From eLearning to mLearning: The Effectiveness of Mobile Course Delivery

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ABSTRACT

This paper summarizes findings from an empirical study that investigated the conversion and delivery of an existing DoD-wide eLearning course, "Trafficking In Persons (TIP) General Awareness Training", to a mobile format. The Advanced Distributed Learning (ADL) Mobile Learning Team deployed the training content and measured user feedback as a field experiment to volunteers in each of the DoD services. This paper presents both quantitative and qualitative results, including learner performance and overall satisfaction with the mobile course.

Based on the findings from the study, this paper will discuss the challenges and broad concerns pertaining to mLearning course delivery in military education and training, and will address the following questions: Should military training materials be delivered on a mobile device, and if so, what device types, browsers and platforms are supported? If military personnel were provided the option to complete their annual mandatory computer-based training on a mobile device instead of a desktop computer, would they do it? What other approaches and enhancements should be considered for future delivery of mLearning materials in the military? Since mobile implementation has the potential for both formal learning experiences and performance support in the military, we will discuss the implications and provide recommendations for future research on the subject of mobile course delivery.

ABOUT THE AUTHOR

Jason Haag's interest and background is in learning systems, web technology, and standards. He spent eight years supporting the U.S. Navy in both engineering and management roles before joining the Advanced Distributed Learning (ADL) Initiative. He is currently employed by The Tolliver Group, Inc. and provides Systems Engineering and Technical Analysis (SETA) support for the ADL, sponsored by the Office of the Deputy Assistant Secretary of Defense (Readiness). His primary focus is mobile learning (mLearning), mobile device platforms & technology, and best practices for implementation. Jason's professional affiliations include serving as chair of the DoD ADL (DADL) Working Group, member of the IEEE Learning Technology Standards Committee (LTSC), and member of the eLearning Guild. He is also a frequent speaker at industry events. Jason received his Master of Education Degree from the University of West Florida where he specialized in Education & Training Management and Instructional Technology.

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INTRODUCTION

Recent advancements in the capabilities of the smartphone coupled with its inherent ubiquity have led to an increased interest in leveraging mobile devices for learning. Mobile devices can provide access to training and performance support materials at the moment of need. Driven by improved software, improved hardware, and evolving habits of mobile device users, the opportunities have increased even more significantly in the past few years. The continuous proliferation of personal smartphones with advanced web browsers has created an incredible opportunity that cannot be ignored. It is now possible to deliver course content across many platforms using the mobile browser. This alternative method has the potential to be more effective and gain wider acceptance by military users over computer-based eLearning. This alternative method of delivery has the potential to optimize time management, make mandatory training more accessible, and can help improve military readiness. Mobile content can provide the US military and DoD workforce with the ability to access critical operational information and support materials regardless of location.

What is Mobile Learning?

Multiple definitions of mobile learning already exist in the world of education and training, and some are even inclusive of laptop computers. However, ADL defines mobile learning or "mLearning" as the use of handheld computing devices to provide access to learning content and information resources. Although studying the effectiveness of mobile course delivery is the focus of this paper, it is important to recognize that mobile learning is also inclusive of many types of informal learning opportunities and is not only limited to formal training courses.

According to Ambient Insight Research, LLC the US market for mobile learning products and services reached $958.7 million in 2010 with revenues expected to reach $1.82 billion by 2015. These numbers illustrate the high levels of spending on mobile learning. This same pattern of interest in mobile devices being utilized for learning and performance support is spreading among all of the DoD military branches as well. The ADL Mobile Team is currently following many of the U.S. Government's mobile initiatives and prototype programs including, but not limited to the following: USA.gov Mobile Apps, The Defense Advanced Research Projects Agency (DARPA) Transformative Apps Program, Navy Apps, Connecting Soldiers to Digital Applications (CSDA), Army's mCare Telehealth Program for wounded warriors, Apps for the Army (A4A), and the Army Marketplace (ATN2Go). The Army is also conducting a cost-benefit analysis and assessment of using mobile apps and is expected to provide recommendations to Army senior leadership by December 2011 (Army News Service, 2011).

Research Need and Applicability

Existing programs that leverage mobile course delivery as part of their overall training strategy have been in existence in the corporate sector for several years, but there is limited research literature on this topic. Furthermore, there have not been many studies conducted on the general effectiveness of this specific form of delivery in a military setting. However, there are pilot programs underway but the results are unknown. For instance, the Army is conducting a pilot program that could potentially change the Army's training environment. Instructors and students of the unit supply specialist (92Y) course at the Quartermaster School have been using tailored mobile applications since July 2010 to provide the students with an alternative platform to continue their learning after leaving the classroom (Desbois, 2011). The program will run through July of 2011 and the results, when published, will help determine the feasibility of using the devices for training purposes in the Army.

