Lessons Learned Integrating Mobile Technology into Two Army Courses

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ABSTRACT

As the Army considers using mobile computing to improve training and assessment, it must be confident in the benefits of that technology and more importantly, it must be able to articulate the requirements needed to achieve those benefits. Although mobile devices and software have proven to be extremely popular in the commercial market, research is needed to identify both the benefits and requirements of this technology before the Army considers its wholesale adoption for training and education. This paper reports on the results of using mobile devices in two Army courses: the Signal Captains Career Course (SCCC) and the School for Command Preparation (SCP). The software developed for the SCCC was an interactive performance assessment tool for the topic of power distribution while the software developed for the SCP was a practice tool for media engagement. In the first experiment, 182 SCCC students either took the traditional paper and pencil practical exercise or the interactive tablet-based version. The tablet-based version significantly reduced the time needed to complete the exercise (1h vs. 3h) without affecting student understanding of the topic. In the second experiment 161 SCP students practiced for the final exercise (mock media engagement) with and without the aid of a tablet-based practice tool. Although the group using the app reported practicing more, their performance on the final exercise was the same as those who practiced without the app. These findings indicate that although mobile technologies have the potential to benefit students and instructors, neither the magnitude nor the type of benefit is easy to predict at this point. These findings and other lessons learned are used as the basis for a proposed strategy for developing mobile applications for use in Dept. of Defense training.

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INTRODUCTION

One popular approach to implementing the Army Learning Model 2015 (ALM 2015) involves integrating technology as a way to increase student engagement. Although the Army has yet to fully adopt mobile computing devices and wireless networks for training, the ALM 2015 vision is that this type of technology will be instrumental in delivering training on-demand , anytime, anywhere. While the popularity of these devices has grown in the commercial marketplace, research on the efficacy of these devices for training is just beginning. Although there are currently guidelines based on the broader learning and educational literature (e.g., Keller-Glaze, et al., 2013, Naismith, Lonsdale, Vavoula, & Sharples, 2004, Tucker, 2010;), for integrating mobile devices into training and education, there is little empirical research validating these guidelines. For example, prior work at the Signal School found that when students were provided with tablet computers and training on how to use them in the classroom, students did not readily adopt those devices for training. Even for those Soldiers who owned a tablet device, usage of the course-provided device was minimal (Killilea, Marraffino, & Singer, 2013).

While there are a number of case studies (i.e., examples of ways to use mobile devices in the classroom) in the literature, few experimental studies have been reported comparing benefits of integrating mobile technologies into classrooms (Tucker, 2010). Additionally, little is known about the cost-to-benefit ratios of employing these technologies to support the next generation of learners. In an effort to fill these gaps in the literature, we conducted two separate experimental comparisons at two different Army schools. In the first project we developed an application that could be used to evaluate student performance while solving a well-defined problem involving power distribution at the U.S. Army Signal Captains' Career Course (SCCC). In the second project, we developed an application to enable students to practice for an ill-defined problem of successfully conducting a press briefing at the U.S. Army School for Command Preparation (SCP).

Students at the SCCC receive instruction on configuring generators to provide power to a tactical operations center (TOC). At the end of this training, students work as a group to complete a paper-based practical exercise (PE) to test their knowledge. This paper based test requires the students to calculate the power needs of each tent in the TOC and then determine which generators are needed to provide sufficient power. Students also need to know how to configure the generators properly. This paper based-exam typically takes students working in groups about three hours to complete. The paper-based PE is not interactive. Students develop a solution and then ask the instructor to check it for errors. If the students do not have the correct solution, they may get some hints from the instructor and then they must go back and try to solve the problem again. This continues until all groups have the correct answer.

The Power Distribution Practical Exercise (PDPE) app was not developed to replace the training that the students receive. It was developed to replace the practical exercise. Because the students typically work on the PE as a group, instructors don't have any indication of how individual students are performing. Instructors don't have time to provide individual feedback to all students, so they have them work in groups. The PDPE app was developed to provide feedback to students when they provided incorrect responses to the PE questions. Although the PDPE app did not provide any form of remedial feedback, the knowledge that a question was answered incorrectly did give the students the opportunity to double check their work or try a different solution before going to the instructor for help. Furthermore, the feedback meant that the instructors did not have to check every question.

