Evaluating and Designing Smartphone Applications for Nursing Education

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Abstract -The smartphone has become a popular accessory in the pocket of many nursing students nowadays. They are widely accepted new devices much cheaper and more universal than PDAs. The use of smartphone applications would be the good supplement for nursing education. The smartphone provides a quick access to educational materials and guidelines during clinical, class and panel discussion. With downloadable applications, subscriptions, and reference materials, they can be used to engage students and reinforce learning anytime and anywhere. New nurses can review references online instructional videos prior to performing skills in their clinical practice. Furthermore, the rapid change of preferred treatments, drug dosages, postsurgical care, and preventive healthcare regimens requires knowledge update and lifelong learning for both nursing students and experienced nurses. This article will introduce the issues surrounding the use of smartphones in nursing education first, then discuss the related technologies in the design and development of smartphone applications.

Index Terms - smartphone, application, nursing education, iOS, Android, UML, prototype

1. Introduction

The smartphones are the most widely used in adolescents and young adults that carry them most of the time. Smartphone users may download additional software to increase their phones' functions. These applications, known as ''apps,'' are developed by companies or independent programmers and loaded onto websites like Apple Store or Google Play for download to iPhone or android phone respectively. Apple has the App store, and Android has the Google Play as application purchasing sites. Apps can be free or for-fee. On average, iPhone apps cost between $0.99 and $4.99. More complex or specialized applications tend to have higher prices. Apps can be used on the phone with and without an Internet connection. Smartphone users have the option of using their smartphone as an independent unit, manually synchronizing it to a desktop, or using cellular and wireless networks to synchronize the smartphone to a desktop computer or another server at a distant location, sometimes known as cloud computing. Thus the mobile phone has the potential to provide learning materials to nursing students. Apps on both iOS and Android platform bring new opportunities to traditional classroom-based learning as well as to lifelong learning outside the classroom. Teachers can use these widely available, affordable and instantaneous tools to deliver relevant information or learning materials to students.This has emerged as a promising trend in nursing education to enhance the availability and accessibility of existing learning resources[1].

2. Smartphone Apps in Nursing Education

2.1 Overview

How to prevent medication errors among nurses and nursing students has become the focus of concern in patient safety. The main contributing factors to medication errors made by nursing students have been identified as performance deficit, not following procedures, and knowledge deficit[2]. Undoubtedly, sufficient academic preparation regarding medications is necessary for nursing students before undertaking their practicum. However, nursing students generally learn medication knowledge and clinical skills through courses on pharmacology and nursing[3]. In order to administer medications safely, students should master the skills in preparing medications, knowledge regarding the action and side effects of different medicines, and have the ability to observe and interpret patients' responses. At the same time, it's a challenge for nursing educators to help students obtain and memorize this information for their professional careers. Several studies have shown that smartphone applications such as the app program , online video and messaging for nurses and nursing students can increase academic achievement, improve knowledge or skills, and increase satisfaction with the learning program[4].

2.2 Smartphone apps for in nursing education

Smartphone can easily be integrated into nursing curricula. Students can use the smartphone to refresh their knowledge on medications and check their clinical experience in terms of hours or patient encounters in real time[5]. They can reference materials or ebooks during clinic and clinical conference to enhance debriefing and student reflection. Several apps can be used to make calculations and conversions quicker and more accurate. The proliferation of applications for specific tasks is expected to be enormous. They can communicate with their instructor through texting and Twitter alerts.

Generally, the smartphone apps for nursing education fall into three catalogs as following:

1. Reference , E-books and flashcards
2. Clinical assistant
3. Portal and integrated client

Potential educational extensions include smartphone apps for other community health priorities which are often the focus of nursing students' clinical practice: monitoring of blood pressure, body weight, blood sugar, dementia screening, depression screening. These smartphone applications have the potential to improve the educational experience for

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undergraduate nursing students and prepare them for the increasing role of e-health in nursing practice. Some typical apps in each catalog listed in Table I below can be downloaded from either App store (iOS) or Google Play(Android).

