

Mobile Application Development in the Classroom

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Abstract

The demand for mobile application development is increasing (Scarsella & Stofega, 2017). To keep pace with the demand, educators and schools are increasingly required to provide the necessary skills and training. In this research article, the demand and career pathways for mobile application development, mobile application development environments, and classroom exercises to teach mobile application development are presented.

Introduction

The goal of this article is to provide educator the necessary tools and information in order to teach students how to create their first mobile application. The article begins by providing a common set of definitions related to mobile application development. Next, a literature review specific to mobile application development (e.g., demand, careers, and market space) and teaching application development in the classroom. This will set the context for the subsequent sections and the discussions therein. Following that, the importance of teaching mobile application development is discussed. Finally, three classroom exercises are presented that will engage students in learning about mobile application development. Although the focus of this research article is on the pedagogical aspects of mobile application development, it is important to note that the mobile application development exercises will result in a fully-functional application on a mobile phone.

Definitions

Application development - The process of designing (software development) for a computational system. This process may include programming, designing, testing, debugging, and maintaining software.

Mobile application development - Application development specifically for mobile applications devices such as phones and tablets.

Integrated Development Environment (IDE) - A comprehensive software development environment that provides editing, publishing, debugging and compiling features all in one package.

Literature Review

In this section the authors will present a review of the literature pertinent to the

discussion on mobile application development. This section will begin by exploring the demand for mobile applications related to cell phone adoption as well as software application downloads. Following that, career pathways and educational requirements for application developers will be discussed. Finally, the income potential for application developers as well as the responsibilities of application developers will be explored.

Demand for mobile applications. The prominence of smart phones and tablets has created an incredible career opportunity in mobile application development. There were 1.53 billion smartphones shipped globally in 2017 (Scarsella & Stofega, 2017). The annual shipment of smartphones is predicted to increase to 1.77 billion in 2021. Sales of smartphones contribute to the 2.53 billion users globally who own smartphones in 2018 (Statista, 2018b). The global tablet market peaked in 2014 with 230.1 million units shipped (Statista, 2018a). In 2017, shipments dipped to 163.5 million units, but production is projected to increase to 185 million units shipped in 2020.

The appeal of these devices can be attributed to the combination of their mobility and ability to run applications. People are attracted to mobile applications because they can make life easier, they are fun, they provide innovative solutions, they facilitate evolving methods of communications, and the applications are inexpensive and provide business benefits (Creed Global Technologies, 2016; Malhotra, 2014). This has created a flourishing market for mobile application development.

The marketplace for mobile application development has increased significantly over the very short term and is projected to grow substantially in the future. According to the statistical portal Statista (2017), worldwide mobile application downloads in 2016 were approximately 149,300,000,000 and is projected to reach 350,000,000,000 in 2021. This represents a large-scale demand side pull for mobile application programmers. As such, it is incumbent upon educators to incorporate this new programming platform into the classroom; much as it was to move from mainframe programming to PC programming years ago.

Pathway to careers in mobile application development. The continued growth in demand for mobile applications has created an enormous demand for individuals capable of developing them. Dickins (2016) suggested that people consider several issues before pursuing a career in mobile application development.

1. What education is required?
2. How much money can be earned?
3. What does a mobile application developer do?

Education. Developing mobile applications requires a strong understanding of multiple programming languages. A well-rounded application developer will be familiar with

programming languages like Java, SQL, C#, C++, Python, PHP, Ruby on Rails, HTML, and Swift (CodeConquest, 2015; IT Career Finders, 2018; Schools.com, 2018; Tittel, 2017). Individuals then must decide how best to acquire these skills.

The traditional path is to pursue a degree in computer science (Bureau of Labor Statistics, 2018; Ku & Capolupo, 2014; Reese, 2015; Schools.com, 2018; Tittel, 2017). A degree in computer science, however, is not a requirement. For those with an aptitude towards learning programming on their own, they may choose certifications and training programs (Schools.com, 2018; Tittel, 2017). There are countless online courses (Adiseshiah, 2018; CodeConquest, 2015), bootcamps (Stewart, 2018; SwitchUp, 2018), and books (Android News, 2017; K. A., 2017; Lewis, 2016; Rocheleau, 2017).

Earning potential. The Bureau of Labor Statistics (2018) has indicated that the median salary for application developers in May 2016 was about \$100,000. This salary was based on the broader category of application development, not specifically to mobile application development. A more focused look at mobile application development suggests that average salaries range from around \$70,000 to \$110,000 (Chegg Internships, 2018; Dickins, 2016; IT Career Finders, 2018; Payscale, 2018; Salary.com, 2018)

Responsibilities. The obvious responsibility of a mobile application developer is to create applications for mobile devices. There are, however, multiple aspects that must be addressed in this process. The responsibilities of a mobile application developer can include (Bureau of Labor Statistics, 2018; Chegg Internships, 2018; IT Career Finders, 2018; Payscale, 2018):

- Create or collaborate in the development of the idea for a mobile application.
- Coding, testing, debugging and documenting changes in the development of a mobile application.
- Adapting or migrating software typically installed on a computer or server into a mobile application form.
- Adapting or migrating web applications into a mobile application form.

