Mobile Learning Decision Path

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Acronyms

ADDIE	Analyze-Design-Develop-Implement-Evaluate
ADL	Advanced Distributed Learning
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
BYOD	"Bring Your Own Device"
CBT	Computer-Based Training
CoPs	Communities of Practice
COTS	Commercial Off-the-Shelf
CSS	Cascading Style Sheets
CTTSO	Combating Terrorism Technical Support Office
DL	Distance Learning
e-book	Electronic Book
GPS	Global Positioning System
HR	Human Resources
ID	Instructional Designer
ILT	Instructor-Led Training
IM	Instant Message/Instant Messenger
ISO	International Organization for Standardization
IT	Information Technology
LMS	Learning Management System
MLDP	Mobile Learning Decision Path
OPSEC	Operations Security
OS	Operating System
PS	Performance Support
RSS	Really Simple Syndication
SME	Subject Matter Expert
SMS	Short Messaging Systems (Text Messages)
UI	User Interface
URL	Uniform Resource Locator
UX	User Experience
WBT	Web-Based Training

1.0   Project Description

Project Background:

Government agencies interested in implementing mobile learning (mLearning) solutions are doing so through pilots and trial and error. There are many important decisions to make prior to and during the design, development, and implementation of an mLearning solution. Best practices for reusing and redesigning existing learning content for the mobile platform do not currently exist. The many variables to consider would be more readily addressed by an mLearning decision support resource. This project was an effort completed for ADL (Advanced Distributed Learning) in coordination with the CTTSO (Combating Terrorism Technical Support Office).

Project Goals:

Several tools exist that provide guidance in the mobile solution process, including *DesignJot*,[1] *mLearning Decision Maker*,[2] *Learning Asset Technology Integration Tool (LATIST)*,[3] *YinYang*,[4] and the *FLOAT Learning Mobile Primer*.[5] While these tools offer answers to some mLearning questions (e.g., *YinYang* and *mLearning Decision Maker* help the user diagnose an organization's primary learning paradigm), none to date offers a comprehensive guide for instructional designers (IDs) to assist them in the wide spectrum of decision points involved in mLearning project efforts.

The **Mobile Learning Decision Path (MLDP)** was created to provide guidance to IDs when they find themselves in situations in which the need for mLearning may arise. For example, IDs frequently encounter mobile redesign situations, where they are tasked to redesign existing learning modules and/or lessons into something suitable for mobile devices. Here, the content (i.e., materials and information to be conveyed to the learner) already exists as part of a course or training event (face-to-face or eLearning). This content needs to be redesigned and reformatted from scratch to make it suitable for a mobile platform, which is a common challenge for IDs. Thus, the MLDP uses a sample project to illustrate how an ID should approach an mLearning solution when there is already a collection of existing training materials, learning objectives, and course content available. Conversely, IDs are much less likely to be familiar with designing a mobile performance support (PS) tool, which is an external resource that can be referred to at the moment of need to assist a user in the completion of a task. PS tools can be based on existing materials, or can be developed from scratch. PS is becoming a growing area for mobile solutions. For this reason, this document also illustrates how IDs can apply the MLDP to better understand the factors involved in making decisions regarding mobile PS tools.

While these two situations represent the sample projects illustrating the application of the MLDP, we also recognize that there are many other situations in which mLearning can be implemented. For example, IDs may be asked to develop mLearning modules for a new training need. In this case, content is developed from the ground up to address the new need, which entails much front-end work to determine the curriculum, learning objectives, and goals prior to creating materials to meet this new training need. Following this analysis, IDs can determine whether there is a need for an mLearning solution.

Other examples include:

- mLearning developed for enhanced collaboration via user-generated content: much of the content is created by learners to share with other learners, including but not limited to learning exercises,

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[1] http://itunes.apple.com/us/app/designjot/id447686146?mt=8
[2] http://itunes.apple.com/us/app/mlearning-decision-maker/id513104879?mt=8
[3] http://latist1.gmu.edu/
[4] http://frankn.net/yinyang/
[5] http://floatlearning.com/apps/float-mobileLearning-primer/

> photo or video examples of concepts, podcasts or vodcasts, self-assessments, and lessons learned documents. This collaboration encourages constructivist-style user participation, discussion, teamwork, and collaboration.

- mLearning for assessment of user performance or knowledge, developed to address a new assessment need: much of the content requires user input and evaluates the performance or knowledge acquisition of the user, often for self-assessment purposes. These assessments usually leverage unique mobile platform capabilities (such as location awareness and the device's built-in camera) and/or are contextually based (such as an assessment that requires the user to be in the process of using a piece of equipment). The content here can be redesigned from existing assessments, or constructed in response to a new assessment need.

Situations such as these will be addressed in follow-on work.

The **MLDP** identifies and analyzes relevant information, resources, and literature relating to the mobile solution process, including important considerations to be addressed prior to and during an mLearning initiative. The MLDP guides IDs in making decisions by describing decision points, good practices, and recommendations. It also illustrates how to apply the MLDP to sample projects (mLearning content redesign and mLearning for PS). This not only educates IDs on the nuances involved in mLearning solutions, but it also allows IDs to provide justification for decisions that are made in their own projects. Thus, by referring to this MLDP, IDs will be able to more fully capitalize on the advantages that are offered by the mobile platform, as well as to avoid potential pitfalls that could compromise the ultimate success of the final product. **Figure 1** describes the target audience for the MLDP.
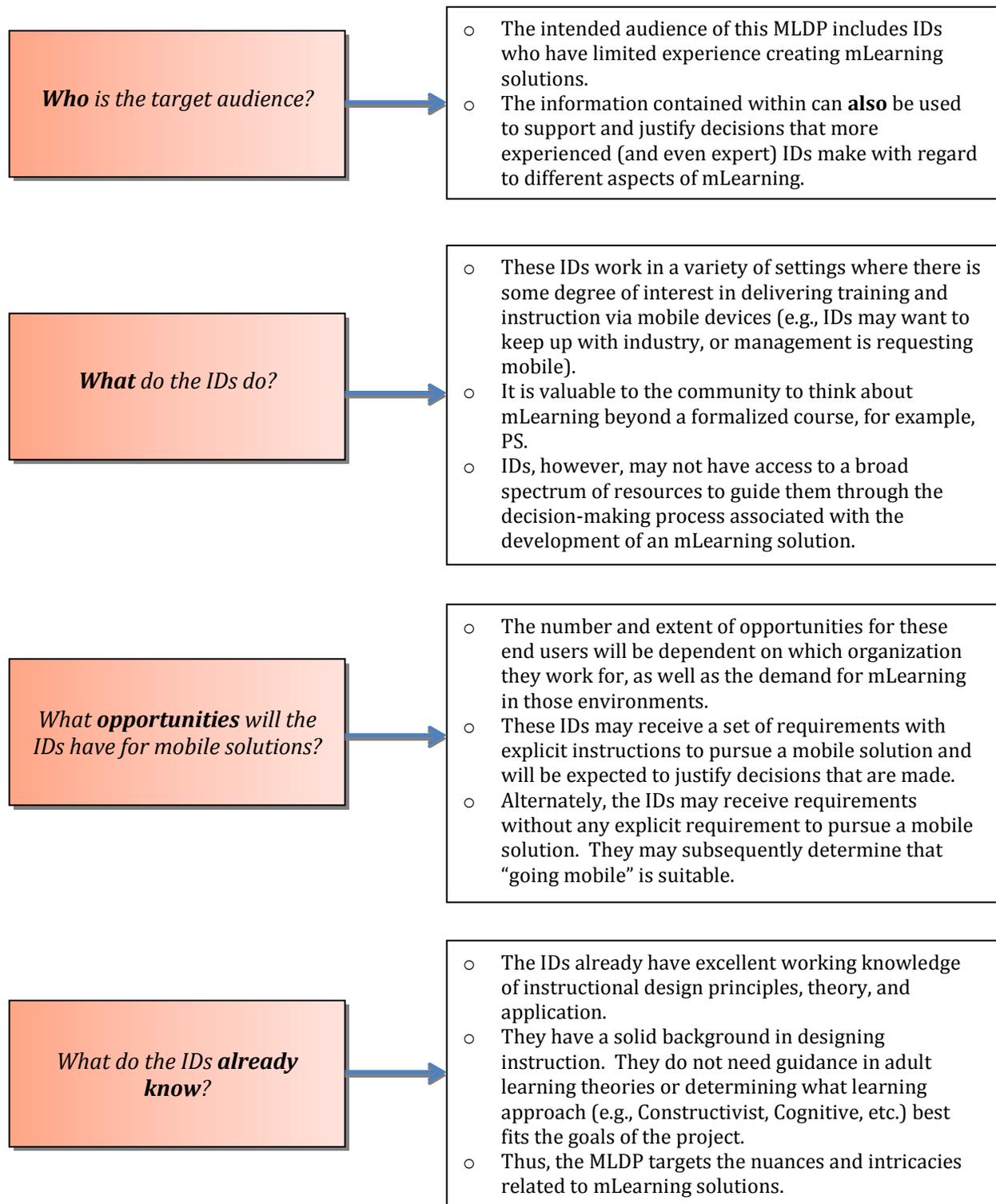
Defining the MLDP Target Audience