One of the early case studies in mobile learning was a pilot project conducted by Merill Lynch in 2007 that involved turning to alternative mobile modalities for

delivering compliance training courses. As is the case for many financial firms, employees at Merrill Lynch were working long hours outside of the office and had limited time to complete the compliance training. In addition, employees often did not complete the eLearning version of the courses they started because of everyday work responsibilities and random distractions from e-mail, conference calls, and meetings. Therefore, the main objective when developing their business case was to ultimately increase the completion rate of the course by providing an alternative means to complete the compliance requirement.

The initial pilot test group obtained a more timely completion of compliance training, including a 12% higher completion rate during a 45-day milestone (Swanson, 2008). In addition, the participants demonstrated a shorter time to completion of the courses taken on mobile devices with no loss of comprehension (Swanson, 2008). Bank of America acquired Merill Lynch during the past few years, and due to the success of this program (called "GoLearn"), they have expanded this alternative offering to nearly all of their employees, from 22,000 completing the course on mobile devices to well over 55,000. They are now offering non-compliance training courses as well.

By leveraging the ubiquitous nature of the mobile device, Bank of America now enables learning for their employees outside of the office during naturally occurring downtime and the content is conveniently provided in small chunks, at any place or time. Sixty-one percent of the eligible population participated, and the results were incredible. Ninety-nine percent of the participants felt the format and presentation supported the learning objectives while 100% responded that they would complete more training in this format (Swanson, 2008).

The results of this particular case study conducted by Merrill Lynch led us to our investigation and ultimate goal of determining whether this same type of use case has equal applicability in a military setting. DoD active duty, civilians, and contractors are currently required to complete several mandatory eLearning compliance courses using a desktop or laptop computer on an annual basis. Much like the employees at Merill Lynch, the users of various Department of Defense (DoD) eLearning systems are often faced with the similar challenges of dealing with random distractions while trying to balance mission-critical work responsibilities with mandatory training requirements.

METHODOLOGY

Course Selection

In order to effectively compare an eLearning course to a mLearning course, ADL first identified the need to utilize a mandatory course that was widely known and adopted throughout the DoD. It was expected that by selecting a well-known eLearning course, we would be able to capture more authentic responses than we would if compared to an unfamiliar eLearning course or if not comparing at all. The level of effort in converting the course was another key consideration when selecting the best candidate course for this effort.

After researching a number of mandatory course topics common through out the DoD, the Trafficking In Persons (TIP) General Awareness course was identified as the best candidate for this study. This course has been available throughout the DoD since 2005. The subject matter of the course is intended to increase general awareness, provide training and reference material about the realities of TIP, and to help serve to end it. The U.S. government defines trafficking in persons as sex trafficking in which a commercial sex act is induced by force, fraud, or coercion, or in which the person induced to perform such act has not attained 18 years of age; or the recruitment, harboring, transportation, provision, or obtaining of a person for labor or services, through the use of force, fraud or coercion for the purpose of subjection to involuntary servitude, peonage, debt bondage, or slavery.

The ADL Academic Co-lab originally created the eLearning version of this course for the Office of the Under the Secretary of Defense (OUSD), and it is mandated by policy under DoD INSTRUCTION NUMBER 2200.01 USD (P&R). The course source files for TIP were readily available to the ADL Mobile Team so this factor alone would help minimize the level of effort required to convert the course to a more concise, but interoperable mobile format.

Course Conversion Approach

In the planning phase we first anticipated the need to support a wide range of mobile device platforms and browsers and thought we would need to create two separate versions –a basic version and an enhanced version. The basic version of the course was converted by the ADL Mobile Team to support the World Wide Web Consortium (W3C)'s extensible Hypertext Markup Language (XHTML) 1.0 Basic profile as this was proven to be most interoperable across a wide range of mid-end to smartphone mobile device

browsers. We intended to use server-side device detection to deliver the basic version of the mobile course to older mobile devices and deliver an enhanced version using HTML5 for smartphones.

However, in order to accurately measure the user experience of the mLearning course, we determined that the content displayed on the mobile device would need to be consistent. Therefore, we needed to decide whether we wanted to provide a minimal user experience using the basic version of the mobile course or an enhanced experience using the HTML5 version; we could not address both within the scope of this study and expect a high degree of validity from the results.

With the recent advances in web standards and responsive design techniques it is now possible to provide a progressive, gradually enhanced experience across a wide array of browsers, using one HTML5 markup document and a variety of different Cascading Style Sheets (CSS). This approach does not selectively deliver content to the user through browser sniffing or server-side device detection, but rather is requested by the mobile browser itself by only rendering the supported web technologies. Mobile devices that fall under the smartphone category currently have superior mobile browsers and support for HTML5 when compared to feature phones.