Students at the SCP receive training on how to conduct a press briefing. Following this training, several students have the opportunity to lead a press briefing while the remaining students role-play as the reporters. Because only one student at a time can conduct the briefing, there is typically only time for 2-4 students from the class to serve as briefer.

One day prior to arriving at the briefing room, all students are provided with an information packet that describe a situation (e.g., a reporter shot at an Army checkpoint) and background information on each of the reporters. Students have the opportunity to familiarize themselves with the information, prepare opening and closing statements and practice for the briefing. The Media Engagement Mobile Environment (MEME) app was developed to provide students with an aid for practicing for the briefing. The MEME software contains all the information in the briefing packets. In addition, the app plays recorded questions from reporters and then uses the device's camera to record the student's response. Students can then play back their responses and self-evaluate.

Predictions

For the SCCC students, we predicted that having all students individually complete the PE using the PDPE app would have two effects:

Hypothesis 1.1: Students who use the PDPE app will learn more than students who use the paper exercise (because they work as individuals rather than as groups).

Hypothesis 1.2: Students who use the PDPE app will complete the exercise in less time than students who use the paper exercise (because the app provides immediate feedback as they answer questions).

At the SCP, we predicted that providing reporter questions and a simple means to record and review responses using the MEME app would have two effects:

Hypothesis 2.1: Students will spend more time practicing the media engagement skills with the app than without it.

Hypothesis 2.2: Students who use the app will be given better performance ratings by peers and instructors than students who do not use the app.

EXPERIMENT 1 PDPE APP METHOD

Participants

Participants were 182 students (65 without the app and 117 with the app). Demographic comparison showed that participants in the with-app and without-app groups were no different in terms of years of service, technology use, and comfort level with new technology.

Power Distribution Practical Exercise App

As with the paper-based PE, the PDPE app focused on demonstrating three key skills: determination of individual equipment power requirements, determination of aggregated power requirements, and placement and connection of generators to power a field command post. The PDPE app was divided into three phases corresponding to these three skills.

In the first phase, students were given a list of equipment (e.g., 24 printers, 3 air conditioners, etc.) and information about their power needs. Students had to then calculate the total power needs of the equipment using provided formulas. In the paper and pencil version of this task, students had to check with the instructor to make sure their answers were correct. In the PDPE app version, the software indicated whether a given response was correct or incorrect. If the response was incorrect, the student's answer would display in red characters and if it was correct, the characters were green. Students could not progress to the next phase until they answered all questions in the first phase correctly. No other feedback was given to students by the PDPE app if their answers were incorrect.
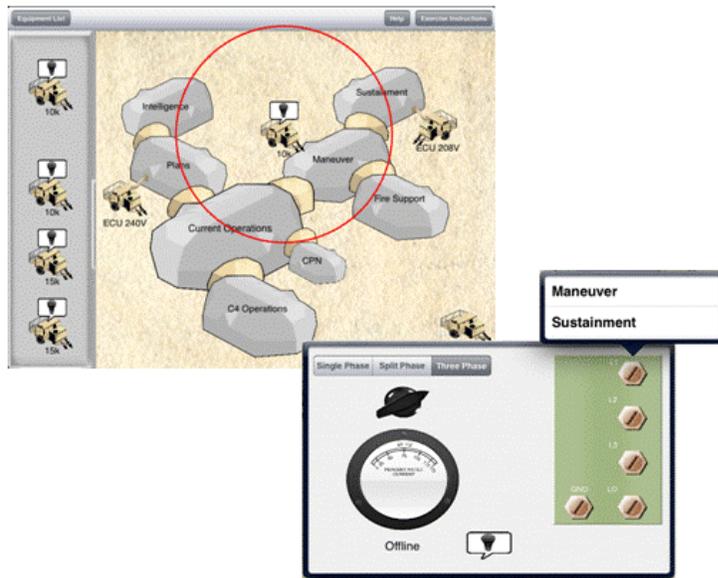
Figure 1. Screenshot of the PDPE App

In the second phase, students were shown a graphic of a tactical operations center (TOC) with tents (e.g., S1, S2, Ops) and other equipment (environmental control units, and radio transmitter). Clicking on the tent brought up a list of equipment in that tent. They then had to calculate the total power needs of the tents and equipment. As with the first phase, the PDPE app indicated the correctness of responses using green or red characters. When all questions were correct, students could progress to the final phase.