Who *is the target audience?*	o The intended audience of this MLDP includes IDs who have limited experience creating mLearning solutions. o The information contained within can **also** be used to support and justify decisions that more experienced (and even expert) IDs make with regard to different aspects of mLearning.
What *do the IDs do?*	o These IDs work in a variety of settings where there is some degree of interest in delivering training and instruction via mobile devices (e.g., IDs may want to keep up with industry, or management is requesting mobile). o It is valuable to the community to think about mLearning beyond a formalized course, for example, PS. o IDs, however, may not have access to a broad spectrum of resources to guide them through the decision-making process associated with the development of an mLearning solution.
What ***opportunities*** *will the IDs have for mobile solutions?*	o The number and extent of opportunities for these end users will be dependent on which organization they work for, as well as the demand for mLearning in those environments. o These IDs may receive a set of requirements with explicit instructions to pursue a mobile solution and will be expected to justify decisions that are made. o Alternately, the IDs may receive requirements without any explicit requirement to pursue a mobile solution. They may subsequently determine that "going mobile" is suitable.
What do the IDs ***already know****?*	o The IDs already have excellent working knowledge of instructional design principles, theory, and application. o They have a solid background in designing instruction. They do not need guidance in adult learning theories or determining what learning approach (e.g., Constructivist, Cognitive, etc.) best fits the goals of the project. o Thus, the MLDP targets the nuances and intricacies related to mLearning solutions.

Figure 1. Defining the target audience for the MLDP.

A set of assumptions guided the research and development of this document:

Assumptions:

- This effort covers only the Analysis and Design phases of the process. An ID should complete a full front-end analysis (with guidance from the MLDP) and then continue through the remaining phases of the ID process to ensure quality of the final product.
- The target audience of this project is professional IDs. They should already have a solid understanding of learning principles. Therefore, this project does not focus on explaining and applying learning principles. It also does not explain the entire ID process (e.g., ADDIE or other), how to conduct a full analysis of the problem or learning need, or full considerations for the project lifecycle.
- This effort does not give special considerations for any particular brand of mobile device. Therefore, all recommendations given in this report are based on generic or mainstream mobile devices and their functions and features. It is up to the reader/user to do additional research on operating systems and devices and how they differ.
- There are many mLearning design and development tools available in various forms. This effort is not funded by any of the tool manufacturers. Therefore, this report does not endorse or recommend a particular tool.
- During the research phase of this effort, a selected group of IDs from government agencies and their contractor were interviewed for input to this project. However, the effort tries to overcome this limitation by bringing in subject matter experts (SMEs) to provide guidance to this project. Therefore, the recommendations here should have wider applications beyond government agencies.
- This is a new and constantly evolving field, with incomplete and limited research. The information provided in this report includes good practices based on experiences and observations. It is just the beginning of the treatment of the mobile opportunity.

With constant changes, developments, and evolutions in the mLearning space, the MLDP provides relevant and applicable information to guide IDs at the time of the project delivery (April 2013). The MLDP was developed with the primary goal of assisting IDs in the early stages of development focused on two situations where the need for mobile may arise: (1) reuse and redesign of eLearning content for mLearning, and (2) mLearning for PS (see Figure 2). A Mobile Resource Library is also included in **Section 8.1** to provide IDs with resources to help them stay up to date with mobile technologies, methodologies, and processes.
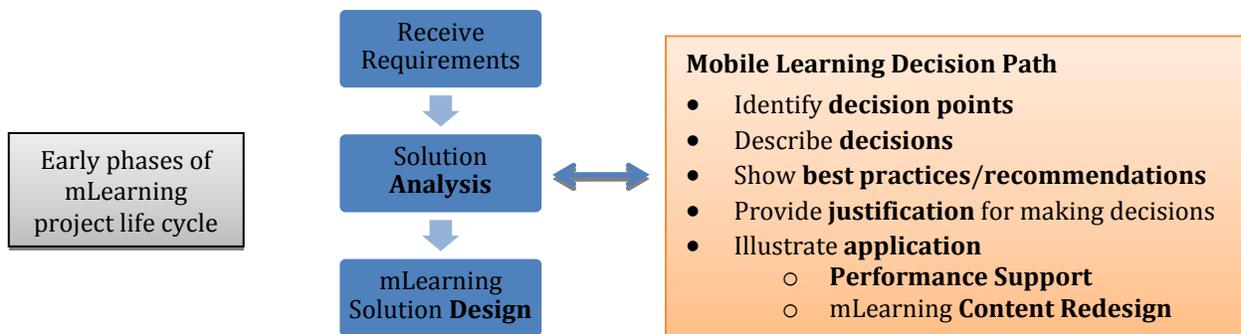

Figure 2. The MLDP fits within the early phases of the mLearning project lifecycle to guide IDs through decision points.

2.0   Analysis of Current Mobile Learning Space

> *mLearning means "Leveraging **ubiquitous mobile technology** for the adoption or augmentation of knowledge, behaviors, or skills through education, training, or performance support while the mobility of the learner may be **independent** of **time**, **location**, and **space**" (ADL Mobile Learning Guide, 2013).*
>
> *"Pressure to provide learning on mobile platforms is coming mostly from **employees**, including increasingly mobile workforces. Approximately 50% of survey responders reported that at least 50% of their employees already use their own **smartphones/devices** to access work-related sites or information—and this number is growing. The notion of **"bring your own device"** is on the rise and organizations may leverage it for their implementation strategies. At the same time, nearly a quarter of responding organizations indicated that [they] feel **no pressure to deliver mobile learning**. IT departments in responding organizations also show little interest in driving mobile learning. Factors that may be constraining the growth of mobile learning include a variety of **technology** and **security concerns**, the availability of **organization-owned devices,** and issues related to the **appropriateness** of using personal devices" (Mobile Learning Pulse Survey, 2012).*

Propelled by advances in mobile computing, such as smartphones and tablets, the current mLearning space is an extension and evolution of the more established field of distance learning (DL). Several leading authorities have suggested that mLearning offers a number of advantages over traditional DL: the ability to provide ubiquitous and on-demand learning opportunities which are unconstrained by the learners' actual physical location (Quinn, 2011); the ability to provide real-time job aids, such as checklists and calculators, which reduce the learners' need to memorize factual information and to perform complex mental calculations (Quinn, 2011); the ability to democratize the learning process by connecting learners with experts and one another in real time (Laouris & Etekleous, 2005); the ability to provide increased opportunities for practice and feedback, to capitalize on "learning by doing," and to help learners correct misconceptions from previous learning activities (Laouris & Etekleous, 2005); and the ability to provide learners with just-in-time instruction based on an analysis of their "presence," as determined by their physical location and schedule (Motiwalla, 2007). While these promises are indeed impressive, at present they appear to be largely unrealized. Extensive anecdotal evidence suggests that many mLearning demonstration projects consist of nothing more than rehashed DL content which is chunked into small segments so that it can be displayed on a mobile device. Another challenge that IDs sometimes face is the non-uniform, even unknown, mobile devices and mobile platforms on which the learning content will be deployed, especially in organizational environments where there is no well-defined "bring your own device" (BYOD) policy for mLearning. BYOD refers to a policy that allows employees or students to use personally owned mobile devices to access mobile content (for learning or PS purposes).

While many end users are receptive to the notion of using mobile devices in the workplace and in educational settings, there is still resistance from organizations in realizing the full potential of mobile devices (Masie, 2012). See the *Mobile Learning Pulse Survey* (Masie, 2012) for a detailed summary of documented reactions to and concerns with implementing mLearning solutions across a wide range of organizations.

Current Mobile Learning Space Themes:

Based on a series of interviews and working group meetings with mLearning SMEs, several themes about the current mLearning space emerged:

- ➢ *Focus on end users.* It is important to understand the people who will ultimately use the mobile solution. What are their habits? Priorities? Expectations? An end user accessing content on a mobile device is expecting to be able to learn anytime, anywhere instead of being constrained by

a classroom environment. Users may also expect mobile devices to be useful as PS during the completion of a task, enhancing on-the-job skills and abilities. These represent significant advantages of using mobile devices, but there are also important considerations involved in creating a mobile solution. For instance, an mLearning solution forces IDs to simplify things, which can be challenging. Additionally, it is difficult (or impossible) to prevent users from using mobile devices to access information that was previously accessed only via desktop and/or laptop computers. Consequently, it can be challenging for IDs to design learning content that can be delivered fairly uniformly across both mobile and non-mobile devices with comparable learning experiences and outcomes. Regardless, mobile can provide solutions that have the potential to far outweigh limitations, relative to other modes of instruction.

➢ ***Mobile offers many benefits, from learning to information and community support.*** Four "Cs" (or capabilities) of mobile devices were defined by Clark Quinn, highlighting ways that mobile devices can enhance the learning process (Quinn, 2011). (1) *Content*: users can read documents, watch video, and listen to content that is delivered via mobile; (2) *Compute*: mobile devices can perform calculations and compute solutions to queries from users; (3) *Capture*: users are able to add content by using the mobile device to capture data from the local environment (e.g., photographs, videos, audio, geo-spatial location); and (4) *Communicate*: users can communicate with each other via the mobile device (i.e., social learning).