Preliminary Survey

During the planning phase of this study, the ADL Mobile Team administered a preliminary survey to help drive the conversion, development, and deployment decisions for the mobile TIP course. The target population for this preliminary survey included DoD stakeholders who would be potential candidates for participating in the actual deployment phase of the study. The survey was distributed to 115 recipients with 50 people responding to the survey, generating a 43% response rate. Of these 50 responses, roughly 40% were from the Services (14% U.S. Air Force, 8% U.S. Army, 18% U.S. Navy), with the remaining 60% from various Department of Defense organizations (Defense Agency at 28%, Joint Staff at 2%, Combatant Command at 8%, Office of the Secretary of Defense at 6%, and other at 16%). Answers to three specific questions from this preliminary survey were critical to our decisions regarding the conversion, development, deployment and final analysis of the study.

The first question queried participants regarding the mobile devices they currently use. Smartphone devices accounted for a quarter of the responses and this number was determined to be sufficient enough for our decision in moving forward with providing only an enhanced version based on HTML5.

The second question of critical importance asked participants if their organization offered a mobile-friendly version of their Learning Management System (LMS) or the courses. Seventy-five percent of the respondents' organizations use an LMS to deliver self-paced training; however, of those whose organizations that use an LMS, only 8% offer a mobile-friendly version of their LMS to their learners. Given the low response rate of having a mobile-friendly LMS, the ADL Mobile Team decided to later investigate whether it would be feasible or even necessary to deliver the mobile TIP course within a mobile LMS application and interface.

The third question of critical importance asked the individual participants if they would complete their annual training using a mobile device as an alternative to using only a desktop or laptop computer. One third of participants responded "yes" to receiving their annual training using a mobile device, while another third responded no, and the final third was unsure. These answers reflect the fact that none of the respondents had previously accessed a mobile version of any course. Therefore, we suspect the results of the end-of-course survey for the mobile TIP course to not be as evenly distributed as the preliminary survey data.

RESULTS & ANALYSIS

Target Population

The population for the study included a wide-range of DoD stakeholders with interests in mobile learning. From April 22nd through May 6th, 2011, 31 DoD stakeholders in various remote locations throughout the U.S completed the TIP mobile course. On June 1st, 2011, 40 participants at Sheppard Air Force Base (AFB) in Wichita Falls, Texas completed the TIP mobile course.

Overall, the age demographic of the participants (see Figure 1) was more heavily weighted toward the younger age ranges of 18-22 and 23-27 year olds. This demographic was representative of the majority of participants that were located at Sheppard AFB. The course was made available to 71 participants including both active duty servicemen and servicewomen (36%) and civilians (63%). Of these 71 participants roughly 86% were from the Services (59% U.S. Air Force, 15% U.S. Army, 7% U.S. Marine Corps, 4% U.S. Navy),

with the remaining 13% from various Department of Defense organizations (Defense Agency at 3%, Combatant Command at 3%, and other at 7%), and 1% did not answer.

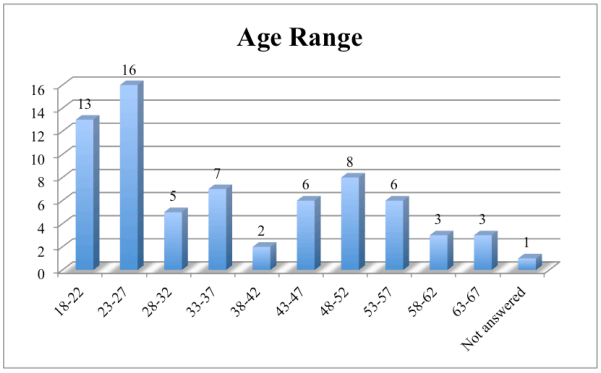

Figure 1. Age Range of Participants

Targeted Mobile Platforms

The mobile platforms targeted for the study included iPhone, Android, BlackBerry Torch, and HP Palm Web OS. All of the aforementioned smartphone platforms provide a mobile web browser with support for HTML5. These direct-touch smartphone platforms were specifically targeted as they provide a superior user experience compared to non-touch mobile devices. In addition, we needed to provide the best possible user experience on mobile in order to compare it to the deskop-based eLearning version that was developed in Flash®.

An enhanced version of TIP was created by the ADL Mobile Team using the jQuery mobile framework. The jQuery mobile framework allowed us to leverage our pre-existing knowledge of HTML to easily convert the content to an interoperable format that would render in any mobile web browser. Instead of writing unique native mobile apps for each mobile device or OS, the jQuery mobile framework allowed us to easily customize and brand the TIP content by merely using an HTML editor.

The mobile TIP course was tested throughout the study on all of the aforementioned smartphone platforms. Although not targeted for this study, the mobile TIP content will also render in older mobile devices that do not support HTML5 because it was built using progressive enhancement. The principle of progressive enhancement starts with a basic HTML web page, layering on additional JavaScript functionality, and giving only capable browsers an enhanced experience. This means that content developed with progressive enhancement will work even in mobile browsers that don't support JavaScript. Less capable browsers will still receive the best possible experience that their platform can handle, and will degrade back to simplified HTML and CSS support. This means that the less capable browsers may not support all the visual elements such as rounded buttons, gradients, and screen transitions but they will still be highly usable.

