Implementing Mobile Environments using Learning Objects: The Athabasca University Digital Reading Room

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Abstract

This investigation determined some of the better strategies for delivering educational resources to mobile devices from the Digital Reading Room (DRR) and the Athabasca University(AU) library catalogue using AirPac, making recommendations on the implementation of Mlearning as part of the AU e-learning strategy. The primary research question addressed in this short paper is

What are the limitations and difficulties in delivering course materials to mobile devices?

1. Introduction

Athabasca University (AU) is Canada's Open University and Canada's leading distance education and elearning institution: The university currently serves more than 36 000 students per year, none of whom are on campus. Students are all at a distance. It is essential that both appropriate existing and emerging technologies be implemented for effective development, delivery, and support for students.

This mobile learning research investigation represents a work in progress building on the work previously described at the MLearn 2005 IADIS Conference Mallta [1]. This short paper describes further developments involving the delivery of files in MP3 format and using podcasting as well as opening access to AU Library's online library system using AirPac

This ongoing investigation involves developing and testing designs for appropriate elearning pedagogy to support learning outcomes. These are specific goals that are expressed in the AU strategic plan [2].

This project has been designed to support and enhance Mlearning at AU. The Mlearning applications are an integral feature of the newest version of the Digital Reading Room (DRR) [3].

2. The Digital Reading Room

The DRR facilitates access by students to library materials that have been selected by faculty and are specific to a particular course.

The DRR is an interactive online reading room, offering digital files for course readings and supplementary materials. The DRR can accommodate a range of formats, including online journal articles, electronic books, audio or video clips, Web sites and learning objects. In 2005 the DRR housed more than 14,000 resources serving 228 courses [4]. The resources available have been specially selected by faculty. are organized by course and by lesson for the convenience of students, and are accessible using persistent links (PURLs). Access to licensed resources is managed by the Library's Web Access Management (WAM) function [5].

3. Literature review

To date, some research from a student's perspective has explored which mobile technologies are the best to employ [6] [7] [8] or what applications enable an effective digital library [9] and what support systems need to be in place for Mlearning [10]. Further work has shown that Mteaching can also be efficiently conducted using mobile devices [11] .

Traditional research on digital libraries focused on developments in technology [12]. Levy and Marshal [13] challenge those who would maintain the traditional view of the library in a digital environment. Various projects, such as WiTEC, tested the usefulness of wireless devices in classroom environments [14] [6] or in class field trips [8].

It has only been recently that studies of digital libraries have moved outside the classroom. Dong and Agogino [15] concluded that Mlearning is most useful when it links real-world situations to relevant information resources. Waycott and Kukulska-Hulme [16] discovered that using PDAs for reading and note taking was less than ideal.

According to Clyde [17], the challenge "is to identify the forms of education for which Mlearning is particularly appropriate, the potential students who most need it and the best strategies for delivering " (p. 46).

Hong, Thong, Wong, and Tam [12] call for a shift in digital library research; "more and more library and information science researchers believe that the future avenues of digital libraries research" must "involve the interactions between the users and the systems" (p. 99).

Hoppe, Joiner, Milrad and Sharples [18] want to move the focus of Mlearning from content delivery to interpersonal relations. These researchers agree that "we are just beginning to realize the potential of Mlearning" [17]. As a result, more research, from a user perspective, is needed to discover the best strategies for

maximizing Mlearning, including discovering what are the optimal features of a PDA for accessing digital libraries such as the DRR, and what form the content needs to take to contribute to an effective Mlibrary.

4. Mobile access to the DRR

This project has been used to articulate the resources currently available in the DRR that are also suitable for Mlearning. The work has resulted in the implementation of a comprehensive mobile library website, containing relevant digital reading files, application tools and software, as well as learning objects (eg mp3 versions of journal articles, video clips, and e-books). These materials include:

- Mobile device-ready learning objects, including MP3 versions of journal articles, video clips and e-books;
- Existing AU library electronic resources organized for Mlearning;
- A Mlibrary website
- A comprehensive list of Mlearning application tools; and
- A best-practice document for Mlearning instructional design.