In the third and final phase, students saw the same TOC graphic used in Phase 2 on the right side of the screen and on the left side of the screen, were a number of different types of generators (see figure 1). The students had to position, connect, and correctly configure the generators to provide power to each tent and piece of equipment in the TOC. Solving this phase was far more difficult than the first two phases. Students had to consider the location the tents and other equipment and then had to determine which generators to place in what locations so that all tents/equipment received the correct amount and type of power. Additionally, each generator could neither be over- nor under-loaded and when relevant, the power load for a generator had to be balanced across all phases.

Procedures

Data were collected from eight separate SCCC classes over a period of eight months. The SCCC power distribution lesson was taught during a single eight-hour day. Typically, a three-hour morning lecture on power generation and distribution was followed by a PE after lunch. Five hours were allocated for the completion of the PE.

At the beginning of each day, researchers were introduced to the students by the instructor. The researchers then proceeded to describe the purpose of the research and distribute confidentiality and informed consent forms. After consent was gained, students were administered a 10 question Pre-Class Knowledge Test to measure baseline knowledge of power distribution concepts

Following training, students in the control group were formed into groups of six to eight people to complete the paper and pencil practical exercise. Grouping was based on physical locations in the classroom (e.g., six people sitting at one table) rather than on the instructor's knowledge of student competencies. Each group submitted a single solution for grading by the instructor. During the PE, students helped each other and could also ask the instructor questions. The exercise was graded on a go/no-go basis. In the event of a no-go, students were allowed to make corrections to achieve a go. The entire group then received the go score regardless of each individual's level of understanding or participation.

For the PDPE app condition, the instructor reintroduced the researchers who issued tablets running the PDPE app to each student. The researchers provided verbal instructions on how to use the PDPE software and the students were provided with paper job aids that also explained the app interface. Students worked individually on the PE using the PDPE app. Students were informed that this was a self-paced, individual effort exercise. During the PE, the research team answered questions about the user interface and helped with troubleshooting when necessary. The instructor answered student questions regarding the exercise.

Upon completion of either version of the exercise, students were administered a 10 question Post-Class Knowledge Test and a survey regarding their opinions of the app.

RESULTS

Pre/Post Knowledge Test. Results of the knowledge test were analyzed in a two factor mixed design (test time by PE type) Analysis of Variance (ANOVA) Both the paper and pencil and the PDPE app groups did significantly better on the post-test compared to the pre-test, $F(1,180) = 175.1$, $p < .001$. The improvement in the PDPE app group from pre to post test was greater, but this interaction was not significant, $F(1,180) = 8.22$, $p = .07$. Thus, we must conclude that the use of the PDPE app for the practical exercise did not impact student understanding. Table 1 shows the average score on the 10 item knowledge test for both groups and both times.

Table 1
Power Distribution Knowledge Test by Technology Condition

		Pre Test	Post Test
PE Type	n	M(SE)	M(SE)
PDPE App	117	5.27 (0.17)	7.86 (0.17)
Paper and Pencil	65	5.52 (0.23)	7.48 (0.23)

Time to Complete the Exercise. On average, participants who used the app, finished the exercise in 59.68 minutes. The fastest time to complete the exercise with the app was 19.07 minutes and the longest time taken was 99.15 minutes.

Because students complete the paper and pencil exercise in groups, it did not make sense to record the time to complete the paper and pencil exercise for each participant individually. Instructors reported that the groups completed the paper-based exercise in 180 to 210 min. The time to complete the exercise by the students using the app were compared to the time for the students using the traditional test using a one-sample t-test with 180 min as the comparison mean. This analysis showed that participants with the app completed the exercise in significantly less time than participants doing the paper and pencil exercise, $t(92) = -68.2$, $p < .001$.

