad tablets using two different development methodologies; individual prototype development for the separate Android and iPad environments, Eclipse and Xcode respectively, and a prototype utilizing the cross-platform framework of Motorola’s RhoMobile Rhodes.

7 Conclusion

7.1 Developmental Conclusion

After developing prototypes under Eclipse, the native Android environment, and Xcode, the native iPad environment, we found using the cross-platform development method to be the best solution. By developing a prototype through RhoMobile we were able to cut development time, and maintained time, in half. RhoMobile is an Eclipse installation, which cuts down the learning curve of having to get familiarized with a new program interface. RhoMobile uses one code base of Ruby on Rails to deploy an application to the iPad, Android and many more devices, which is unlike its alternative of programing
for an multi-device-compatible application in their native environments of the iPad tablet, which uses Objective-C, and the Android tablet, which uses Java.

7.2 Work-To-Date

Our work so far consists of three functional prototypes; one developed through the native Android environment only compatible with the Android tablet, see figure 11, one developed through the native iPad environment only compatible with the iPad tablet, see figure 12, and one developed through RhoMobile with multi-device compatibility.

- Figure 11

- Figure 12
All three user interfaces feature the same options and information from Do2Learn’s original web application. The prototypes error check to make sure the necessary information on the main menu screen has been inputted or selected before the user can start the game. In game mode, the prototypes feature placeholder images to be later filled in with Do2Learn’s image and video library; see figure 13. While the user plays the game a logic method checks to make sure that the move is correct and that the image repositions itself to the image place holder location the user just touched, see figure 14. After the selected rounds have been played and completed, the score integer is incremented and sent to the report screen along with username and rounds played, see figure 15.
7.3 Future Work

Future plans include continued development on the cross-platform prototypes to use in comparison against the native environment prototypes. This comparison will yield one of three choices for further application development. Option one is native environment development that would involve separate programming for both the Xcode and the Eclipse environments. Option two and three is development on one of two cross-platform environments, RhoMobile or Appcelerator. Future work includes the comparison between native environments, RhoMobile and Appcelerator through the development of an Autism application’s prototypes. Further work needs to be done on both of the cross-platform prototypes needed for comparison. Once the comparison between the three options yields which developmental method is the most effective and efficient, application development on the selected prototype(s) will evolve to include, multi-level game play, a more detailed option selections, additional navigation pages,
video and animation implementation, the integration of the stock images from Do2Learn’s original web application, interactive sound clips, and user interface adjustments, like layout images and positioning of graphic elements. Upon completion, the application will be deployment to both the Android and Apple markets places.
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