TABLE I The smartphone apps available for nursing education

Name	Platform	Description
Nursing in a Flash Mobile	iOS	It provides nursing students with an easy, efficient tool to learn vital nursing content on the go.
Drugs Diction-ary	Android	A pocket drugs dictionary provides all information about drugs: uses, how to take, side effects, precautions, drug interactions, missed dose, storage.
Nursing Flashcards Lite	Android	Nursing Flashcards Lite, a study aid for nurses, nursing students, med students. Upgrade to Nursing Flashcards Pro with included decks, Terminology, Fundamentals, Vocabulary, Abbreviations, Vital Signs
Mosby's Nursing Consult	iOS	The app includes the following content from Nursing Consult: Evidence-based nursing monographs; Patient education; Drug monographs; Drug calculators
Instant Heart rate	Android	The most accurate Heart Rate Monitor app for any smartphone
Infusion Nurse	Android	This app made by a nurse lets you calculate drop rate, infusion speed, dose/strength/ volume and lets you convert speed.
Nursing central	iOS	All-in-one mobile and web solution helps nurses and students find detailed information on diseases, tests, drugs, and procedures.
Mini Nurse Lite	Android	This app is made for student nurses and for those who are just curious about some of the education nurses need to know.

Apart from apps, online video courses such as newly emerged MOOC(Massive Open Online Course) and text messaging or mobile IRC(Internet Relay Chat) tools such as Weixin can be used as tools to support online learning at school or during their clinical practicum. It is more economic than voice communication and print-based instruction. In Norway, teachers in medical college used mobile phones to give students prior knowledge ahead of biology lectures. The professor introduced selected topics using PowerPoint slides with text, pictures, and graphics in several short video clips. Students downloaded course materials and pre-recorded video clips from the university's learning management system onto their mobile phone. Interviews with participants suggested using mobile phones in this way contributed positively to their learning. Another research was designed to seek nursing students' feedback on the usefulness of text messages in an anatomy course. The text message contained questions that were to be answered in the next day's lecture, as well as the main points of the previous day's lecture. The result showed over half of the interviewees found the method very helpful. A study using SMS to inform 59 healthcare students during their practicum showed that both tutors and students were positive about the value of providing extra support and communication alongside other resources. In summary, as potentially effective tools in a variety of learning contexts, online video and text messaging are positively evaluated by both instructors and students[6].

3. Related Technologies in App Development

3.1 Android vs. iOS programming environment

The main difference beetween programming applications for Android or iOS is the programming language. Android is really Java-based so the apps are native applications in pure Java code. The Android SDK comes with an emulator for testing the applications. Programmers will use a programming environment like Eclipse or Netbeans, which are generally integrated with the Android SDK. If developers want to publish their application on the android app market they need to pay the developer fee of $25 for one time.

When it comes to developing apps for iOS, it is essential to have a Mac with the programming environment Xcode from Apple. The main programming languages are Objective-C and somtimes C or C++. It is recommended to use a real iPhone or another device with iOS for testing. The simulator didn't work if your application wants to use built-in GPS-module or the camera[7].

3.2 Native application vs. Hybrid application

Native application uses the normal way to develop an app. Native means the application is written in a language like the operating system. It is Objective-C in iPhone and Java in Android. But both the operating systems are not written in only one language, for example, the graphical driver is written in C/C++. Native applications are able to use the operating system APIs (application programming interface), which means a direct interface to the libaries and the functions on the device. Native apps can be distributed directly on an app-store or a marketplace. The compiler produce an executable binary packed to a distributable package with ".app" extension, then it is published onto the App store. Figure 1 shows the development for native application.

Hybrid application acts like web application, so we can code with a simple editor like Notepad++ and test with the browsers Safari and Chrome. When the developer wants to transform it into a real native application, he just copies the content and the iWebKit to the "www" folder. The hybrid application can be written in some middleware-like, cross-platform framworks such as Phonegap[8, 9] and Appcan, a similar framework developed by Chinese. Figure 2 shows the development for hybrid application.