DISCUSSION

In the SCCC class, as in many other Army courses, the final PE is used both as a learning exercise and a final assessment of student understanding. The instructor is available to the students throughout the exam to provide help on the PE. Because of this, all students receive a "go" on the final exam, though some may do this quickly without any assistance from the instructor while others may take more time and require more help.

The overall result is that the virtual app version of the practical exercise did not significantly improve learning outcomes as theorized in Hypothesis 1. This conclusion is based on the findings of the knowledge test administered before and after the training. There was a tendency for students in the PDPE app condition to do better than students with the paper and pencil exercise, but this effect was not significant.

There were, however other advantages to using the PDPE app, most notably, the time it took to complete the exercise. Students using the app were able to complete the exercise in about one third the time (1h vs. 3h) as students taking the paper and pencil version, supporting Hypothesis 2. This savings of two hours per class could be used to provide more in depth training on power distribution or for the training of other topics in the SCCC.

It is interesting to note that although students in the PDPE app condition did as well as students in the paper and pencil condition on the post exam knowledge test, the group that took the paper and pencil version self-reported a higher level of understanding than the group that used the app. We don't have data to explain this apparently contradictory set of findings, but our observations of the training suggest two possible reasons.

A first possibility is that the post-exercise knowledge test was not sensitive enough to detect that students in the PDPE app condition did not learn as much as the students who took the paper version of the exercise. This hypothesis seems unlikely however for two reasons: first, the test was sensitive enough to detect improvement in performance after the training for both groups; second, the post-test scores of the PDPE app students were higher (though not significantly higher) than the scores of the students taking the paper and pencil test. Thus, a more

sensitive test would be expected to find that the PDPE app students did better than the students taking the paper exam.

A second possibility is that students using the app only thought they were not learning because they experienced frustration using the PDPE app. Some students expressed frustration with the PDPE app in the survey comments and during the exercise in class. The frustration generally resulted from inaccurate expectations about the capabilities of the app. Specifically, a number of students suggested the PDPE app should "do the calculations for us and recommend solutions." These students seemed to perceive the app as a job aid rather than as a medium for taking the practical exercise. This was also observed by researchers during the exercise. Students who were unable to correctly answer questions in the PDPE app, sometimes became frustrated when the app did not provide hints or a help function. Although the app did not provide remedial feedback or hints, it did indicate whether a particular response was correct or not. This meant that students could engage in a process of trial and error to solve the problem. Unfortunately this is an inefficient means of learning (Sweller, 1999). If that approach did not provide a correct answer, students would often grow frustrated and would only then turn to the instructor or sometimes peers for help. Students taking the paper version of the exercise worked in groups. Students in this condition who didn't understand the solution did not experience the same frustration as long as someone in the group could solve the problem. Additionally, if that student wanted to have a better understanding, he or she could turn to a peer for an explanation.

EXPERIMENT 2 MEME APP METHOD

Participants

Participants were 162 students (93 without the app and 68 with the app) attending the School for Command Preparation (SCP). Demographic data showed there were no differences in average years of service or self-reported use of technologies and comfort level with using new technologies.

Media Engagement Exercise App

The Media Engagement Mobile Exercise (MEME) app provides students an opportunity to practice the process of conducting a press briefing. After launching the software, the student is presented with background information about the topic of the selected briefing and background information on the members of the press pool. By studying this information, students can develop their talking points and can anticipate the types of questions likely to be asked by the reporters.

Figure 2. Screenshot of the Media Engagement App

Once the student feels ready, he or she may begin the press briefing. On starting the briefing, the student is prompted to make an opening statement. The app uses the device's camera to record a video of the statement. To insure the student properly aims the camera, a frame showing what the camera is recording, appears in the upper right corner of the screen.

Next, the student sees a room of reporters (see Figure 2) and selects one to hear his/her question. After hearing each question, the student can record his or her response. The student continues answering questions until no more questions are asked or until the student decides to end the briefing. At this point, the student is prompted to record a closing statement. After concluding the briefing, the student sees a series of self-rating questions and can review his or her recorded responses.

