

AN APPROACH TO MOBILE DEVELOPMENT THAT EMBRACES LEARNING THEORY AND BEST PRACTICES

KEYWORDS

Mobile learning, m-learning, native applications, mobile web, behaviorism, constructivism

1. INTRODUCTION

As mobile devices become ever more pervasive, students in higher education expect their college experience to reflect the new norms this medium has established. Information technology staff must adapt traditional university web content for access on mobile devices, such as student course schedules, library resources, and athletics content. Educators are simultaneously identifying the pedagogical benefits of mobile learning (herein defined as learning via a smartphone device) along with how and where to effectively integrate mobile learning into the curriculum. While addressing pedagogical uses of this new medium is clearly within the purview of educators, the many challenges associated with mobile learning development is, on the whole, outside their area of expertise.

This paper explores the benefits and pedagogical implications of mobile learning solutions through three of the most popular learning paradigms: behaviorism, cognitivism, and constructivism. It also addresses how the approach to development, be it a mobile application, mobile website or both, should be considered alongside the goals and objectives of the learning solution.

2. STUDENT MOBILE USE

2.1 College Students and Smartphones

There are over 327 million mobile phone subscriptions in the United States alone. Of these, more than one third are smartphones, (Smith, A. 2011) while 51% of these are among the Millennial generation (ages 18-34).

2.2 College Students, Smartphones, and the Internet

According to research from the Pew Internet and American Life Project, as seen in Figure 1, college students are far more likely to use the Internet on their mobile phone as compared with any other population. In fact, young adults, in general, represent the highest population of Internet cell phone users at over 60%, compared to 41% for the general adult population (Smith, A. et al 2011).

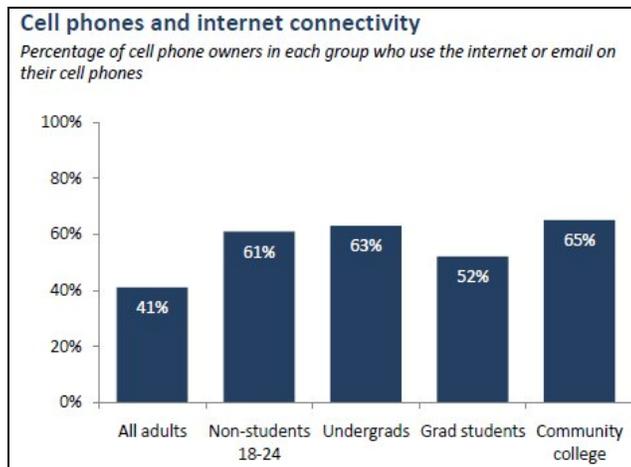


Figure 1: Pew Research Center's Internet and American Life Project 2010 tracking surveys.

3. BENEFITS OF MOBILE LEARNING

Mobile devices offer a unique opportunity for teachers and students. Not only do they allow students to access content anytime, anywhere, but they also have a number of unique characteristics that instructors can take advantage of in the classroom. The following sections outline some of these unique characteristics in relation to three of the most popular learning paradigms: behaviorism, cognitivism, and constructivism.

3.1 Behaviorism

3.1.1 Definition

The belief that instruction is achieved by observable, measurable, and controllable objectives set by the instructor and met by the learners who elicit a specific set of responses based upon a controlled set of stimuli (ABC CLIO 2011).

3.1.2 Related Learning Theories

Classical Conditioning, Operant Conditioning, Radical Behaviorism

3.1.3 Implications for Mobile Learning

Just-in Time Learning: Mobile devices accompany students in their everyday experiences and become a convenient tool for testing their knowledge. They provide just-in-time access to learning resources such as web pages, instructional videos, or animations.

Self-Paced Learning: Students can direct their own learning in order to meet a set of learning objectives, access content when they want and where they want, and proceed at their own pace for the time they have available.

Reinforced Learning: Mobile learning gives instructors the opportunity to provide immediate feedback to students, whether it be in the form of a reward or as written, audio, or video feedback.

3.1.4 Example: NCSU Flashcard Study Tool and Self-Paced Learning

The Flashcard Study Tool, as seen in Figure 2, allows faculty to author sets of cards, supplementing text with images, sounds, and video. Flashcards can be chained together so that complex concepts will appear back to back across multiple cards. In addition to being used to teach definitions, this tool is also being used in identifying objects or parts of objects, to diagnose a problem given a case scenario, and in teaching correct pronunciation of terms.



Figure 2: NC State University flashcard study tool

3.2 Cognitivism

3.2.1 Definition

Cognitivism is the belief that human thinking and learning are similar to that of computer information processing. As such, the focus of cognitivism is on learning inputs and outputs that are processed by the human mind, much as the computer processes information (ABC CLIO 2011).

3.2.2 Learning Theories

Cognitive Load Theory, Elaboration Theory, Attribution Theory

3.2.3 Implications for Mobile Learning

Chunking: Mobile learning encourages instructors to break content up into manageable chunks of information. This process of breaking up information into smaller units so that it is easier for the human brain to remember and process is supported by the cognitive load theory. It is particularly important on mobile devices because of the small screen size and the fact the users want to learn while they are on the go (waiting for a bus or standing in line at the grocery store).