Although the Windows Phone 7 platform is considered a smartphone, it currently falls under this category as its mobile browser does not support HTML5. This approach of progressive enhancement also supports accessibility and could be applied to most any type of future electronic training content. In fact, if content developers started with a progressive enhancement approach when building their eLearning courses, then it is completely possible to support both a mobile-based and a computer-based deliverable from a single code base.

All of the participants in the study used their own smartphone devices for testing the mobile TIP course. This question was presented with the intent that only smartphones would be used to test the mobile TIP course. However, a number of users tested using tablets and those were answered as "other" in the results. The most popular type of mobile device used (see Figure 2) was the Android device (39), followed second by the iPhone (23). One user tested with a HP Palm device, and one user did not answer the question. Among those who answered "other" the following mobile tablet devices were used: iPad (3), iPad2 (1), Samsung Galaxy Tablet (1), and Acer Iconia Tablet (1).

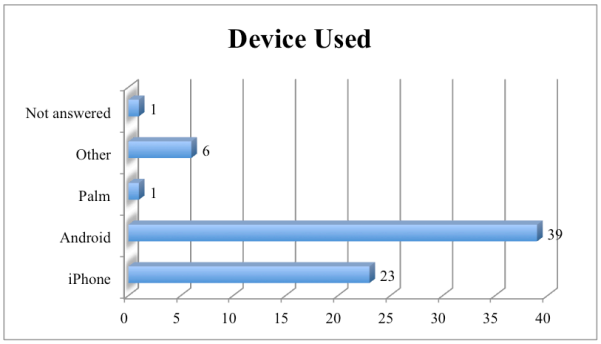

Figure 2. Mobile Devices Used by Participants

Mobile Delivery

It is important to note that the research described in this paper represents a field study. Therefore, we had no control over changing the instructional design and could only suggest minimal changes to making the content more concise for the mobile version. There were an equal number of learning objectives in the

mobile version of the TIP course as there were in the eLearning version. The pretest and posttest both required the students to complete 25 questions in each test. Ideally, this number of questions would have been reduced to improve user experience, but the subject matter experts of the TIP course did not approve such a change as the questions were directly tied to the learning objectives. Minor modifications were made to module one and module two to eliminate redundancy.

The ADL Mobile Team decided to deliver the course independent of a mobile LMS or mobile application. The options for integrating the course with a mobile LMS or third-party application would involve providing an additional interface layer and could negatively impact the primary goal of only measuring the effectiveness of the course. In addition, the Flash® animations in the original eLearning course were converted to static images in the mobile version in the course. This change to convert to more simplified, static images was also expected to help reduce the amount of time to complete the mobile course.

The original eLearning version of the TIP course had an estimated course completion time of 40 to 60 minutes while the new mobile version of the TIP course had an estimated completion time of 25 to 45 minutes (see Figure 3).

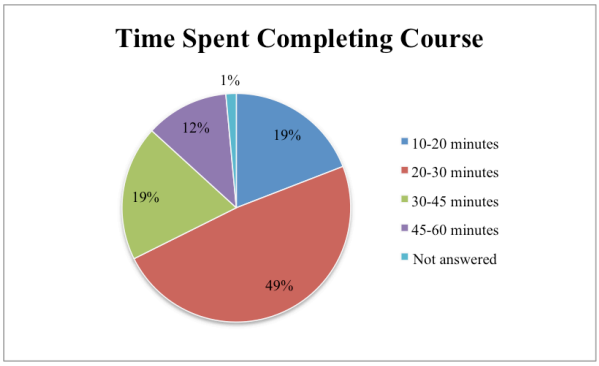

Figure 3. Time Spent Completing Mobile TIP Course

Overall, the average time to complete the mobile TIP course was much lower than the estimated time to complete the eLearning version of the course. Forty-nine percent of the participants completed the mobile TIP course within 20-30 minutes while 19% of the participants actually completed it within 10-20 minutes.

We believe these minor changes made to the mobile version of the course resulted in a drastic reduction in time spent to complete it. This is most likely attributed to the ease of use in the interface design of the mobile course coupled with the elimination of lock-step Flash® animations. The 19% of participants finishing within 30-45 minutes still fell within the estimated 25 to 45 minute timeframe. We surmise that the 12% of the participants who finished the course within the 45 to 60 minute timeframe may have included the time used to answer the end-of-course survey (although they were asked not to) and/or may have simply navigated through the course at a slower pace.