➢ ***Requirements may not be complete.*** Requirements define how an mLearning solution is designed and developed. Requirements analysis is and should be one of the most important steps in an mLearning effort. Because mLearning is still a relative new area and is changing at a rapid pace, the individuals who define requirements may not be up to date with mLearning theories, trends, developments, and technologies. Therefore, the requirements they define may not provide IDs with all the meaningful information, objectives, and outcomes for designing an effective mLearning solution. At times, developing an mLearning solution is not a result of the analysis, but a mandate from the management or the client. This presents IDs with a new challenge. During the requirements analysis, they may need to educate, guide, and influence the management or the client to actively seek the missing or correct requirements.

➢ ***Mobile is advancing as a priority.*** More organizations are looking to mobile solutions as viable alternatives and supplements to classroom-based instruction, training, and eLearning. Mobile solutions are also being used more frequently as supplements in the classroom. For example, a mobile solution may serve as a refresher for prerequisite information for a class; here, the mobile solution does not replace anything and simply serves to augment the classroom instruction. Finally, mobile solutions can also be significant components within blended solutions, where both traditional classroom learning and mLearning are used in tandem to achieve training outcomes. Owing to the growing interest in mobile solutions, organizations must be able to maintain awareness of the different technology options, mLearning trends, issues relating to mobile solutions, lessons learned, and when mobile is a suitable delivery method. As we become increasingly mobile, organizations have little choice but to embrace this trend and develop for the new mobile learner; this in part is driving mLearning adoption.

➢ ***IDs are passionate but overwhelmed.*** Many IDs are passionate about their work and equally passionate about the people who need and use their final products. That being said, many IDs are overwhelmed by the pace of technology and the emerging alternatives available to them. There is a great deal of useful information about mLearning in print and on the Internet, but finding the right information—in the right format, and in a timely manner—is a challenge. In addition, some organizations are seeking mobile solutions in cases where they are not appropriate to the task at hand. Finally, administrative requirements—including security and marketplace reviews—are stretching resources and forcing IDs to compress already tight development schedules.

➢ ***Recognize possible limitations of mobile devices.*** Mobile devices may not be effective in all situations and contexts. Specific mLearning strategies may be inappropriate to the real-world setting, the requirements, and the users, so consideration of the larger learning context should inform the decision to pursue a mobile solution. For example, delivering multimedia content in a noisy and distraction-filled environment may not produce substantial changes in performance because the learners will have difficulty processing the information. Will they have use of both of their hands? Will they have connectivity? Will they have time to reach for a device? Mobile devices are more susceptible to interruptions and distractions as well. Similarly, the democratization of learning via social and peer learning will produce effective outcomes only when colleagues can be trusted to provide timely and accurate counsel. Finally, while these mLearning solutions are advantageous, PS may render the user dependent on it. This dependency could be a good thing for environments or tasks where using a PS tool is a part of the procedure. But it could also have a negative effect for environments or tasks where users need to have the competency to perform without assistance at some point in the future. Nevertheless, certain scenarios should be considered when creating PS tools. What if the system fails? What if there is no time for reference? These questions highlight the importance of carefully selecting sweet spots for mobile solutions.

➢ ***There are barriers to success.*** In the current landscape, there are many barriers to success that must be considered in the early stages of mobile solution development. These barriers include issues associated with the technology, mobile solution process, and the culture of the users and the organization. A range of potential barriers to mobile solution success are outlined in **Section 6.0** of this document.

➢ ***Success in mobile depends on anticipation.*** In many ways, developing an mLearning solution is like other instructional design efforts. Major elements of the Analysis-Design-Develop-Implement-Evaluate (ADDIE; Grafinger, 1988) and Instructional Design (U.S. Department of Defense, 2001) models still apply and are essential, although they may need to be "infused" with targeted considerations that are unique to the specific mLearning approach that is adopted (Berking, Haag, Archibald, & Birtwhistle, 2012). For example, with regard to the project budget, if the decision is made to develop a Native Application (App), the ID will need to scope the budget so that it includes the costs of software engineers; a decision must also be made regarding whether this type of work can be done in-house, or whether the work will be done by someone external to the company. Similarly, if commercial off-the-shelf (COTS) tools are being used to translate existing DL content into content that can be used for an mLearning solution, then the budget should reflect the cost of that software license. With regard to the delivery of software, the schedule will need to consider factors such as internal software reviews and usability testing, legal and operations security (OPSEC) reviews, as well as marketplace reviews (if the software is to be distributed as a Native App via a third-party marketplace).

The themes of the current mobile landscape outlined here illustrate some of the complexities and challenges associated with mLearning solutions, and they are certainly not meant to be exhaustive. They represent a sample of some of the challenges (and potential barriers to success) that IDs must be aware of. IDs must also be able to make informed decisions regarding pain points throughout the mLearning project lifecycle.

The MLDP:

The MLDP was created to help IDs make decisions involved in the Analysis and Design stages of the process. The MLDP offers significant benefits for IDs who are considering mobile solutions:

- IDs will be able to justify decisions about mobile solutions, including suitability, technology alternatives, and trade-offs.

- IDs will understand how responses to questions can impact recommendations for two sample projects, described in **Section 3.0**.
- IDs can consult the MLDP Resource Library (see **Section 8.1**), which consists of current resources (e.g., books, apps, blogs, software tools, and webpages) that can help IDs stay current on mLearning technology and trends.

The key higher-level issues an ID needs to consider and address (which also form the framework for the sections of this document) can be found in **Figure 3**:
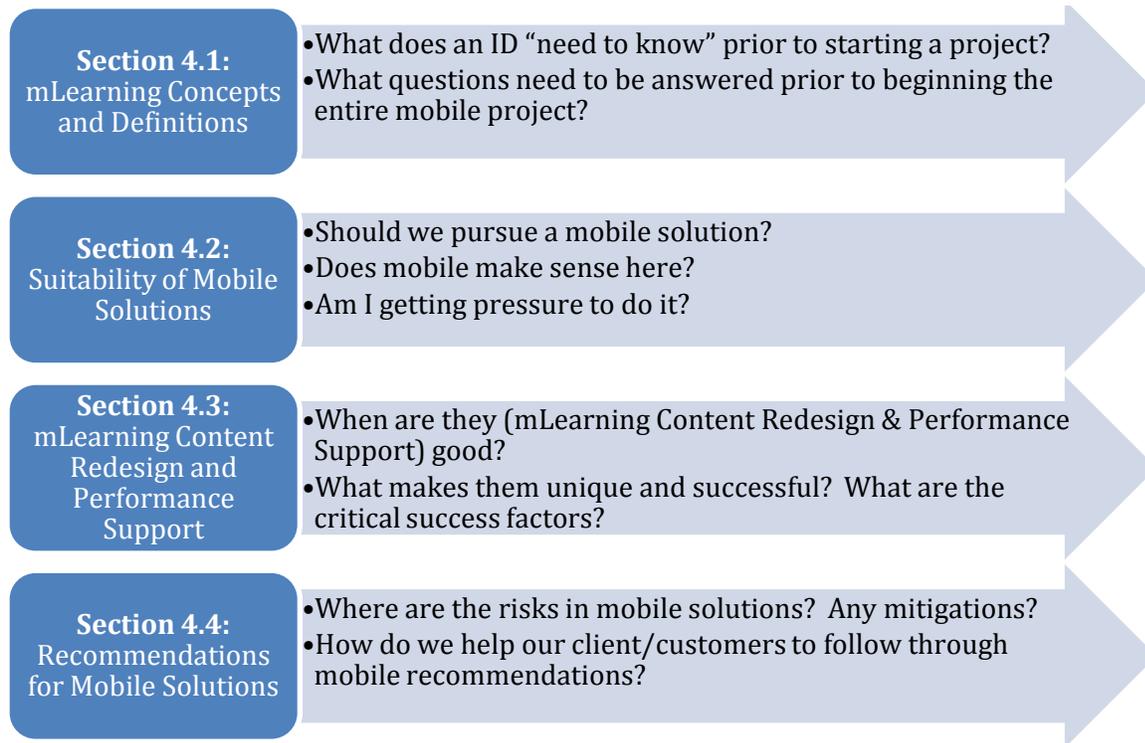
Section 4.1: mLearning Concepts and Definitions	•What does an ID "need to know" prior to starting a project? •What questions need to be answered prior to beginning the entire mobile project?
Section 4.2: Suitability of Mobile Solutions	•Should we pursue a mobile solution? •Does mobile make sense here? •Am I getting pressure to do it?
Section 4.3: mLearning Content Redesign and Performance Support	•When are they (mLearning Content Redesign & Performance Support) good? •What makes them unique and successful? What are the critical success factors?
Section 4.4: Recommendations for Mobile Solutions	•Where are the risks in mobile solutions? Any mitigations? •How do we help our client/customers to follow through mobile recommendations?