5. Athabasca University AirPac

AirPac is the software module of the Innovative Interfaces Inc. (III) automated library system specially designed for compatibility with wireless mobile devices. AirPacruns on the Library's server and sends out JavaServer Pages formatted for the mobile devices that are requesting information. AirPac allows mobile users with wireless internet access to search and browse the library catalog, check due dates, request materials, and view their patron records in real-time. Library staff and patrons as well as the disabled can now access the online public access catalogue (OPAC) via wireless LANs, WiFi, 802.11b, and Bluetooth. Digital information is re-formatted on-the-fly for different browsers and screen resolutions. AirPac also recognizes that the information needs to be formatted in WAP. If the user submits a search from a wireless PDA (such as a mobile phone or handheld computer), AirPac formats a response for that type of device. For example, a mobile phone will receive a minimal display to accommodate the smaller screen area, while AirPaC will send a larger display to a PDA with more screen area available. The AU AirPac can be accessed at http://aupac.lib.athabascau.ca/airpac/

6. MP3

MP3 (*Moving Picture Experts Group Audio Layer III)* is a compression format that shrinks digital audio files, yet retains nearly the original quality of the audio. The DRR takes advantage of this new technology by offering MP3 audio reading files for curriculum use. In particular, the DRR features the use of *MP3Producer*, which is a CD ripping and MP3 encoding program (http://www.softsia.com/MP3Producer-download-8ts0.htm). Using *MP3Producer*, tracks were extracted from a CD provided to the DRR developer consisting of first year oral French language lessons. The tracks were then converted to MP3 files. The resulting encoded files are more compact and are suitable for playback on an iPod or on a media player program on a mobile device. The ripping program saves the extracted audio in a WAV compressed format. The extracted audio is then encoded with a lossy codec, such as MP3. The program uses a file renaming utility called *ID3Tag* to tag the encoded files with metadata. The standard bit rates (near CD quality result) for each DRR audio file is 128 or 112 kb See: **http://library.athabascau.ca/drr/view.php?course=fren&id=452)**

The Mobile DRR also features the use of text-to-speech (TTS) technology to convert machine-readable text into MP3 audio files. Using a software program called *River Past Talkative* (*RPT*) (http://www.riverpast.com/), a curriculum guide for a Master of Arts in Integrated Studies course was converted from text into an audio WAV file, providing a choice of natural human voices. See: http://library.athabascau.ca/drr/view.php?course=mais&id=496&sub=0)

Once created, these audio files can be saved as MP3 files and listened to on a mobile device or portable MP3 player. The *RPT* program uses a text editor interface and supports plain text and RTF files as input, or text copied from a clipboard. The interface contains simple and readily accessible controls for different voices, including AT&T (R) Natural Voices http://www.naturalvoices.att.com with adjustable speaking speed, volume, audio codec, sample rate, and channel. With *RPT* MPEG-4 Booster Pack the file can be outputted to M4A (MPEG-4

AAC audio), the format used by iTune and iPod. This program is also used to convert books and articles into MP3 audio books and audio articles for use in the mobile DRR. For example see http://library.athabascau.ca/drr/view.php?course=demo&id=418

To further enhance the audio books and articles with full-text display and content reading aloud, a software program called *MP3 Stream Creator* is used to add streaming MP3 audio-to-text and convert the file in a SWF format (http://www.guangmingsoft.net/msc/).

7. Podcasting

Podcasting is a term describing the combination of an RSS feed and multimedia materials. It is becoming popular as multimedia capable devices such as Apple iPods and other handheld smart devices become ubiquitous. Most podcasts are in MP3 audio format. The iPod is not wireless-enabled, and it functions simply as an audio player.

Using the DRR, researchers added some multimedia clips of different formats and created a podcast RSS channel. We tested the channel with a RSS aggregator called Pluck http://client.pluck.com/1.0.0/pie/intro/ on a desktop PC, a RSS aggregator called Pocket RSS on a PPC, Apple iTunes (version 4.9), and Apple iPod (with colour screen). In the RSS file, in addition to the common RSS tags, researchers also added some iTunes specific tags for enhanced capabilities. We aimed at testing and exploring three different groups of multimedia clips: audio, video, and enhanced audio with pictures and chaptering capabilities and their applications.