Refinements and Enhancements

During the conversion and development of the mobile TIP course several factors were considered in the overall interactivity and the interface design. As previously discussed, we were not allowed to reduce the instructional aspects of the content or make any of the contextual information more concise. The subject matter experts of TIP did completely remove some redundant content from module one and module two, but we believe further refinements to the content should have been made. The contextual information could have easily been made less verbose and would still be effective. The jQuery mobile framework allowed us to provide the best possible user experience with its built-in screen transitions, animations, and responsiveness. We carefully analyzed and then replicated the linear navigation design of the eLearning course. We were able to provide a comparable experience in terms of how the training content was accessed, but provided a more enhanced glossary capability than the original eLearning course. We improved the amount of interactivity by linking the terminology within the learning content directly to the glossary. Further refinements were made to optimize the graphics used in the mobile TIP course to reduce the amount of bandwidth needed to deliver the course to the participants' smartphones. It was expected that the participants would at the very least have a 3G data connection to access the mobile TIP course. While the original eLearning course was a total of 13.4 megabytes in size the mobile TIP course was reduced to 3.6 megabytes (not including the video files). The mobile TIP course was deployed using an HTML5 video technique that provided multiple formats. Unfortunately, there is a known issue with video being consistently supported across the various mobile devices and browsers. The two most common video formats supported on mobile platforms are .3GP and .MP4. The mobile TIP course provided these two formats as well as a link to the videos hosted on You Tube® with the expectation that one of these three would be accessible by the participants. The total size of the packaged mobile TIP course was 8.1 megabytes with the multiple video files. However, depending upon the mobile device only one of these video file would be

accessed so the mobile TIP course size would actually range anywhere from 3.6 to 6.2 megabytes.

Benefits of Mobile Course Delivery

Participants in the study believe that mobile course delivery provides many benefits (see Figure 4). Thirty-four percent of the participants cited convenience as the most beneficial feature. Time management (22%) and touch screen interactivity (20%) were nearly even as the second and third highest responses, respectively. More concise information (11%) and training with no distractions (10%) were also closely matched for the fourth and fifth ranking positions while 3% answered "other." For those participants that answered "other" they provided the following comments:

- User actually felt more distracted when using the mobile phone.
- Portability of the training

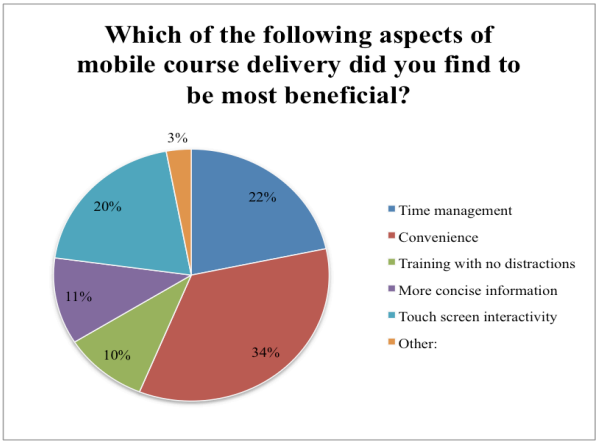

Figure 4. Benefits of Mobile Course Delivery

Design & Technical Issues

The participants reported a number of design and technical issues with the mobile TIP course while only 18% reported no issues at all (see Figure 5). The most frequent technical issue reported was related to video playback by 24% of the participants. Sixteen percent of the participants reported that they experienced issues with the user interface. Since this course was delivered through the mobile web browser during the study, connectivity was expected to be one of the highest reported issues, but only accounted for 8% of the responses. Fourteen percent of the participants reported that there were "other" issues or technical problems with the mobile TIP course. Among those who answered "other" the following issues were reported:

- Book marking was not provided, but was expected
- Images were too small or should be able to be enlarged
- Text size could not be increased

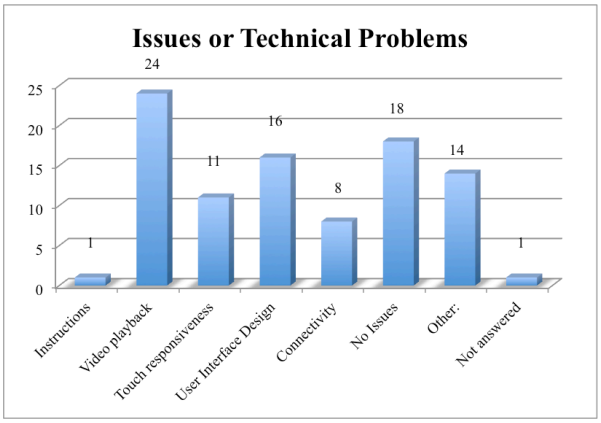

Figure 5. Issues or Technical Problems with Mobile TIP Course

Learner Performance

The overall performance of the participants improved when comparing the pretest scores to their posttest scores (see Figure 6).