3.2.4 Example: Mobile Video Framework and Cognitive Load Theory

A mobile video framework, as seen in Figure 3, was created to host how-to videos for courses. Videos are broken up into short, manageable segments that students can watch anywhere, anytime - whether it be in the lab while they are operating a sewing machine or at home for review. Videos are supplemented in the mobile interface with additional resources such as tips, FAQs, and glossary terms.

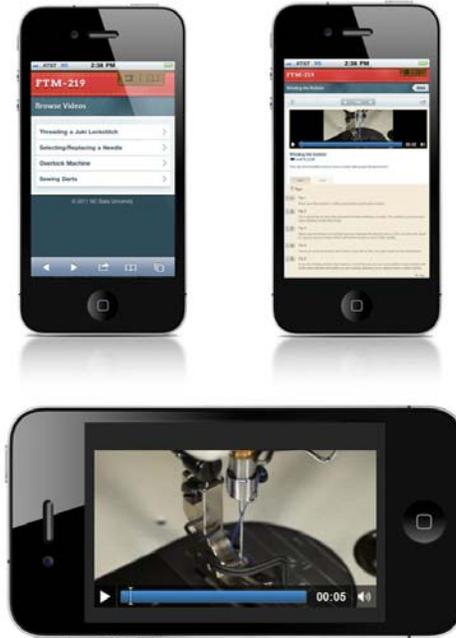


Figure 3: NC State University mobile video framework

3.3 Constructivism

3.3.1 Definition

The belief that learners, having some prior knowledge and experience as a basis from which to test out their hypotheses, build their own set of content to solve a particular set of problems posed by the instructor (ABC CLIO 2011).

3.3.2 Learning Theories

Active Learning, Collaborative Learning, Discovery Learning, Situated Learning, Problem-Based Learning

3.3.3 Implications for Mobile Learning

Situated Learning: Situated learning is based on the belief that learning is enhanced when it takes place in authentic context. Mobile devices allow for immersive experiences such as those provided by simulations and games.

Location-Based Learning: Mobile devices offer location-sensors (e.g., GPS, RFID, WLAN) and they can deliver multimedia content that is both time and place relevant.

Collaborative Learning: Learning can be more effective when learners converse with each other, coming to shared understanding of the world or of a particular learning challenge. Mobile devices support collaborative

learning by allowing individuals to connect and share data, files, and messages. They can also be connected to a shared data network, further enhancing possibilities for communication (Naismith, L. et al, 2000).

Discovery Learning: Discovery learning believes that it is best for learners to discover facts and relationships for themselves. Mobile devices support this way of learning by allowing students to explore content and the world around them in a non-linear fashion.

3.3.4 Example: MicroExplorer 3D and Discovery Learning

The MicroExplorer 3D, as seen in Figure 4, is an interactive mobile application, developed in Unity 3D, that includes a 3D model of a compound microscope with supporting photographs, video, and textual descriptions of each part. Students can choose to explore the microscope by clicking on the model or by navigating through menu options. It does not provide a linear direction for students to learn about microscope. Instead, students are encouraged to discover the functionality of the parts by creating their own path through the content.



Figure 4: NC State University MicroExplorer 3D

4. CHALLENGES

There are many reasons why educators should consider mobile learning solutions in course design, and perhaps just as many challenges in pursuing them. Putting aside the question of mobile web versus mobile app, let's first consider the realm of mobile apps. As seen in Figure 5, there are several smartphone OS options currently on the market, with significant shares (over 92%) going to three of them: Android, Apple's iOS, and the Blackberry RIM. Yet, if a learning app solution is developed for Android, the platform that currently holds the largest share of users at 54%, this will leave the 41% of users among the iOS and RIM base out in the cold (Prabhudesai, A., 2011). However, developing for three separate platforms can be cost prohibitive. Each platform runs a different set of code, meaning that in order to develop for each platform you need individuals with a specialized set of skills.

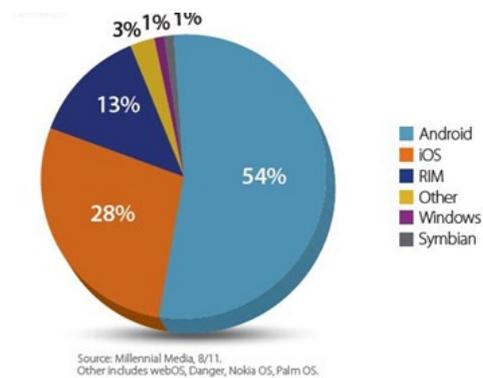


Figure 5: Impressions on the Millennial Media Network, 8/11

What is needed is a strategy that both leverages development technologies and common sense to help direct our efforts. With iOS and Android each having six times the number of mobile apps available as compared with RIM, and ongoing service issues experienced by Blackberry users, it would appear that a sound development strategy at present would focus resources on iOS and Android.