Figure 3. Key higher-level issues an ID needs to consider and address in the mLearning process.

IDs must not only understand the decision points highlighted by the MLDP, but they must also know how to apply the MLDP to their own projects. Thus, this document describes two sample projects, each with different initial requirements. These projects are referenced throughout the document as a way to illustrate how the MLDP applies in real-world contexts. **Section 3.0** summarizes each of the sample projects and defines the initial requirements for them.

3.0 Sample Project Requirements (Use-Cases)

Here, we describe two sample projects where the need for mobile may arise, along with relevant requirements. They are presented to the ID as he or she would receive requirements in advance of creating a mobile solution. The goal is to set the stage for communicating two possible uses of mLearning in context, as well as to provide validation for the MLDP in this document. Typically, when IDs receive a set of requirements, they should perform an analysis to determine whether to pursue a mobile solution. For the purpose of this project, however, both sample projects have a given set of requirements that lead to a recommendation for an mLearning solution. The sample projects will be used throughout the remainder of this document to illustrate the application of the MLDP. It will demonstrate the decision path that IDs should follow for these two scenarios, from the initial receipt of requirements through the decision points involved in the Analysis and Design phases of the mobile solution process.

To help readers navigate this document, Figure 4 below (and Figure 7, Figure 10, Figure 12, and Figure 13 later in this document) shows the MLDP processes. The highlighted step in the figure indicates the process that is being addressed by the current section.
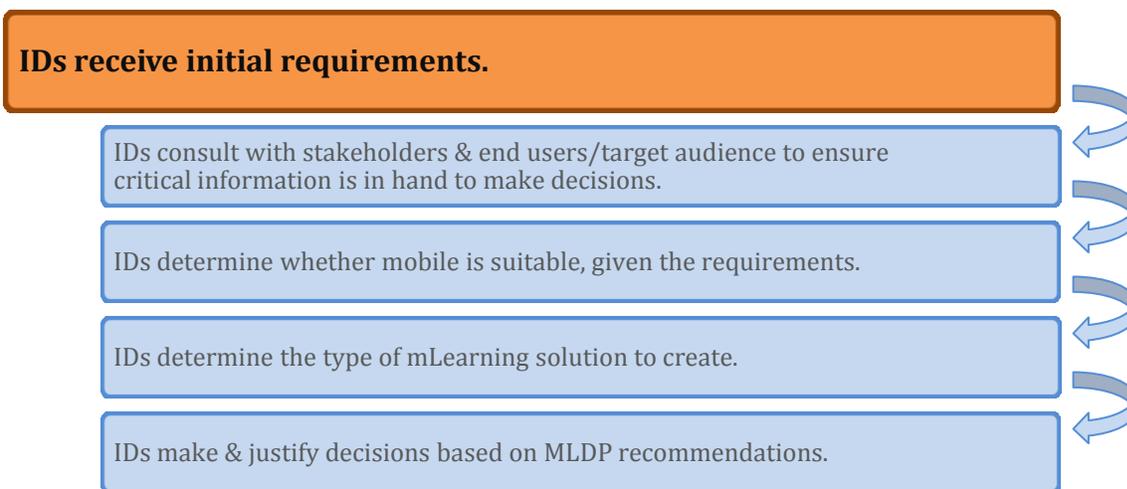
IDs receive initial requirements.

IDs consult with stakeholders & end users/target audience to ensure critical information is in hand to make decisions.

IDs determine whether mobile is suitable, given the requirements.

IDs determine the type of mLearning solution to create.

IDs make & justify decisions based on MLDP recommendations.

Figure 4. Current mLearning process – IDs receive initial requirements.

3.1 *Sample Project 1—Information Awareness Training*

Organization A requires all employees to take a traditional eLearning course on *Information Awareness* on an annual basis, in an effort to keep intellectual property safe—compliance is important! The course introduces new employees to unfamiliar concepts and increases their knowledge of how to safeguard information. It also serves as a refresher for those employees who have been with the organization for an extended period of time and have gone through the course multiple times. The course is made up of a large collection of information, images, navigation controls, and videos. Recently, employees have been inquiring about the possibility of offering the option of completing the course on their own mobile devices so that they are able to complete the training anytime and anywhere. Because so many have asked (in addition to "mobile" being a great buzzword), management has taken notice. IDs have informed management that, for several reasons, eLearning course content cannot simply be reformatted, shrunken, and plopped onto a mobile platform. First, the *Information Awareness* training was designed to be completed in a one-hour block of time while sitting at a desktop computer. Employees likely will not want to spend this much time on their mobile devices; rather, the content needs to be redesigned and broken into smaller chunks (Feser, 2010). Second, a mobile solution will enable employees to access it at the moment they need it (anytime, anywhere). This means that the content should be easily accessible without the need for the users to commit everything to memory (Feser, 2010). Third, the *Information Awareness* training had to set the context prior to the training, providing extensive background information. With a mobile solution, the context (and importance) of training is typically already established (Feser, 2010). Thus, Organization A management has given the IDs a set of requirements (see **Figure 5**) and would like them to inform management about their recommended mobile solution as soon as possible.

INFORMATION AWARENESS TRAINING (Sample Project 1)
Requirements Given to the IDs:

- Build a good **mobile solution** based on the current eLearning course content (high quality, includes videos and photos).
- Employees have to learn the same information, whether they are on a mobile device or taking the eLearning version.
- Employees can start training on a mobile device and continue where they left off on their desktops, and vice versa.
- The goal of training is to develop technical skills and knowledge about information security and protection of personal and intellectual property.
- Another goal is to be able to identify possible knowledge gaps.
- Another goal is to reinforce learning/content from previous training sessions.
- Updates to training content will happen rarely.
- Employees have roughly the same mobile habits and expectations as their coworkers. Everyone owns a personal mobile device.
- Employees are not motivated to take the course.
- Organization needs compliance.
- Completion of the course is tracked across employees (e.g., who took what, at what time, did they finish?)

Figure 5. Initial requirements given to the IDs for Information Awareness Training Sample Project 1.

3.2 *Sample Project 2—Boarding Officer Support for Rules & Regulations*

A group of boarding officers from Organization B are responsible for boarding ships to make certain that the ships are in compliance with a long list of detailed rules and regulations. For example, are the ships environmentally sound? Do they have the proper equipment? Are they using the equipment in the correct ways and situations? Do they meet safety regulations? If they catch fish or shellfish, are the animals the ships are catching the approved ones? Are they catching the right number of fish? What of their licenses? And most important of all, are those on the ship who they say they are and doing what they are supposed to be doing? Organization B has invested many days, even weeks, in training boarding officers to perform interviews and searches, investigate questionable items, and report results at an adequate skill level. Still, there were boarding officer complaints about the complexity of the procedures they were required to learn and apply on the job. For this reason, the users wish they had more immediate access to resources and information while they were on the job; they wanted some form of support that they could use on the ship. A well-respected leader recently expressed interest in addressing the concerns that the boarding officers raised. He tasked IDs to create a solution or tool to support boarding officer skills, knowledge retention, fluency, and ease of reporting. Without the tool, the boarding officers could still perform the job, but the tool will most certainly support and enhance their performance of complex tasks. Thus, Organization B management has given IDs a set of requirements (see **Figure 6**) and would like them to inform management about their recommended solution as soon as possible.
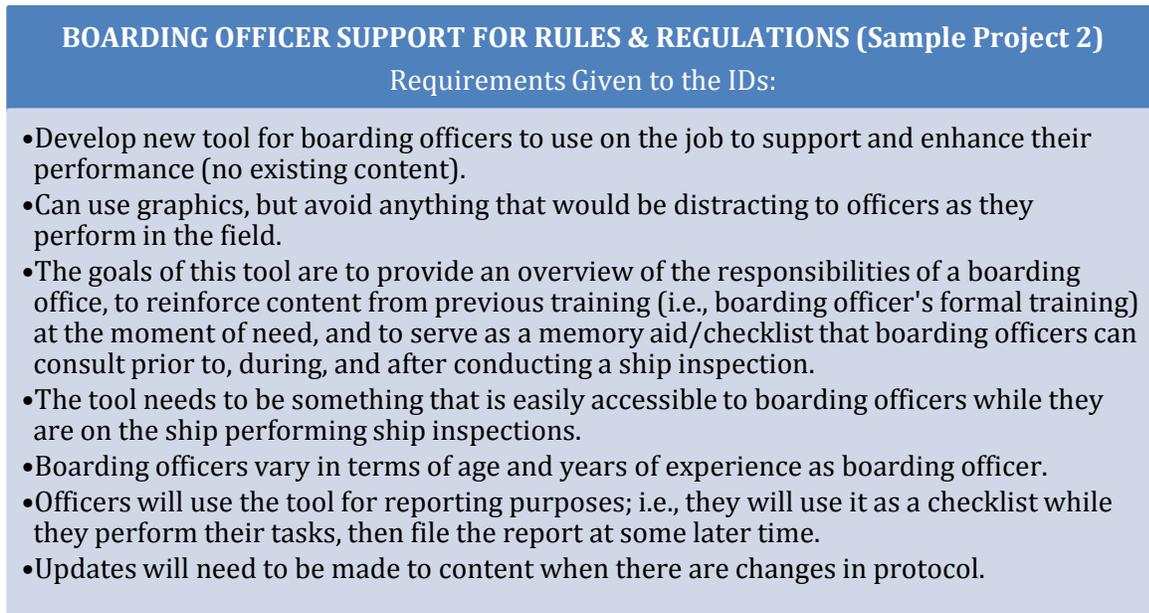
BOARDING OFFICER SUPPORT FOR RULES & REGULATIONS (Sample Project 2)
Requirements Given to the IDs:
• Develop new tool for boarding officers to use on the job to support and enhance their performance (no existing content).
• Can use graphics, but avoid anything that would be distracting to officers as they perform in the field.
• The goals of this tool are to provide an overview of the responsibilities of a boarding office, to reinforce content from previous training (i.e., boarding officer's formal training) at the moment of need, and to serve as a memory aid/checklist that boarding officers can consult prior to, during, and after conducting a ship inspection.
• The tool needs to be something that is easily accessible to boarding officers while they are on the ship performing ship inspections.
• Boarding officers vary in terms of age and years of experience as boarding officer.
• Officers will use the tool for reporting purposes; i.e., they will use it as a checklist while they perform their tasks, then file the report at some later time.
• Updates will need to be made to content when there are changes in protocol.