Procedure: MEME App

On the day preceding the mock press briefing, researchers introduced the project, and distributed privacy act and informed consent forms. Students then received approximately 2h of in-class training on best practices for engaging with the media. At the end of the class, students in the without-app condition were provided with briefing packets with one of two scenarios used in the mock press briefing. The packet included background on the incident, interviews with key witnesses, and background on the individual reporters. Students in the with-app conditions were issued iPads with the MEME app installed. The information in the briefing packet was built into the MEME software. Students were also provided with job aids describing the use of the software and were given verbal instruction by the researchers on the use of the devices.

For both conditions, the two scenarios were the same. One was based on an accidental shooting of a civilian at a check point in a hostile country. The other was based on a controversial award of the Distinguished Service Cross (DSC) instead of the Medal of Honor to a deceased Soldier. All students were told to be prepared to play the role of both the briefer (Battalion Commander) as well as the reporters. Students were told to prepare by outlining the opening statement, practicing in a mirror and rehearsing with classmates.

The following day, students reported to a room set up as a television studio and took turns as reporters or briefers in the mock press briefing. The studio included a podium, seating for the reporters, and a large television camera. Bright studio lights were trained on the briefer at the podium. Upon arrival, student surveys and peer evaluation forms were handed out. In some classes the students volunteered to serve as briefers and in others they are chosen to brief by the instructors.

Briefers began with an opening statement. They then fielded questions for five to ten minutes and finished with a closing statement. The engagement was immediately reviewed and discussed by the instructors and students. Depending on how quickly the briefings went, between 4 and 6 students served as briefers. All student surveys and peer/instructor evaluations were collected at the conclusion of the briefings.

RESULTS: Media Engagement

Hypothesis 2.1 was supported. Students in the with-app condition practice more than students in the no-app condition. Those participants in the with-app condition ($N = 64$, $m = 1.03$, $sd = .31$) rehearsed more times than those in the no-app condition ($N = 93$, $m = 0.84$, $sd = .65$), $t (155) = 2.21$, $p < .001$; $d = 0.35$. It should be noted, however, that the effect size was small.

Hypothesis 2.2 was not supported. There was no significant difference in the performance ratings of either group by either peers ($t(67) = 1.29$, $p = .41$) or instructors ($t (53) = 0.81$, $p = .18$, see Table 2). While having the app did not significantly improve the performance of the students it should be noted that it did not detract from their performance either. Also in testing hypothesis 2.2, a regression was conducted to see if amount of App Usage Time would affect student performance scores. App Usage Time did not predict performance scores as rated by peers ($N = 14$, $b = .006$, $t (12) = 1.35$, $p = .20$) or instructors ($N = 14$, $b = .002$, $t (12) = 0.252$, $p = .81$). A similar analysis was not possible with the no App group because they did not record the time they spent practicing.

Table 2
Peer and Instructor Ratings of Student Briefers.

Condition		Peer Ratings		Instructor Ratings	
	n	Mean	Standard Deviation	Mean	Standard Deviation
No App	37	5.36	0.57	5.20	1.03
MEME App	32	5.52	0.47	5.40	0.74

DISCUSSION: MEDIA ENGAGEMENT

The purpose of this project was to examine the benefit of using a mobile app to facilitate practice and performance on a media engagement exercise. The MEME app closely approximates the in-class exercise. Participants given the opportunity to use the app rehearsed more than those who were not given the app. Participants in both the with-app and no-app conditions were both given the same recommendation to practice using any of several methods (e.g., outlining the opening statement, practicing in the mirror, rehearsing with classmates). Those in the with-app condition had the app as an additional practice tool.

One interpretation of this finding is that the app promoted practice because it was a more appealing or engaging way to practice than the other modes that were recommended. Another interpretation however, is that participants in the with-app condition were simply complying with implicit demands of the researchers and even instructors. These demands may have arisen from the fact that only in the with-app condition were students given a specific tool with which to practice. The desire to fully contribute to the research may have inflated the extent to which the students used the app. In hindsight, a better design might have been to distribute hand-held mirrors (or some other practice aid) for the without-app participants.