Classroom Activities

The following three classroom activities are designed to engage students in the exploration of mobile application programming. There is no *a priori* knowledge of mobile application development required for either instructors or students. However, basic computer, mathematics, proficiency with personal computers, and some knowledge of application development environments is required. These activities are meant to build upon each other. The first is an exercise designed to assist students in understanding a basic Integrated Development Environment (IDE). The second is an activity that will assist students in learning about mobile programming within the IDE. The final activity is a programming exercise that demonstrates mastery of the IDE and the specifics of

mobile application development learned in exercises one and two.

Learning Objectives

1. Students will demonstrate knowledge of an IDE.
2. Students will demonstrate specific knowledge of a mobile application development environment.
3. Students will synthesize knowledge gained in objectives one and two to create a mobile application.

Required Materials

1. Computer with Web Browser
2. Internet Connectivity
3. MS Visual Studio IDE w/ Xamarin
4. (Optional) Mobile Device

Classroom Exercises

1. Installation of MS Visual Studio.
 - a. The instructor begins the discussion on IDEs. The following definitions should be explained:
 - a. Application development
 - b. Mobile application development
 - c. Integrated Development Environment
 - b. Students may review the literature on the Internet for further information and discussion on IDEs.
 - c. The instructor will then demonstrate the download and install of MS Visual Studio with special attention on installing Xamarin.
 - d. Students should familiarize themselves with the System Requirements for installing Visual Studio and Xamarin, see systems requirements in References section (Microsoft, 2018).
 - e. Students will then download/install MS Visual Studio with Xamarin using the following instructions:

Visual Studio Community 2017 installation steps:

If you already have Visual Studio installed, open **Control Panel > Programs and Features**, choose the **Visual Studio 2017** item, and click **Change**. When the installer opens, click **Modify** and skip to step 5 below.

1. The installation might restart the computer a few times, so save any work in progress and close all the applications.
2. Download Visual studio community from the following link:
<https://www.visualstudio.com/download>
3. Open the downloaded .exe file and select mobile development with .Net from the workloads.

- Click install and the installer will download the required packages. This might take anywhere between twenty minutes and two hours.

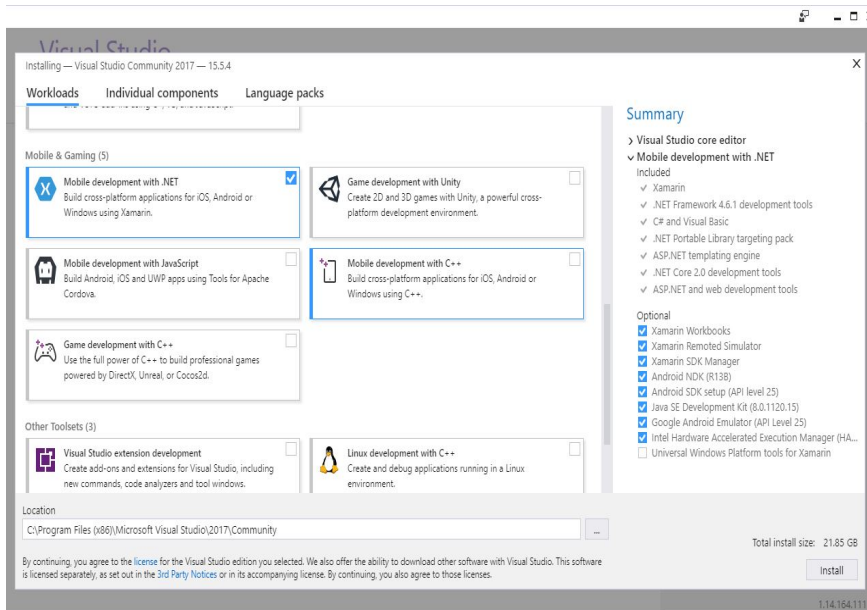


Figure 1. Selecting Mobile development package for installation.

- The below image shows the progress.