Figure 6. Initial requirements given to the IDs for Boarding Officer Support for Rules & Regulations Sample Project 2.

4.0   Mobile Learning Decision Path

Here, we detail the MLDP, which was developed based on interviews with IDs, close collaborations with SMEs, and an extensive literature review of the mLearning space. This section is divided into four subsections.

- In **Section 4.1 (Mobile Learning Solution Concepts and Definitions)**, we define basic mobile concepts, including a list of very specific questions that an ID should ask during initial consultations or analysis with the customer. While this is not part of the actual decision path, its purpose it to make sure IDs obtain relevant information prior to beginning the project, which becomes critical when making decisions about the mobile solution during the process.
- **Section 4.2 (Suitability of Mobile Learning Solutions)** reviews considerations and good practices for determining when it is appropriate to turn to a mobile solution. Here, we also highlight decision points that are closely related to mobile specifics, such as usability, device functions, and features of the mobile solution.
- **Section 4.3 (Mobile Learning Content Redesign and Mobile Performance Support)** covers special considerations that need to be made when efforts involve mobile PS, mLearning content redesign, or a combination of the two. However, while we are focusing this document on PS and content redesign, it is important to note that there are many different directions IDs can choose to go with mLearning.
- Finally, in **Section 4.4 (Recommendations for Mobile Learning Solutions)** we review recommendations and good practices for incorporating different content, such as videos, into mobile solutions. We also consider factors involved in deciding what type of mobile app to use.

4.1   *Mobile Learning Solution Concepts and Definitions*

This section is not part of the decision path. Rather, it is a foundation for educating IDs with baseline information about the mobile solution process. Here we emphasize information that an ID "needs to know" before he or she starts working on a mobile solution.
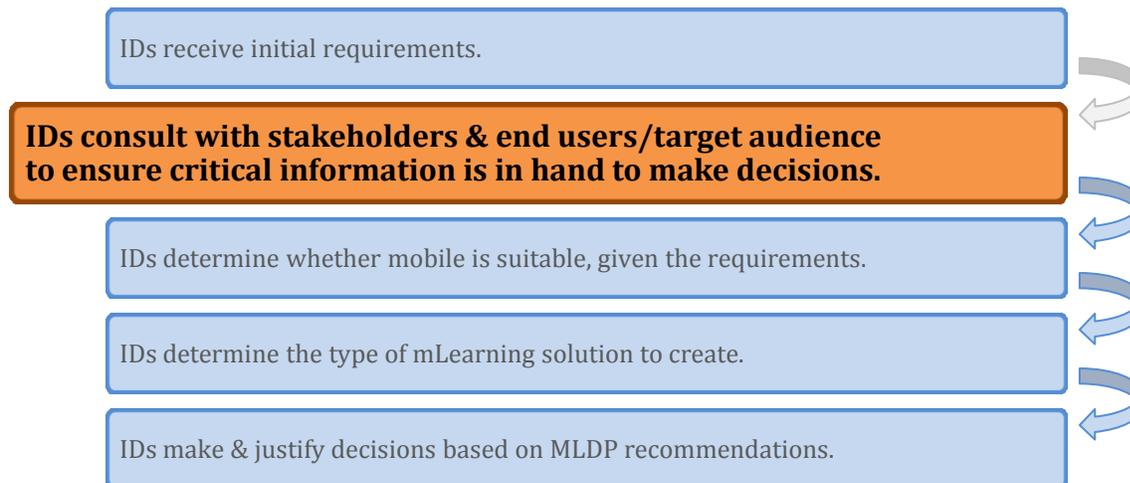
IDs receive initial requirements.

IDs consult with stakeholders & end users/target audience to ensure critical information is in hand to make decisions.

IDs determine whether mobile is suitable, given the requirements.

IDs determine the type of mLearning solution to create.

IDs make & justify decisions based on MLDP recommendations.

Figure 7. Current mLearning process – IDs ensure criticalinformation is in hand to make dicisions.

The first step in the mLearning process is to analyze requirements. Some of this information may be acquired as part of the initial requirements given to an ID, but other information will need to be solicited

from the management/client prior to starting the project. For example, at an organizational level, an ID will want to make sure the management/client expectations are achievable. IDs should also be aware of the project vision, goals, and benefits that the organization has generated (and while these should be included in initial requirements, they may be omitted at times). Any security concerns and policies that will have a bearing on the mobile solution should be discussed prior to beginning the project. IDs also may find it useful to consult some mLearning literature, such as ADL's *Mobile Learning Guide* (2013) for more in-depth descriptions of common terminology. In addition to familiarity with terminology, IDs should also have a working knowledge of mobile device alternatives and associated technology trends. While it can be a daunting task to maintain awareness of the constantly changing technology, it is important to stay current in this area. **Section 10.0** defines common mobile terminology and provides a list of valuable resources to reference.

Many times, an ID does not have all the necessary information, even after receiving requirements to pursue a mobile solution. **Table 1** should assist IDs in completing such an analysis by making sure that relevant questions are asked and answered, and critical information is acquired prior to starting the project. In addition, recommendations for ways to obtain this information, and the reasoning behind asking the questions, are outlined.

Please note: When Accessibility and Section 508 Compliance are part of the requirements, it is strongly recommended that IDs consult with Section 508 compliance SMEs. Design considerations for the compliance are different for different types of apps and platforms, and are different between a general mLearning and a PS solution. Since there is no one solution or tool to address all the variations above, IDs may have to use different guidelines for designing different types of solutions on different platforms. For instance, W3C recommends the same guidelines for mobile websites and PC websites, Apple recommends its own application programming interface (API) for the iOS platform, and recommendations for the Android mobile OS include user interface (UI) design considerations and using a peripheral device like a trackball. The Mobile Gov Wiki's entry on accessibility provides more detailed information on the subject ("Accessibility," 2013).

Table 1. Relevant questions to ask your management/client prior to beginning the mobile project.

Question	Explanation	Responses
1. Do you feel confident that you have sufficient understanding of the problem or opportunity to be addressed?	It is important to first develop a thorough understanding of the situation that requires a solution to be developed, as well as the intended outcomes (e.g., human performance improvement). An ID needs to go through the following general process: • Identify and clarify the perceived problem or learning need that the training will address. • Why is it a problem or need? • How can it be solved through training, a PS tool, etc.? • What are some alternative ways to solve that problem (e.g., face-to-face discussions, handbooks, mobile solutions)?	**Yes:** Ask management/client next question. **No:** Consult with management/client, and make sure that you are clear on why a solution is needed and what problem is being addressed.
2. Is a mobile solution the right way to do this?	It is important to differentiate needs from desires. To accurately and effectively address mobile learning need, IDs should identify existing problems or gaps and define requirements. Should mLearning be leveraged to address these requirements? There are many factors that should be considered when making this decision. See **Section 4.2** for guidance in making this decision.	**Yes:** Ask management/client next question. **No:** Consult with management/client, educate them about mLearning, and ask additional questions to see whether there is actually a need that has not been clearly articulated.
3. Do you know your target audience?	Knowing who the intended users of the mLearning are will help you tailor the mLearning. You can access Human Resources (HR) reports to help with basic demographics. Contact Information Technology (IT) departments to provide tech profiles, usage data, and what skills they possess. Training colleagues can help you determine what kinds of content you need. Also, it may be helpful to look at web analytics and reports (Udell, 2012). When current information about the end users is not readily available, the ID should ask to conduct a learner analysis to better understand the target audience.	**Yes:** Ask management/client the next question. **No:** Ask management/client to describe the target audience along with any associated behavioral characteristics relating to mobile devices and training. You may also need to conduct a learner analysis to better understand the end users.