The use of the app did not result in enhanced performance scores. Scores were higher in the with app groups, just not significantly so. One possible explanation is that one night with the app was simply not sufficient to allow the students enough practice to improve their own performance, so although they did practice more, it was not enough to have an effect.

Although the use of the app did not significantly affect performance, there are ways that the app could benefit students. First, the mobile app might be an acceptable surrogate for the media exercise. This would add significant value because the in-class exercise takes a considerable amount of time. Indeed, only four or five students get the opportunity to brief in a two hour time period. In that same amount of time, every student could complete the app exercises. The advantage of this would be to allow all students to get the experience of conducting a press conference. Second, the recordings of each student could be played for the class allowing each student to get peer and instructor feedback on their performances.

GENERAL DISCUSSION

In the course of conducting this research we learned three valuable lessons about incorporating software for mobile devices into Army classrooms. These lessons came not so much from the experimental measures but from our experiences designing, building, and introducing the technology into the classrooms.

With regard to both apps, we faced a dilemma in designing the software. From an experimental design point of view, we needed to design the apps to substitute for existing elements in the courses. In this way, we could be sure that any differences observed when using the apps were the result of the technology as opposed to the content. For example, with the PDPE app, we developed the app to replicate the practical exercise as closely as possible. For the MEME app, we provided a structure for rehearsal of the press briefing.

By taking this approach, however, we were aware that we were not utilizing the full potential of these hand-held devices. For example, it would have been possible to develop hands-on training exercises for use in conjunction with the instructor-led training. This would have enabled students to actively learn concepts and procedures being trained in the classroom. The encouraging news is that despite very limited use of the capabilities of the technology in these classrooms, we did see significant benefits including reduced time to complete the power distribution PE and more practicing by students for the press briefing.

Lesson 1: Do not Simply Insert New Technology into Old Training.

One of the key advantages of new technology is that it makes it possible to train in new ways. To leverage all those capabilities, it is often necessary to change the curriculum as well. As we discovered, this is an iterative process because it takes time to fully understand the ways in which the new technology can transform the learning process.

For example, one of the many advantages of apps is that they give students more control over their learning environment and access to a wider range of materials (Hays, 2005). However, the instructors and training developers must put careful thought into the level of control they want students to have and they must understand how to adapt their lesson plans to accommodate this capability (Keller-Glaze, et al., 2013). When using a new game, app, or activity that is designed for instructional purposes, it will take time to understand how students will interact with and react to the technology-based training. Because training developers and instructors may not be able to anticipate student reactions to a new technology, it is likely the curriculum will need to be adjusted even after the technology is introduced.

Lesson 2: Adding technology to the Classroom Requires Instructor Development.

Another lesson learned had to do with the acceptance of the technology by the instructors. In these experiments, instructors received hands-on training with the apps. However, because the researchers were always present to introduce the technology and help with troubleshooting, the instructors didn't need to become app experts before the experiments began.

As the data collections began, we noted that some instructors in both courses voiced indifference and even sometimes dislike of these products. In one case, an instructor commented that he worried that the device was going to replace him and take his job away. In all cases, we noticed that these attitudes changed significantly as the instructors became more familiar with the apps and realized that they were tools they could use to help the students. In fact, in most cases the instructors completely changed from being critics to being advocates for the tablets and apps.

Preparing the faculty to confidently and effectively use technologies in the classroom is critical to creating a successful learning environment. As noted throughout the literature, those instructors with both the right attitude and aptitude for technology experience less frustration and are more successful when adopting new technology based training tools (e.g., Tucker, 2010; Keller-Glaze, et al., 2013).

Instructors must be given time to become comfortable with the technology. This goes beyond simply knowing how the software works. Instructors know that they will have to be troubleshooters and will have to answer other questions about the technology. Additionally, instructors that are only comfortable using a lecture format for teaching will have to learn new instructional strategies such as providing guidance using a problem-centered training approach (Vogel-Walcutt, Fiorella, & Malone, 2013). Until instructors understand the technology's strengths and weaknesses first hand, they will understandably be apprehensive about using it.