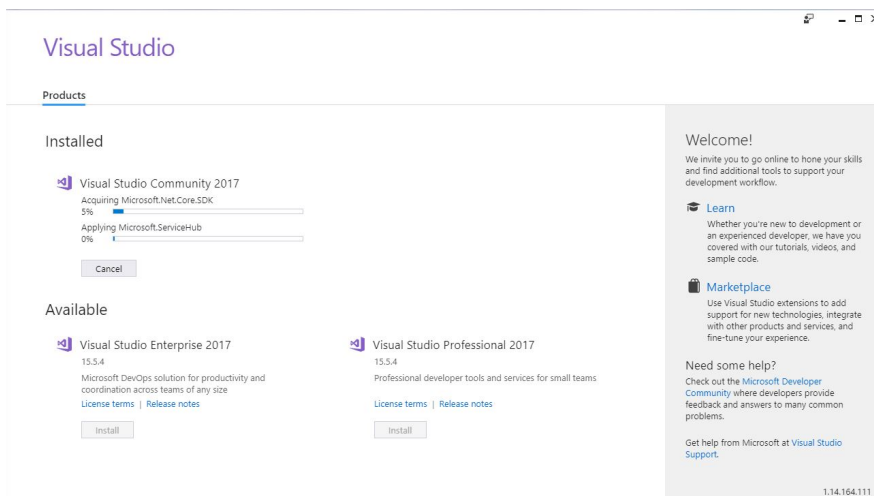


Figure 2. Installation progress.

6. Once installation is complete, launch Visual Studio and sign in with your Microsoft account if you have one or simply start using Visual Studio. Task is complete.

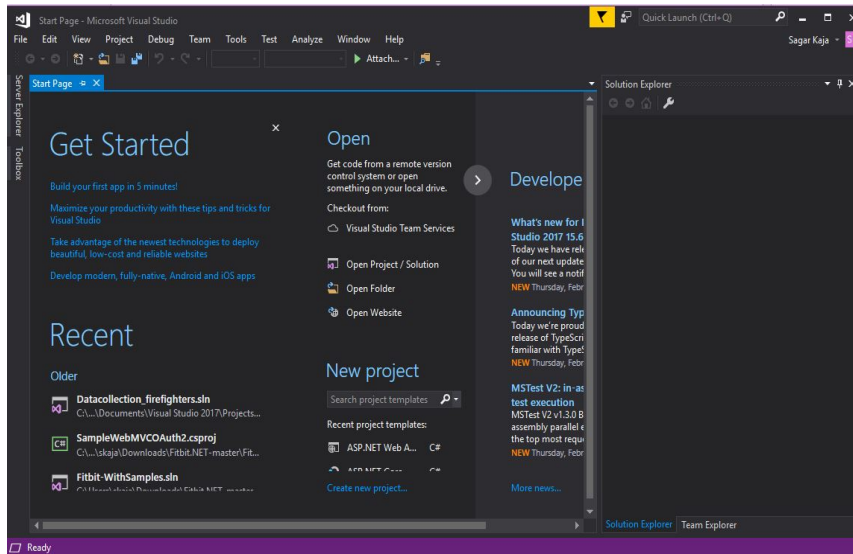


Figure 3. Visual Studio launch after logging in with Microsoft Account.

2. Classroom Discussion of the Xamarin Mobile Programming Platform.
 - a. The instructor explains differences between mobile application development and PC application development
 - b. Students compare and contrast the two environments.
 - c. Instructor demonstrates controls and objects specific to Xamarin and compares similar controls to the PC application development environment.
3. Programming of Xamarin/Visual Studio application.
 - a. The instructor tasks the students to write a click counting application (ClickCounter).
 - b. Utilize the phone emulator to design and test.
 - c. (Optional) After testing, implement the ClickCounter mobile application on the students' devices.
 - d. The following steps can be followed to create the mobile click counting (ClickCounter) application:

Android Phone: Development of a Simple Mobile Application

Introduction to Android development with Xamarin.

In this walkthrough, a simple mobile application is created that provides a text-based counter and button. The counter increments by one every time the user clicks the button and the counter reports the total number of clicks. Xamarin is the development environment for Android mobile phones within the Visual Studio environment installed

in Classroom Exercise 1 above. The click counting application is provided by Microsoft and the source code is installed (by default) in Classroom Exercise 1 as well.

Mobile Application programming within the Emulator.

1. If not already opened, launch Visual Studio and sign in with your Microsoft account if you have one.
2. Click on Create new project and select **Visual C#, Android, Single-View App (Android)**
 - a. Note the location on the hard drive where Visual Studio stores this application. By default, it is located in Documents\Visual Studio 2017\Projects
 - b. Give the Application a name such as “ClickCounter” then click the OK Button.
3. The Getting Started with Xamarin environment is now loaded. In the upper right corner is the Solution Explorer for the ClickCounter application. In the Explorer, the **MainActivity.cs** contains the source code for the click counter. By default, the example code is already given by Microsoft and all that is left is to compile and run the application.
 - a. The instructor may encourage the students to explore the Xamarin environment using the Solution Explorer window.
 - i. The source code is in the MainActivity.cs file.
 - ii. The phone screen and design layout (Buttons, Text boxes and other GUI tools to add to the application) are in the Solution Explorer, Resources, **Main.axml** file.
4. To compile and launch the application, click on **Debug, Start Debugging** or simply press the F5 key.
 - a. This will launch the Android Phone emulator (after successful compilation) that is part of the Visual Studio 2017 environment as shown in Figure 4. The emulator behaves as an android phone and the mouse and left-click button are used to press icons on the phone emulator’s screen.
 - b. Using the mouse, click on the **Apps** button and select the application (**ClickCounter**).
 - c. The mobile application is now running. Testing of the mobile application is complete. Task is Complete.