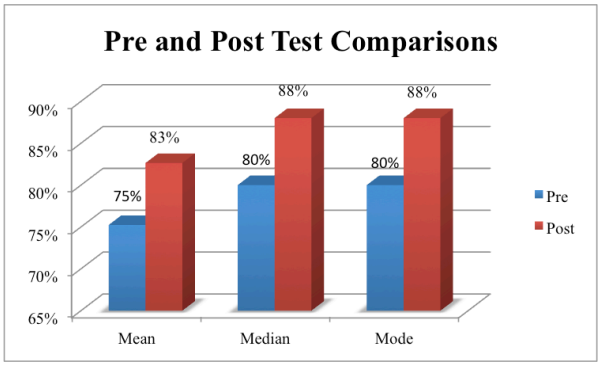

Figure 6. Learner Performance on Pretest and Posttest

The pretest minimum score achieved was 8% while the maximum score achieved was 96%. The test reliability for the pretest using Cronbach's Alpha was 0.841, and 0.879 for the posttest. The mean for the pretest was 75.24% with a standard deviation of 16.8%. There was an 8% increase in the mean for the posttest at 83% with a standard deviation of 16.92%. The pretest, posttest, and survey data were collected from the particpants using Questionmark Perception. At the time of the study it was the only known assessment software that could support any mobile browser. The ADL Team did not have the time or resources needed to manually develop a testing and reporting capability. We were provided with the opportunity to leverage this tool for the study and felt it would be a good decision since

much of the DoD was already familiar with using this application for delivering assessments.

eLearning Version of TIP

The original version of the TIP course is currently a mandatory training requirement and widely known throughout the DoD. In order to make effective use of our participants' time for this study it was decided that they would not be required to complete the eLearning version of TIP immediately prior to accessing the mobile version. However, we felt it was important to know how recently the participants had completed the eLearning version of TIP and attempt gauge how relevant this might be toward impacting their attitudes toward the mobile version (see Figure 7).

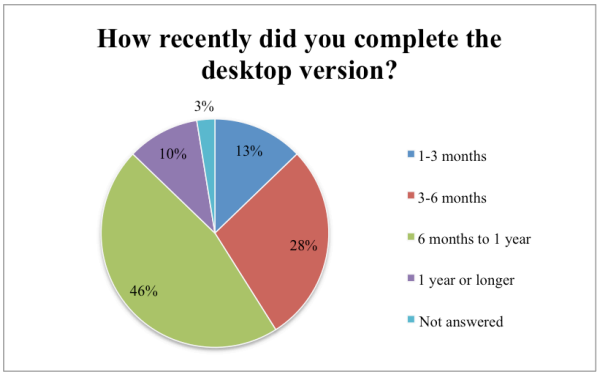

Figure 7. Recent Completion of eLearning Course

Of the participants who had previously completed the eLearning version of the TIP course, 46 % had completed the course within 6 months to 1 year ago, 28% within 3 to 6 months, 13% within 1 to 3 months, %10 answered 1 year or longer, and 3% did not answer. Since 87% of the participants had completed the course within the past year it is believed that this variable may not have impacted their attitudes more favorably toward the mobile version. If a majority of the participants had completed the eLearning version a year ago (or longer), then it is possible that this variable might have more positively affected their attitudes toward the mobile version.

Attitudes Toward Mobile Content

Should military training materials be delivered on a mobile device? Based on the results of this study, we believe mandatory training should definitely be provided as an alternative option to eLearning courses. The following question in the end-of-course survey was asked: If given the option, would you prefer that other mandatory computer-based training courses be available on your mobile device (instead of only on a desktop or laptop)? The responses to this question were evenly distributed in the preliminary survey. However, in the end-of-course survey (see Figure 8) fifty-eight of the participants answered, "yes" to this question, with an overwhelming response rate of 85%. Since this was the participants' first experience with completing a course on their smartphone, the response to this question could have been quite different if they had a negative experience with the mobile TIP course. This response indicates there was definitely a high degree of effectiveness of the mobile TIP course. Only eight of the participants (12%) answered "no" to this question. This response could be either indicative of learners who prefer eLearning courses or it could perhaps stem from the negative feelings that are so often associated with obligatory training.