The literature is replete with evidence supporting the need for instructor training so that they can effectively teach using new methods and technologies (e.g., Guskey & Yoon, 2009). This creates special challenges for the Army because instructors in uniform typically only serve a 24 month assignment and therefore must be given this training quickly. As the Army attempts to incorporate technology into classrooms, it will have to significantly change the way it trains and develops future instructors.

Lesson 3: More Research is Needed to Develop General Rules to Predict the Return on Investment for Mobile Apps.

It is worth considering what might be learned from this effort regarding return on investment (ROI) for mobile applications for training. On the investment side of the equation, we have the cost of developing the apps. Because these were research tools, the cost of developing them was higher than what we would expect for a typical app simply developed for training purposes. Each of these apps cost about $75K to develop. That does not include the cost of the devices themselves or the recurring costs for maintaining the software and equipment.

We contacted three companies to get an estimate for the cost of building an app like the media app for training purposes. They each stated that cost is driven by the complexity of the design, graphics, and calculations required in the app. Additionally, cost can increase significantly if the customer needs the developer to do a significant amount of design work. Cost estimates for an app like the media app ranged from just over $13,000 from two college students operating out of a basement office, to $65,000 from a well-respected application development firm.

On the benefit side of the equation, some costs are easy to estimate while others are not. Cost savings related to training delivery are relatively easy to estimate. For example, the technology can reduce costs such as training time or consumables used in training. In the case of the PDPE app, training time was reduced by about 2 hours per student. There are currently 6 classes per year with 32 students per class which means that the app saves about 396 total personnel hours for all students and instructors per year. Assuming a loaded labor rate (i.e., all salary and benefits) of about $80 per hour (for an O-3), the app could save about $31,360 per year in labor alone. If the app is used in other courses, those savings increase.

More difficult to quantify, are cost savings related to improved training outcomes such as improved proficiency or skill level. These are often called cost-avoidance measures. For example, higher levels of proficiency can save money by reducing the need for refresher training, reducing errors or accidents in the operational unit, or otherwise improving the efficiency with which the unit completes its mission. Estimating these cost savings is very difficult because many of them may be 2nd or 3rd order effects. The most definitive way to determine these cost savings is through direct comparison of all relevant unit expenditures before and after the training technology is introduced.

Other cost-avoidance benefits are related to greatly reducing the cost of having a new capability. For example, one of the benefits of mobile devices is their portability (Tucker, 2010). Tablets enable Soldiers to bring a powerful computer to almost any location for job support. Apps used in the classroom can therefore serve a dual purpose. In the classroom they can serve as training aids and in the field they can serve as job aids. For example, if the MEME app had an authoring capability, leaders could use it as a job aid to practice talking points before key leader engagements or press briefings. Several students commented that this would be very valuable at battalion echelons and below because they lack a public affairs staff. The cost avoidance here would be the cost of using an app vs. providing a public affairs staff to those echelons.

Another cost-avoidance benefit of the MEME app is that it enables all students to receive feedback on their briefing skills. Without the MEME app, the class would have to double or triple (i.e., take 1 to 1.5 days) the time spent in the studio to get the same benefit. Adding that much time to the training schedule would most certainly be cost-prohibitive.

Our conclusion at this point is that the use of mobile devices for training holds promise for improving training outcomes while lowering training costs but the research literature is not extensive enough to provide general rules for predicting ROI. Because exact cost savings or cost avoidance produced by any app will depend on how well a given app is designed, how well it is incorporated into the curriculum, how well the curriculum is adapted to leverage the full potential of the device and software, and how well the instructors are prepared to use the app, ROI currently needs to be determined on a case-by-case basis.

On the cost side of the equation, although the cost of developing a single app is not particularly high, the cost of developing and maintaining hundreds or thousands of apps would be substantial. Furthermore, it should be noted that if the Army decides to adopt mobile devices for training on a large scale, it will have to pay not just for the cost of developing and maintaining the software but also for the cost of purchasing devices, providing secure wireless networks, modifying existing curricula, and providing professional development opportunities for instructors. Due to the number of unknowns with regard to both estimating benefits and costs for mobile software in training, it would not be prudent for the Army make a wholesale investment into mobile technologies for training at the present time. Instead, a phased approach is recommended so that lessons learned from early phases can be applied to subsequent phases.

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