Question	Explanation	Responses
4. Are you aware of the target audience's current learning habits, and how they prefer to get information on the job? How do their habits and preferences affect reliance on mobile devices?	If current information is not available based on previous analyses, the ID will need to conduct a learner analysis to better understand the end users. Some ways that end users may prefer to get information on the job include: • Through mLearning • Ahead-of-time training by an instructor • Ahead-of-time training via eLearning • Calling on colleagues for guidance/mentoring • Take-along handouts or other job aids • Referring to company resources like knowledge bases or wikis • Just-in-time access/search online resources and documentation	**Yes:** Ask management/client the next question. **No:** Ask management/client for this information; possibly survey a representative sample of the target audience (learner analysis) to determine this.

5. Do you know how the target audience currently uses mobile devices?	If current information is not available based on previous analyses, the ID will need to conduct a learner analysis to better understand the end users. Some ways that end users may use their mobile devices on and off the job include:
	
	• Is interaction with a mobile device required to perform the job?
	• Do employees communicate with each other through mobile devices at work?
	• Do employees communicate through mobile devices outside of work?
	• Do they use mobile devices frequently?
	• What mobile devices do they use? (e.g., simple cell phone, smartphone, tablet, other)
	• What do they use their mobile devices for?
	    o Browse information on the Web
	    o Watch videos
	    o Play games
	    o Use social media websites and apps
	    o Use apps for finance, home management, or other more complex tasks
	    o Text messages (Short Messaging Systems, SMS)
	    o Send emails
	    o Use voice communications
	    o Find directions or use maps
		Yes: Ask management/client the next question.
		
		No: If you do not know this information, it may be best to take some time to survey your intended audience and conduct an analysis so you can make more informed decisions (Udell, 2012).

Question	Explanation	Responses
6. What is their comfort level with the mobile devices?	Determine the audience/end user comfort level with mobile devices. The experience level of the user will shape the usability design, including the UI. **Low comfort levels**: Keep the UI simple and the features minimal. For users without domain knowledge or experience, create a more guided experience. Wizards, tutorials, and limiting the number of choices presented at any one time are good ways to prevent overwhelming the novice user. **Midlevel:** Complex, but keep the advanced features minimal, or at a learnable, non-intimidating level. **High comfort levels**: Use of advanced design features is acceptable, and information content can be more complex because less cognitive resources will be devoted to understanding the mobile app and more resources can attend to the information to be learned. The primary focus of an app designed for experienced users with deep domain knowledge should be the app's efficiency. Providing shortcuts and keeping the full set of tools accessible are simple ways to aid an experienced user in efficiently completing a task. A user's comfort level for using a mobile device impacts how well he or she is able to control the device and navigate the content. IDs need to design the user experience according to the comfort level of the end users. Some of the advanced design features unique to mobile are: • Using mobile device's physical position as a part of the input. Users provide input by moving and tilting the mobile device. Many mobile games and simulations use this technique for input. It requires a certain level of hand-eye coordination. Some users may not feel comfortable at the beginning. • Using fingers from both hands for touchscreen control. This is another common method used in mobile games and simulation when a user needs to control an object with a combination of different movements, such as moving while rotating. Often, fingers from both hands have to perform different types of movement independently, such as "slide+tap" or "straight motion+circular motion." This requires a certain amount of hand-eye coordination plus hand-hand coordination. Some users may not feel comfortable at the beginning and may not be able to control the object.	**Yes:** Ask management/client the next question. **No:** If information is not known, you could survey a representative sample of the target audience.

Question	Explanation	Responses
7. Do you know who the stakeholders are for this project?	Knowing who the stakeholders are helps IDs design the mobile solution that meets the needs and requirements. Also consider: A champion has great impact on the success of a mobile solution. A champion can help define, refine, promote, and steer a mobile solution. And afterwards, once the solution is in place, sponsors are critical to sustaining success. Stakeholders include everyone with some viable interest in the mobile solution, including leadership, management, and end users. End users (or their representative body) drive the needs; leadership and management drive the requirements. The end users must want to use the product, and any rejection of the mobile solution can derail the project. Following is a list of possible stakeholders of an organization where the mobile solution will be implemented: • End users • Legal/Compliance • HR/Personnel • Management • Executive Leadership • Sales and Marketing • Operations • IT/Systems Administration	**Yes:** Ask management/client next question. **No:** Consult with management/client and help them identify stakeholder(s), the target audience, and identify possible champion(s). If stakeholders are not identified at this point, the project can still move forward.
8. Have you thought about what outcome a successful solution will achieve?	Having a clear vision of what outcome a final mLearning solution will achieve is critical for an ID. It is essential for an ID to focus the design efforts toward that vision. Also, IDs should educate and guide users and stakeholders during the process so they can understand the design, share the vision, and expect the same outcome.	**Yes:** Share your vision with management/client to align expectations. **No:** Work closely with management/client to clearly define desired outcomes of the solution.
9. Do you have organizational polices, rules, and processes to support mLearning?	Rules guide and govern the implementation and adaptation of a mobile solution. IDs need to be clearly aware of these rules before starting a mobile project so the solution will be designed within the guidelines. If rules governing mLearning are incomplete or not in place, IDs should start the dialog with proper management and educate them about the impact of mLearning on the organization. Discussions could include: • Security procedures • Access protocol for mobile and Wi-Fi	**Yes:** Ask management/client next question. **No:** Strongly suggest management/client to establish relevant rules and processes. Work closely with management/client on establishing these rules and processes during project.

Question	Explanation	Responses
10. Does your client/organization have a plan for maintaining app content and sustaining updates for the mobile solution?	mLearning is a relatively new and changing space. Will the initial appetite for the approach continue? Mobile solutions must have updates and a continued budget stream to sustain and refresh.	**Yes:** Ask management/client next question. **No:** Work closely with management/client, educate them, and prepare them for the changes associated with mLearning.
11. How do I know whether there is an organizational preference or requirement for BYOD?	Answer the following questions: • Will trainees have to bring their own devices to access mLearning? • Will trainees start on one device and end on another? • Will trainees use multiple types of devices to perform training (e.g., smartphone, tablet)? • Does your organization allow personal devices to be on the network? • Will you be creating content for more than one platform? When BYOD **is** a requirement, then it is recommended to build either a mobile website or a Hybrid App so that it can be accessed by any type of mobile device. When BYOD **is not** a requirement, you do not have to worry about making the content work on all types of devices. Rather, IDs can design the mobile solution based on mobile devices that are provided/will be provided by the organization. However, if you are planning to create content for more than two different types of devices, it may be best to create a mobile website or a Hybrid App. It is still good practice to take into consideration that the organization may switch to a different platform or upgrade mobile devices in the future. IDs should also consider the mobile platforms that collaborating or partnering organizations will be using. In particular, this should be considered when: • The mobile project is part of a **joint-project initiative**, where multiple agencies collaborate to jointly develop the solution which will then be used across agencies, or • The mobile project is developed by one agency with the intent that the mLearning solution will deploy across **multiple agencies**. **Note:** IDs should pay attention to the constantly changing market trends and to forecasting what will be relevant in six months (or however long it takes to build and update the mobile solution; Udell, 2012).	**Answering "Yes" to any of the questions listed here is indicative of BYOD.**

Question	Explanation	Responses
12. Have you explored some user experience methodologies to evaluate the system?	It is important not only to think about the mobile solution design, but to consider how the mLearning solution will be evaluated. Some methods include: • Usability testing: expert evaluation (heuristic evaluations, cognitive walkthroughs) • Usability testing: lab-based comparisons, A/B Testing (evaluating changes in design by comparing two versions in an experimental setting) • User testing: testing/feedback from the target audience • Attitudes of users: subjective surveys (Likert scale) and look for trends in answers to indicate potential problems (e.g., UI issues) • Field-based interviews, observations, walkthroughs (e.g., ethnographic analysis, critical incident studies) • Learning outcome measures • Logbooks and diaries of users; records of activity, patterns of use • Telephone probes, polls, focus groups • Automatic logging: recording when, where, and how a mobile device is used	**Yes:** Think ahead about which evaluation method(s) you will use, and verify it (them) with management/client. **No:** Educate yourself and management/client. Decide which method would be best to use in your situation.

Question	Explanation	Responses
13. Have you considered how the final mLearning solution should be deployed?	During the requirement analysis, IDs should consider the way the final mLearning solution will be hosted or delivered because the design of the solution impacts the hosting and delivery of the solution. Here are some key areas for consideration: • For security, does IT infrastructure support user and/or device authentication? • For access control, can IT infrastructure limit access from the public network to protect sensitive information in the mLearning solution? • If the mLearning solution is delivered from a Learning Management System (LMS): ○ Does the existing LMS support mobile? ○ Is there any technical limitation on the types and formats of the content to de delivered? • If the mLearning solution is a mobile website: ○ Does the IT department have the infrastructure and resources to host the solution 24x7? ○ For sensitive content and security, will the mobile website support user or device authentication? ○ If tracking is required for learning activities, can integration between the website and LMS be implemented? • If the mLearning solution is a mobile app: ○ Is an account or an agreement in place to distribute the solution through distribution services, such as Apple App Store and Google Play Store? ○ Are there policies, procedures, and IT infrastructures in place to distribute mobile solutions without using third-party distribution services? ○ Does the mLearning solution contain sensitive information that prevents it from being distributed through third-party distribution services? ○ If tracking is required for learning activities, how should learning activity data be collected and transmitted to the LMS?	**Yes:** Work with the IT department and/or distribution services to ensure that the final mLearning solution meets the requirement and guidelines. **No:** Research different hosting and delivery options and include them as a part of the requirement analysis. When designing the mLearning solution, make sure there is a hosting or delivery option that satisfies the requirement.