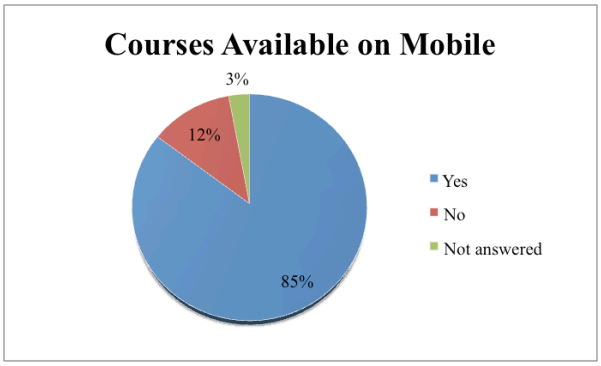

Figure 8. Option to Complete Mandatory Courses on Mobile Devices

Learner Satisfaction

The participants were asked to rate the overall satisfaction with the mobile TIP course. The question was rated on a scale of 1 (very poor) to 5 (very satisfied). Thirty-eight percent of the respondents rated the mobile Tip course with a "5", 46% rated it with a "4", 13% rated it with a "3", and 1 person gave it a "2" rating. There was definitely a high level of satisfaction among the participants. Out of those who had previously completed the eLearning version of the course, 70% of the participants actually preferred the mobile version to the eLearning version (see Figure 9).

Surprisingly, only 26% of the participants preferred the eLearning version, and 4% did not answer the question. Forty-three percent of the participants felt that the quality of the learning experience remained the same in the mobile version of TIP when compared to the eLearning version while 19% actually felt the learning experience was increased by the mobile version, and only 5% felt there was a decrease in the learning experience.

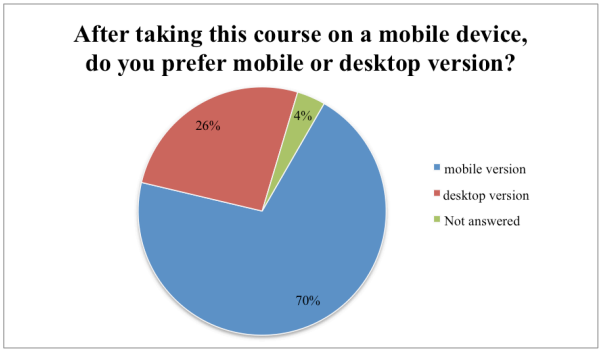

Figure 9. Course Delivery Preference

Focus Group Discussions

While the participants accessing the TIP mobile course from April 22nd through May 6th, 2011 were dispersed and allowed to access the course anytime during that two week period, the participants accessing the mobile TIP course at Sheppard AFB on June 1st were brought into the same building and required to complete the TIP mobile course within one sitting in the same room. The participants at Sheppard AFB were also divided into three groups so that follow-on focus group discussions could be conducted and qualitative feedback could be collected from each group. The first group (Group 1) consisted of Non-Prior Service (NPS) students who recently completed Basic Military Training (BMT). The second group (Group 2) consisted of Officers in casual status waiting to start pilot training. The third group (Group 3) consisted of a mix of civilian and military personnel from the 82nd Training Group tasked with supporting training operations and activities for the Air Education Training Command (AETC). Two focus group discussions were independently administered. The format of the focus group discussions simply involved having an informal discussion with the groups. We asked between 10 to 15 open-ended questions and spent roughly 30 minutes in each discussion.

The first focus group discussion was held with Group 2 as they were the first to collectively finish the mobile TIP course. All of the participants from Group 2 used their personal Android devices. In addition, all of the participants from Group 2 had previously completed the eLearning version of the TIP course and expressed some negative views toward mandatory computer-based training in general. One of the participants stated, "CBT's don't change your life, and they aren't relevant to our jobs." Several more participants quickly responded and contributed to the discussion by mentioning that computer-based tests for mandatory courses are usually poorly designed and they can easily write down the answers to the tests until they achieve 100% or even use Google to find the answers to the tests. Another participant felt that mandatory training was too repetitive and they should be able to test out of it every year, but that option is rarely provided.

Overall, Group 2 preferred the mobile version to the eLearning version, and felt that all mandatory courses should provide a mobile-based alternative for convenience. Some of the positive comments from Group 2 about the mobile version of the TIP course included the following:

- The mobile version was more to the point, less fluff, and presented in succinct bullet points.
- The videos and content loaded very fast, and was more convenient than a CBT course.

There were a few issues with the mobile TIP course that were reported by Group 2. The forward and next navigation buttons had glitches if the phone was rotated to a landscape orientation. One user was unable to complete the pretest on his Palm Pre. A number of users reported problems with playing the videos on module one. It is important to note that the issues varied and were not universal issues or problems for all participants.

The second focus group discussion was held with both Group 1 and Group 3. Only a handful of the participants from Group 3 had previously completed the eLearning version of the TIP course. None of the participants from Group 1 had previously completed the eLearning version of the TIP course as they had just finished BMT and had not yet been exposed to many computer-based training materials. A majority of the participants from both Group 1 and Group 3 had their own smartphones and data plans. The topic of being able to test out of mandatory eLearning was also brought up by this group and some of the participants admitted to skipping past most of the content to quickly complete the tests. Some of the positive comments from Group 1 and Group 3 about the mobile version of the TIP course included the following:

- The mobile version of TIP provided a good quality of learning and the fact that it could be made available on mobile devices would be very convenient.
- A mobile option would allow the training to be completed at home without having to pay for an Internet connection at home.
- Interacting with content using a touch screen is more engaging than using a desktop computer.
- This type of training access would be invaluable for mandatory/yearly requirements, especially for personnel who travel.