A built-in podcasting capability was added to iTunes. Using that new capability, learners successfully subscribed to our DRR podcasting demo feed in iTunes. The default setting automatically retrieves the metadata of all items, as well as the most recent clip. The user can manually access other multimedia content by clicking on the button next to the item title. After subscribing to the channel in iTunes, we connected to the iPod device. Again, with the default settings, these clips are automatically transferred from iTunes to the iPod.

Researchers first tested iTunes and iPod with an MP3 audio file. From subscribing to the channel to listening to the clip on an iPod, the process is straightforward and smooth. In addition, users can view the descriptions of that item while it plays. The text is very legible on the high resolution color screen. The simple interface allows the user to easily scroll through the page.

Researchers then added a video clip to the RSS channel and set the iTunes to check the channel daily. It successfully detected the new items and retrieved them automatically. iTunes plays the video clip using Quicktime format video, either in the preview box on the lower left, in a separate window, or in a full screen. Unfortunately, iTunes only accepts video in the proprietary Quicktime format. We tested to see if iPod can play the video, and once connected iPod returns an error message and does not retrieve the file. More information on how this can be achieved is available at this website: http://www.makezine.com/blog/archive/2005/07/how_to_make_enh.html

IPods demonstrated one major disadvantage compared to other mobile devices for learning. This is the lack of interactivity associated with the one way retrieval of materials. Although it is possible to add a microphone to an iPod and allow users to create materials on the road, this practice is still uncommon and requires a personal space. The interface can only be used for playing and searching. Not for inputting information. There is no internet connectivity, relying on syncing with the iTunes running on a desktop computer with Internet connectivity. Another device disadvantage is the lack of a video capability even though the iTunes software can retrieve and play video clips.

Podcasting works like a radio, with better audio quality, and no need to tune-in at a specific show time. With a combination of iTunes on the desktop and the iPod, students can retrieves the materials when they are connecting the device to a desktop, and listen to the materials on the road. iPod is far superior to analog devices such as cassette tapes. We can add chapters in the clip, allowing learners to jump to the appropriate section. For some MPEG 4 Audio files, we can also encapsulate pictures for each chapter.

iPod allows students to listen to audio lectures anytime, anywhere. The subscriptions model streamlines the process for students to locate and retrieve the newly available materials. Podcasting opens up a new and better way to deliver audio clips.

8. Challenges

1. Bandwidth and system resource limitations.

The current high speed wireless internet connection for mobile devices is limited to 802.11b (11mbps data transfer rate). Multimedia objects take up significant bandwidth and may not be ideal for mobile DRR use at this time. The result is that students either only access textual content or download a minimal amount of content at a time. Bandwidth may also degrade with a large number of users on a single wireless network.

The mobile device has limited memory; a palm device usually comes with 8 MB of memory and a PPC with 16 MB. The system is vulnerable to crashing if a student continues to download content without first removing existing materials.

In addition, all data and programs are stored in volatile memory. Therefore, if left uncharged for a number of days the device will lose all the data and programs. A mobile device is less robust and has limited potential for upgrades and expansion compared to a desktop PC. And, a mobile device can become obsolete very quickly.

2. Content intended for mobile use must be formatted to suit the device.

The Mobile DRR contains mobile and web content. Much of the DRR content made available by DRR developers was not optimized for mobile use, making it difficult to read. One workaround is to use subscription-based browser services like Thunderhawk to better display content on the PPC (http://www.bitstream.com/wireless).

In the future it should be possible to separate the content from the format through the use of Extensible Markup Language (XML). XML will allow the mobile DRR to specify the content and also to specify how it appears on different types of devices using appropriate Cascading Style sheets (CSS) or XML Stylesheet languages (XSL). XML also has significant advantages with regard to data repurpose and reuse.

3. Difficulties with mobile printing.

The current mobile devices have no built-in support for mobile and wireless printing. Students wishing to access mobile printing have to use third party programs such as *HP mobile printing* or *PrintBoy*. These programs do not support all devices as they run different operating systems.