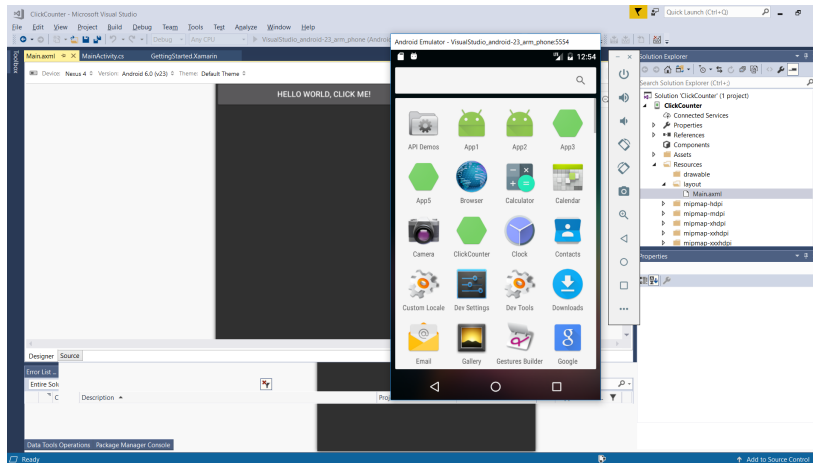


Figure 4. Solution Explorer and ClickCounter mobile application within Visual Studio (Xamarin) Emulator.

Mobile Application program deployed to the Android Phone (Optional).

1. In this optional exercise, the mobile application created in the previous step will be ported to the student's phone. Android debugging must be enabled on the mobile phone for this to work.
 - a. Navigate to Settings > About Phone > scroll to the bottom > tap Build number seven (7) times.
 - b. Go back and now access the Developer options menu, check 'USB debugging' and click OK on the prompt.
2. With USB debugging enabled, plug the phone into the computer with a USB cable. The phone will now appear as the default Build platform instead of the Android Emulator.
3. To deploy to the phone, click on **Debug, Start Debugging** or simply press the F5 key.
4. The mobile application is now deployed to the phone, the application will launch on the phone automatically after it is deployed over USB as shown in Figure 5. Run the application on the phone. Testing and deployment of the mobile application is complete. Task is complete.

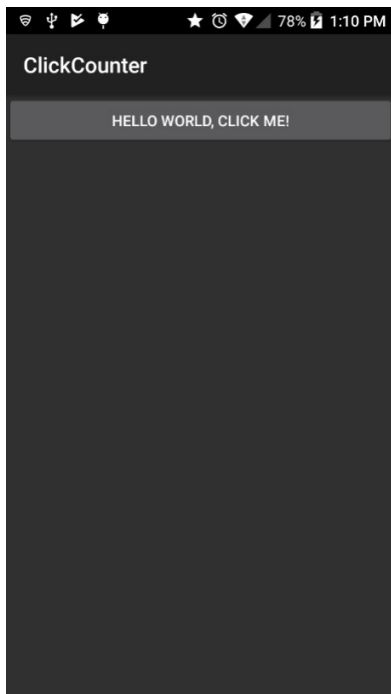


Figure 5. ClickCounter mobile application running on an Android phone.

Configuring Emulators

Various Android emulator tools are available in Visual Studio. Each has different device and performance characteristics. Select the emulator that best suites the target phone including the Android version and screen size. That will simplify the debugging process and assist in the Graphical User Interface (GUI) presentation. To access the Android emulators within Visual Studio, click on **Tools, Android, Android Emulator Manager**. This will bring up the Android Virtual Device Manager.

Conclusion

In this article, the authors begin by providing a literature review and definitions specific to mobile application development and teaching application development in the classroom. Definitions of terms pertinent to mobile application development were provided. A discussion of the importance of teaching mobile application development was presented as well.

At the culmination of this article, three classroom exercises were presented that will engage students in learning about mobile application development. Instructions for completing a click counting mobile phone application were provided. Instructors can follow the steps outlined above, and students will create their own Android applications either on a device or within an emulator.

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