Question	Explanation	Responses
Recommendation	Once the ID has obtained all relevant information from the management/client, he or she should have a more complete understanding of why a mobile solution is needed, who the target audience and other stakeholders are, what organizational policies and procedures are currently in place, and how the final product can be evaluated. All of this information will help the ID make more informed decisions throughout the project.	You should integrate information obtained from discussions with the management/client with the initial requirements you have already received. Make sure that the new information is complete and aligns with the requirements you have in hand.

Once an ID has captured the critical pieces of information, he or she should integrate that knowledge with the initial requirements to get a more accurate perception of what the final mobile solution should look like. Now, the ID will be ready to start making informed decisions regarding the mobile solution. To illustrate how this baseline information can supplement initial requirements so an ID can make more informed decisions, consider the sample projects. In both sample projects, key pieces of information are missing. The ID requires more information before moving forward with the initiative.

4.1.1 Sample Project 1—Supplementing Initial Requirements

The requirements received for the *Information Awareness* project (i.e., developing a mobile solution for annual employee training completed on a desktop) lacked a key piece of information about who would be supplying the mobile devices for employees to use (or whether it would be a BYOD situation). The ID determined, based on a discussion with the management/client, that this project would be BYOD. The figure below shows how the ID organized the information from the initial requirements and the added piece of information from the consultation with management (see **Figure 8**).
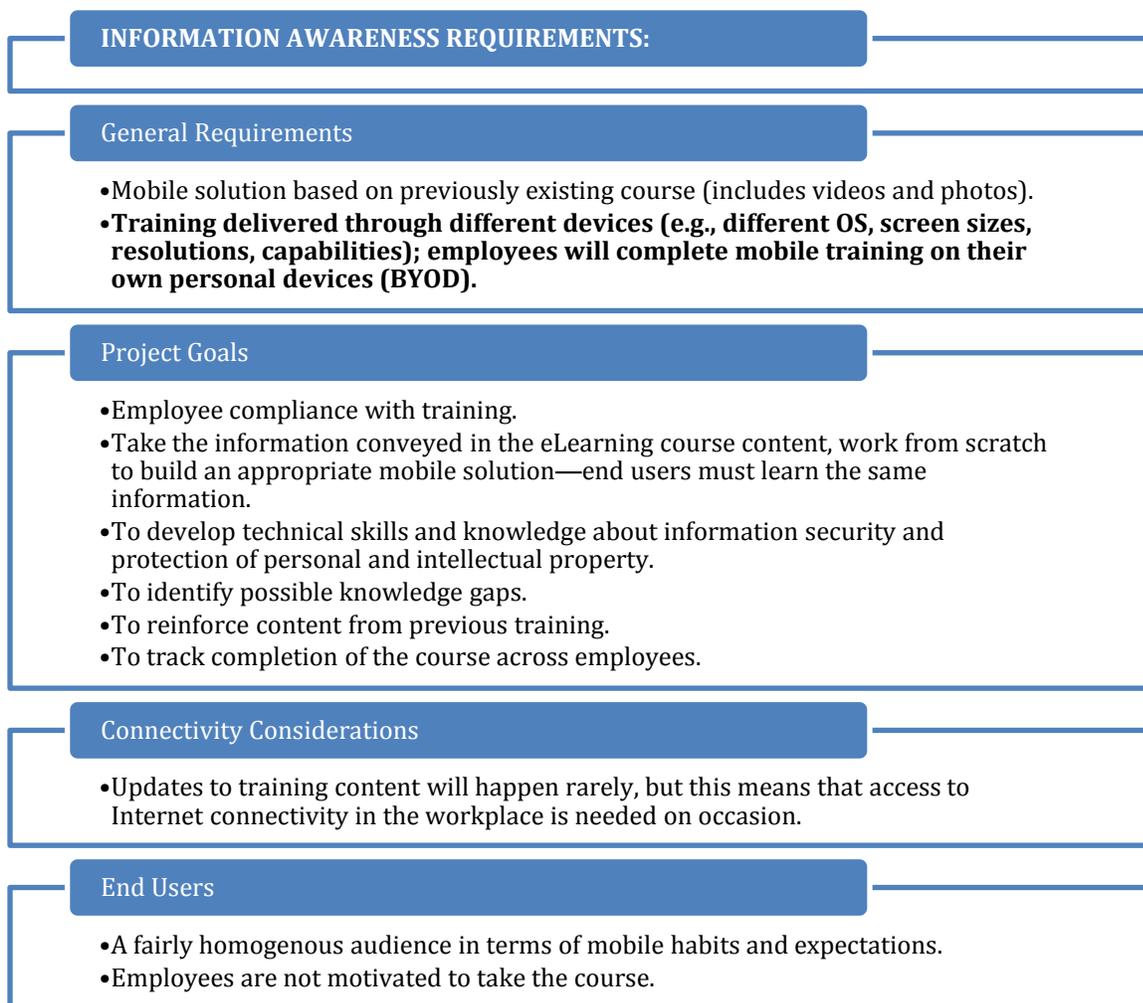
INFORMATION AWARENESS REQUIREMENTS:

General Requirements

- Mobile solution based on previously existing course (includes videos and photos).
- **Training delivered through different devices (e.g., different OS, screen sizes, resolutions, capabilities); employees will complete mobile training on their own personal devices (BYOD).**

Project Goals

- Employee compliance with training.
- Take the information conveyed in the eLearning course content, work from scratch to build an appropriate mobile solution—end users must learn the same information.
- To develop technical skills and knowledge about information security and protection of personal and intellectual property.
- To identify possible knowledge gaps.
- To reinforce content from previous training.
- To track completion of the course across employees.

Connectivity Considerations

- Updates to training content will happen rarely, but this means that access to Internet connectivity in the workplace is needed on occasion.

End Users

- A fairly homogenous audience in terms of mobile habits and expectations.
- Employees are not motivated to take the course.

Figure 8. The ID organized the information from the initial requirements and the added piece of information from the consultation with management.

4.1.2 Sample Project 2—Supplementing Initial Requirements

In this project, the ID is responsible for designing a solution to support boarding officers in their jobs. During discussions with management, the idea of pursuing a mobile solution was mentioned several times. Even though mobile was not an explicit requirement, the ID should examine the feasibility and suitability of creating a mobile solution. In this scenario, the ID consults with the management/client and determines that mobile devices will soon be issued by Organization B and will be carried at all times by boarding officers as a safety precaution. The ID also further explores the idea of a mobile solution by inquiring about connectivity in the environments where boarding officers will be using the tool. **Figure 9** shows how the ID chose to organize the initial requirements and the new information derived from the conversation with management.

BOARDING OFFICER SUPPORT FOR RULES & REGULATIONS REQUIREMENTS:

General Requirements

- Develop new **[possibly mobile]** tool for boarding officers to use on the job to enhance their performance.
- Can use graphics, but avoid anything that would distract officers on the job.
- **Mobile devices will be issued by Organization B and will be carried at all times by boarding officers.**

Project Goals

- To provide an overview of the responsibilities of a boarding officer.
- To reinforce content from previous training (i.e., boarding officer's formal training) at the moment of need.
- To serve as a memory aid/checklist that boarding officers can consult prior to, during, and after conducting a ship inspection.
- Officers will use the tool for reporting purposes; i.e., they will use it as a checklist while they are performing their tasks, then file the report at some later time.

Connectivity Considerations

- **Access to Internet connectivity in the workplace.**
- **Internet connectivity may not be available in some areas (e.g., Top Secret facilities).**
- **Internet access unavailable to boarding officers while they are in the field performing ship inspections.**

End Users

- Users of different ages and years of experience as boarding officers.

Figure 9. The ID chose to organize the initial requirements and the new information derived from the conversation with management.

Next, with all the necessary information in hand, the ID can begin the process of making Analysis and Design decisions regarding the solution. The remainder of **Section 4.0** presents a series of **decision**

points for IDs as they progress through the mobile solution process. We will also illustrate real-world application of the decision path by following these two sample projects through the various decisions that are pertinent to each.

4.2   *Suitability of Mobile Learning Solutions*

While mobile can be a desirable option for delivering training, information, and content to users, it is not always the right way to meet the particular training need (Stayton, 2011). In fact, the suitability of a mobile solution depends largely on the learning goals, characteristics, and context of each project. For example, mobile is very desirable for certain kinds of learning (especially constructivist and PS). In these cases, mobile may be a priority where it can enhance learning experience and effectiveness, regardless of logistical complications and other potential costs. This section presents what to consider when reflecting on whether mobile is the right solution. IDs will be able to answer the question: Does mobile make sense, given the initial requirements?