4. Lack of common platform.

Mobile devices come with different size screens and operating systems (e.g. a horizontal screen with some handheld computers and small square screens with mobile phones. Handheld devices run either PPC or Palm Pilot and mobile phones use a proprietary system). The current mobile DRR can be accessed by some smart phones (e.g. Samsung and Nokia model) but not all.

5. Small Screen size.

Small screens limit the amount and type of information that can be displayed. For example, horizontal scrolling can be quite frustrating and great detail cannot be properly displayed.

6. Wireless connectivity

Access to online content on mobile devices requires multiple access points or hot spots to access the Internet and must be within the radius of a wireless internet connection. There are also security issues when accessing the online content through a wireless network via a mobile device.

9. Conclusion

This project has been designed to test the boundaries of Mlearning and to begin to build a platform for AU to raise an effective m-library. Building on the research conducted in Canada and abroad, the researchers are investigating PDAs and learning objects in order to maximize the potential of Mlearning.

What constitutes an effective Mlibrary? Within the limits of this research investigation, an effective Mlibrary must store the contents in a format accessible and configurable by a wide variety of devices and software applications. Special programming is required to implement optimal delivery on a variety of devices and software applications.

What resources can be made available in the Mlibrary (content and resource development)? It seems that a wide variety of resource types can be made available on mobile devices subject to formatting limitations. With appropriate programming there are few if any limitations on text displays and only size-comfort limitations on graphics, sound, and video.

What are the technical difficulties in implementing the DRR on mobile devices?

Because of the difference in the operating systems and the pocket browsers in the PPC and the POS, the CSS stylesheet cannot be implementd in a generic manner. This causes

difficulties in designing accessibily/usabilty features for the two different systems.

This research project answered the research questions through a comparative study of the two PDAs accessing the current DRR and the new m-library. The investigation included an investigation into some of the technical and organizational implications of opening library accessibility to mobile devices, namely PDAs. From a user's perspective, the research has provided us with experience in determinining modalities for such an implementation. It also provides guidance for other researchers as they investigate the shifting terrain of mobile learning.

To summarise, a mobile delivery application has been set up in the DRR enabling access by PDAs, specifically the PPC and the Palm Pilot. These devices have been used to access the varied resources in the mobile version of the DRR. The researchers have compared the PDAs and identified some of the critical features each operating system and pocket browser. The DRR now has a comprehensive Mlibrary website, including a listing of Mlearning applications and software relevant to the mobile delivery of course materials and applications.

To visit the Digital Reading Room go to: http://library.athabascau.ca/drr/

[Work is progressing on this implementation. A final paper will be submitted in August.]

10. Helpful sites

What's New in Pocket Internet Explorer

http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnppcgen/html/ppc_snewpie.asp

Netfront (alternative browser for Pocket PC)

http://nfppc.access.co.jp/english/

IBM

http://www-306.ibm.com/software/wireless/weme/

Palm Web Pro

http://www.palmone.com/us/software/webpro30/

Java on Palm

http://www.palmos.com/dev/tech/java/

http://www.palmone.com/us/support/jvm/

Symbian OS specifications

http://www.symbian.com/technology/symbos-v7x-det.html

Pocket Internet Explorer specifications

http://msdn.microsoft.com/library/en-us/wcedsn40/html/cgconPocketInternetExplorerFeatures.asp?frame=true

Windows CE, Pocket PC 2002 and 2003 comparison

http://www.windowsfordevices.com/files/misc/WindowsCE_PocketPC.doc

Pocket PC Web site development tips

http://www.builderau.com.au/program/windows/0,39024644,20277096,00.htm

Using Pocket Internet Explorer On The PPC

http://www.the-gadgeteer.com/pocket-ie-article.html

Guidelines For Creating Web Content For Mobile And PC Browsing

http://forum.nokia.com/main/1,,040,00.html?fsrParam=2-3-/main.html&fileID=5957

Liquid Design - A Step Forward to Make http://www.mardiros.net/liquid-design.html

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