There were also a few issues with the mobile TIP course that were reported by Groups 1 and 3. Roughly 75% of the users with Android devices experienced issues with playing the videos in module one. Groups 1 and 3 also reported the same issue with the navigation buttons becoming nonfunctional after changing the device orientation.

Other Types of Military Training Materials

The focus groups reported several examples of where mobile technology is already being used on the job, including the following: 1) continuous development and learning through Defense Acquisition University (DAU), 2) public affairs messaging and updates to Air Force community using Facebook and Google mail, 3) digital kneeboards for pilots provide performance support and access to technical publications and emergency procedures during flight, and 4) looking up FDA and CDC regulations and using an Excel checklist on mobile device makes conducting inspections more efficient and gives the inspector a competitive advantage over those who don't have a smartphone.

The focus groups also discussed potential uses of mobile technology for their jobs such as the following: 1) Interactive reach-back content, 2) using tablets to access to technical manuals and documentation would save time, money, and paper, and 3) problems with supervisors updating subordinates' records in the current LMS.

IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

In this paper, mobile delivery effectiveness focused on three specific outcomes: learner performance, attitudes toward mobile courses, and learner satisfaction. The results of this study clearly demonstrate the positive impact of providing a mobile alternative for mandatory eLearning courses. The participants improved their scores in the posttest indicating an increase in overall performance. Comparing the scores of an eLearning course to a mLearning course was outside the scope of this study, but would be a useful future study in further exploring the effectiveness of mobile course delivery.

One of the primary objectives of this study was to determine whether or not smartphones would provide an acceptable alternative for the delivery of mandatory training content. Mobile courses should not be expected to replace traditional eLearning courses delivered through the desktop web browser. Eighty-five percent of the participants said they would complete their annual mandatory training on mobile devices if this alternative option were provided. This response indicates there was definitely a high degree of effectiveness of the mobile TIP course. We believe this outcome was heavily dependent upon the design and length of the content. However, further research should be conducted to compare a poorly designed mobile course to an effective one to confirm this belief. Eighty-four percent of the participants reported a high level of satisfaction. The mobile TIP course was also compared to the original eLearning course in order to provide another method to measure learner satisfaction. Seventy percent of the participants that had previously completed the eLearning course actually preferred the mobile version.

Mobile learning is still immature in terms of its technological limitations and pedagogical considerations (Park, 2011). Another area of future research would involve investigating the research literature on the topic of new instructional design theories and models for mobile content. The development of structured training content will undoubtedly require new approaches to address the unique design constraints exhibited by mobile devices.

In this paper, it was suggested that developers could support both an eLearning and an mLearning deliverable from a single code base if they started with the mobile deliverable first using a progressive enhancement approach. This approach to support multiple deliverables from a single code base has already been widely proven in the web development community, but further research could explore this recommendation by focusing on requirements specific to eLearning content in the military, such as the Sharable Content Object Reference Model (SCORM®).

There are several other technological limitations that may present challenges to mobile learning in the military. One specific area of huge significance is security to include development, testing, certification, and accreditation standards for mobile applications in the military. The Defense Chief Information Officer was directed to develop policies for the use of smartphone applications on military networks by 2012 (Brewin, 2011). However, there are still many opportunities to leverage existing personal mobile devices and data plans for mLearning until that time comes (Marine Corps CDET, 2010). Mobile apps that can be installed locally on the device have created an overwhelming mainstream interest, but have also created a new security concern that also must be

addressed for content delivered through the mobile web browser.

The most frequent technical issue reported was related to video playback (by 24% of the participants). This is in part due to known issues of operating system and browser fragmentation on the Android platform. Roughly 75% of the users with Android devices experienced issues with playing the videos in module one. The issue of fragmentation can be addressed by providing creating a universally supported encoded MP4 video file that will play in any smartphone browser supporting HTML 5. The ADL Mobile Team was able to resolve the issue after receiving the feedback from the participants. While using video for mobile learning purposes may not be a universal limitation, it definitely presents some technological challenges.

The purpose of this study was to collect empirical data on the general effectiveness as well as begin to identify the challenges and concerns pertaining to mLearning course delivery in military education and training. This paper revealed the results of the study, and further provided our approach to developing and delivering a mobile learning course targeted toward smartphone browsers that support HTML5. Based on the results of this study, it is believed that mandatory training could be made more accessible and to feel less forced upon if a mobile alternative was available. Mobile course delivery affords true self-paced opportunities for completion, anytime and anywhere. The results of this study should begin to help Military education and training stakeholders formulate plans for future research in using mobile devices for delivering courses or other types of learning activities.

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