Most hospitals with IT department have professionals like web programmers and web designers for the website and intranet. Usually they do not have specialists in Objective-C/C++/Java programming languages. So, if they decided to bring out an app for the nursing staff and students, they have to outsource for a native application. But with hybrid app development, inhouse experts with web-design skills can set to work if they decide to develop the app. The benefit of inhouse development is not only the reduction of cost but also the protection of sensitive data. Furthermore, it would be much easier to create new content on the website or to make an update if the developers want to upgrade the app. The cross-platform advantage makes it easy to publish your apps on multiple platforms with effective effort and minimal cost.

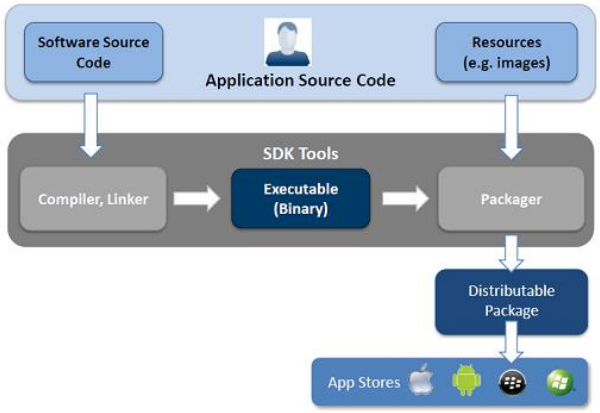

Figure 1 Native App Development[10]

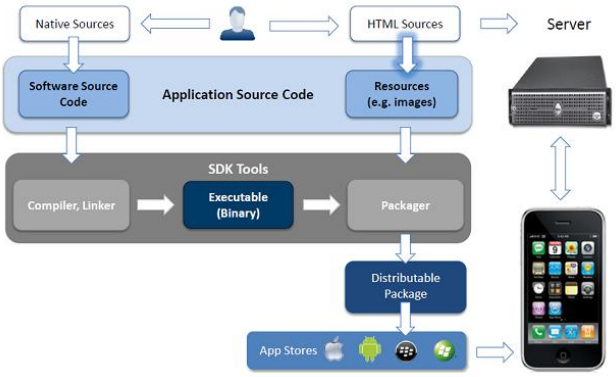

Figure2 Hybrid App Development[10]

3.3 Other design and development issues

The design of mobile apps is completely different from that of desktop applications[11]. On smartphones the users will have only a small screen where the information presented so he has to use the screen by touching or with a pen to navigate in the app. For the limitation of the screen, nurses or nursing students should take part in the early system design and milestone testing. Considering the actual situation in clinical practice, the completed app would be more user-friendly and efficient. The developers must fully understand the users' opinion and try to overcome the obstacles and difficulties during the design and development.

The UML method could be used to help analyze and visualize smartphone apps [12-14]. In UML, a diagram is defined as the graphical presentation of a set of elements in a connected graph of vertices (things) and arcs (relationships). A diagram could be any combination of things and relationships. The following diagrams are used in the model: class diagram, object diagram, use case diagram, sequence diagram, collaboration diagram, state chart diagram, activity diagram, component diagram, deployment diagram. However, five most useful views are often encountered, which are consistent with the five that comprise the architecture of a software-intensive system, namely use case view (for end-user: functionality), logical view (for analysts/designers: structure), process view (for system integrators: performance, scalability, throughput), implementation view (for programmers: software management) and deployment view (for system engineering: system topology, delivery, installation, communication).

4. Conclusions

The use of smartphone applications would be the good supplement for nursing education. The smartphone provides an efficient and user-friendly access to references and learning materials. With downloadable applications, clinical assitants and reference materials, they can be used to engage students and reinforce learning anytime and anywhere. Nursing students or new nurses can review references and online instructional videos prior to performing skills in their studying and clinical practice. The hybrid app development is highly recommended considering the skill of IT professionals inhouse, the cost and the data security. App users should closely cooperate with the developers in the system design and software testing to produce an efficient and user-friendly smartphone app for nursing education.

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