Another option toward multiplatform development is a software development kit (SDK) solution designed to service multiple OS platforms. The Titanium SDK by Appcelerator, for example, outputs to Android, iOS and Blackberry. More work is involved to adapt development for the unique qualities of each system; however it is an approach that involves far fewer resources if the ultimate goal is a solution for more than one platform.

Unity 3D, an open source game engine with a strong user base in higher education, supports development for both iOS and Android, and can also be run in a web browser on Windows and Mac (as well as the popular gaming platforms). The larger real estate available in a web browser as compared to a smartphone will result in additional resource needs directed toward visual design and differences in interface strategies. However, the flexibility of Unity 3D to leverage code and assets toward both smartphone and browser output is a real plus for learning solutions.

In fact, often the greatest challenge in the development of mobile learning solutions involves insuring every student has access to the learning solution, even those students without a smartphone. This will often mean some form of browser-based learning solution.

Accessibility must also be a consideration, and a browser-based option is often a solution that provides the most direct path to compliance, adding flexibility of access for all learners. However, mobile learning can be made more inclusive by following some basic guidelines. For example, the use of cloud-computing for accessing content and for sharing files, an interface design that is simple and straight-forward, the use of SMS readers and other mobile-specific assistive technologies, and a design strategy that delivers content in small chunks.

5. NATIVE APP VS. MOBILE WEB

One of the biggest debates when it comes to developing for mobile right now is whether to develop a mobile website or a native application. A native application is an application program that has been developed specifically for use on a particular platform or device and mobile website applications are Internet applications that run on smartphones and other mobile devices. Below we have outlined some of the key advantages that go along with each development option. Before beginning development, it is important to consider these advantages alongside the goals of your application and how your target audience might use it.

5.1 Native App

5.1.1 Connectivity

Data connections can be spotty depending on one's location and service provider, and there are still places even in populated areas where you can't get connected (like in a subway). Mobile web apps require a constant data connection while native apps can be built to interact with users even while they are offline. In a recent report from Localytics, a real-time analytics firm, it was found that 15 percent of all mobile apps are launched while the device they are running on is offline. This is a clear sign developers need to be building offline modes into their apps.

5.1.2 Data Caching

Native apps are able to cache data persistently. This reduces data usage and provides faster access to the data.

5.1.3 Performance

Native apps are by far the leader when it comes to performance. They use more of your device resources and capabilities and therefore are faster than web apps. The overhead of HTML/Javascript rendering and loading can make mobile web apps run slower than similar native apps.

5.1.4 Discoverability

Since native apps are connected to an app store, it is easier for users to discover or happen upon native apps than mobile websites. App stores typically have a search function built into them which can bring visibility to your app. This does not mean that users are unable to discover mobile web apps, but more of an effort needs to be put in place to link out to and advertise the app if visibility is important.

5.1.5 Integration with Phone Hardware

Native apps allow you to take advantage of the many built-in features of particular devices such as camera, GPS, and motion sensors, that most web applications cannot currently integrate with.

5.1.6 Design Conventions

Native apps have design conventions for specific devices that users come to expect from the device. With mobile web, you are designing an app that is meant to work on a variety of devices, meaning that it cannot cater to any one set of design conventions.

5.1.7 User Experience

In native apps, you have more control over the user experience because you know how the experience will render on a specific platform. With mobile web apps, it is more difficult to design the user experience because it will display differently on different devices. As Jakob Nielsen writes, "My main conclusion from watching iPhone app users is that they suffered much less misery than users in our mobile website tests. In fact, testing people using iPhone apps produced happier outcomes than testing people attempting to use websites on the same phone"(Nielsen, 2010).

5.2 Mobile Web

5.2.1 Platform Independent

While a native app must be built specifically for a particular platform, posing challenges and limitations discussed previously, a mobile web app is accessible by all devices with Internet browsing capabilities.

5.2.2 Cost and Time

One of the biggest benefits mobile web apps have over native apps is that they typically take less time to develop and require fewer resources than native apps.

5.2.3 No Censorship

Some app stores such as iTunes have strict guidelines for submission and a tedious approval process. Mobile web apps are not censored so you can publish what you want, when you want.

5.2.4 Instant Updates

Some app stores require that you go through an approval process for each release according to a defined schedule. With mobile web, development releases can happen instantaneously and according to your own timeline. Users always have access to the most up-to-date version.

6. CONCLUSION

In the world of higher education, we often talk about engaging students through technology but we don't necessarily know where to begin. We know what technologies students are using but we don't necessarily know how to apply our content and our teaching styles to this new medium. As a result, we often end up repurposing what we have already created and placing it in a new format. Instead, we should be focusing on the unique characteristics of mobile and what affordances it buys us and our students. We also need to be smart at how we approach development so that we can take a full advantage of what mobile devices have to offer. Currently, the debate is still centering on whether to develop a native application or a mobile website or both but this is shifting. New opportunities for creating hybrid applications are emerging which employ native capabilities while also serving as a strategic stepping stone towards adoption of HTML5.

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