IDs receive initial requirements.

IDs consult with stakeholders & end users/target audience to ensure critical information is in hand to make decisions.

IDs determine whether mobile is suitable, given the requirements.

IDs determine the type of mLearning solution to create.

IDs make & justify decisions based on MLDP recommendations.
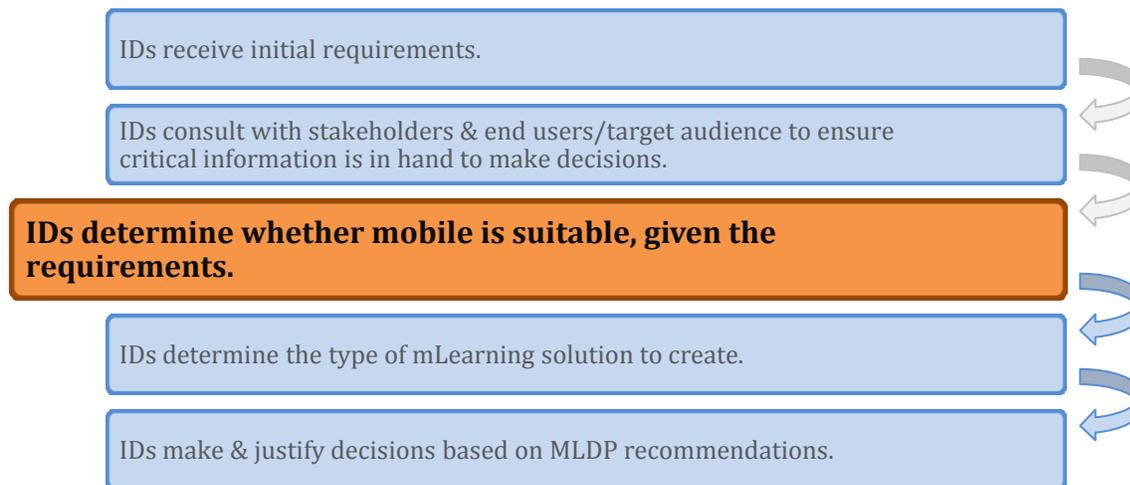
Figure 10. Current mLearning process – IDs determine whether mobile is suitable, given the requirements.

Situations where the priorities for learning include speed (ability to access information quickly), availability (ability to access anytime), mobility (ability to access anywhere), collaboration (social learning), and immediate feedback may benefit most from mLearning and leveraging the capabilities of mobile devices (Stayton, 2011). For instance, prompting users with feedback on a mobile device, such as texts, at spaced intervals may help reinforce learning over time, prevent skill decay, and lead to better transfer of knowledge, similar to the idea proposed by Thalheimer (2012) in his work on eLearning. Conversely, situations that require (1) comprehensive information to be conveyed which cannot easily be chunked into smaller, meaningful components, (2) carefully sequenced content, or (3) the end user to be completely immersed in learning are less appropriate for mLearning solutions.

The suitability of mLearning is contextual, yet research has suggested that there are specific moments in an individual's life that are conducive for mLearning solutions (Stayton, 2011). Mosher and Gottfredson's Five Moments of Need model (which focuses on when people learn and when they need support) contributes to the decision about whether mobile is suitable to deliver certain types of learning (see Gottfredson, 2011). The moments of learning need are outlined in **Figure 11** and can be applied to the mLearning domain.

Five Moments of Learning Need (Gottfredson & Mosher, 2012)				
1. **NEW**: When learning to do something for the first time	2. **MORE**: When learning more about a previously learned topic	3. **APPLY**: When applying what was learned (planning, remembering, and adapting)	4. **SOLVE**: When things go wrong, things break, or problems arise	5. **CHANGE**: When things change and you need to learn a new way of doing something

Figure 11. The Five Moments of Learning Need.

Mobile solutions can be tailored to meet user needs at each of these five moments. For example, imagine that an organization has implemented mobile solutions to supplement computer-based training (CBT) methods to address the moments of learning need for employees. Here, in Moment of Need 1 (New), mobile can be used to supplement new hire CBT, allowing users to learn (anytime, anywhere) sets of procedures that they are unfamiliar with. At Moment of Need 2 (More), mobile can allow users to access more detailed information about specific steps involved in processes, why these steps are implemented, possible problems that could arise, ways to mitigate risks, etc. In this scenario, mobile can also be used for Moment of Need 3 (Apply) as a real-time PS tool for new hires, where users can immediately reference training manuals if they forget procedures while performing a task. At Moment of Need 4, users can reference a mobile troubleshooting checklist to determine the cause and/or fix for the problem if the equipment they are operating malfunctions (even if they have not been exposed to this particular problem before). Finally, for Moment of Need 5, a mobile solution can be used to help more experienced employees learn about changes to an existing procedure that will affect the way they perform their jobs.

These five moments of learning need and other specific considerations are highlighted in the following sequence of questions (see **Table 2**), which allow IDs to determine whether a mobile solution is the right solution for any given project requirements. The questions here should be answered by all IDs who are considering using a mobile solution, regardless of the initial requirements and/or the type of mobile solution. In particular, an ID should make sure that when he or she receives a requirement for pursuing a mobile solution that the rest of the requirements align. There may be times when the management/client wants to create a mobile solution, but the rest of the requirements are not suitable for mLearning. In these cases, the ID will need to communicate with the management/client in order to determine whether requirements should change, or whether there is an alternative method, such as eLearning, that would be more appropriate. If an ID notices that any of the requirements do not align, the decision to build a mobile solution should be reconsidered.

Table 2. Should you pursue a mobile solution?

Question	Explanation	Responses & Scoring
1. Does your learning address Moment of Need 1: Learning something for the first time?	Mobile may be appropriate here as part of a **blended program**. The focus here is on new material. The user is being introduced and will be expected to do something as a result of the new knowledge. Mobile may play a part in that solution. For instance, perhaps the primary training is done via traditional classroom instruction. A mobile solution can complement this training by explaining why this material matters. Or it might introduce how they will be expected to use what they learn. For example, concepts can be first introduced in short mobile tutorials, and then discussed and applied in the classroom environment. Here, the lecture is on the mobile device, whereas interaction and application of knowledge are done in the live classroom.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
2. Does your learning address Moment of Need 2: Wanting to learn more?	Mobile can be suitable here, especially as a part of a **blended program**. A mobile solution here can augment instruction that already exists by providing users with the option to learn more. For example, a student may learn about a concept in the classroom, but owing to time constraints and curriculum, the instructor may not be able to teach extensively about the applications of that concept in the real world. A mobile tool that includes animations, case studies, and additional resources allows students to drill down into the details of the concept on their own time, when they are interested in learning more about how it applies to real-world environments.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
3. Does your learning address Moment of Need 3: Trying to remember?	Mobile is great here in the form of PS and learning aids, where just-in-time access to information and content is a capability (Kadle, 2010); for example, content retention should be reinforced or a job aid needs to be accessed for details that are not in memory. This information will likely be brief and serve as a memory jog. Mobile is being used more frequently as a standalone, just-in-time job aid, where individuals may or may not have previous exposure to the task at hand. Mobile can also be used here as part of a blended program. For instance, for a face-to-face course, the mobile solution can provide opportunities for drill and practice, for review, to check a policy, and to encourage students to be part of community, to link with others tackling similar concerns.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
4. Does your learning address Moment of Need 4: When things change?	Mobile devices allow people to learn continuously and support tasks that may be constantly changing or evolving. People can carry these devices with them at all times and turn them on instantly, regardless of where they are and when they need the information to help them perform (Kadle, 2010). This is a great way to make sure that contemporary views, ideas, events, and resources are there when needed.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
5. Does your learning address Moment of Need 5: When something goes wrong?	Here, just enough information is presented to help end users troubleshoot and move past a barrier to performance, enabling them to do something they otherwise could not. The users may also be experiencing time pressures and stress (Kadle, 2010), so it is critical to give them access to the right information at the right time.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
6. Will the end users have to know the information and content by heart?	If end users must know information by heart and apply this information, then a lot of practice will be required to learn and maintain that level of knowledge over time. Here, a mobile PS solution can be extremely helpful because it can aid end users in remembering information while they are performing or applying their knowledge in the field. In this way, mobile enhances performance on tasks and can help users sustain their training over longer periods between practice sessions. Even if end users do not have to remember information by heart, mobile is still a very viable solution as a PS tool. An important consideration for PS tools is the intention of the tool: (1) is the intent to help people remember information, or (2) is the intent to help people perform? If the tool was designed to help people remember information, the assumption is that users will gradually learn to the point which they no longer need the tool for assistance. Conversely, if the intent is to help people perform, those users will always have access to the tool without the need to ever commit anything to memory.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
7. Does training need to occur anytime/anywhere? Will it require more ready access by users?	A mobile solution is the preferred solution when training needs to occur anytime and anywhere, as the learning should not be constrained to the workplace or classroom environment. For example, during his daily bus commute, a user may watch some podcasts to learn more about a new procedure at work . The user is not constrained by his environment and is able to learn when it is most convenient for him. Mobile access allows more ready learning to occur, in the moment of need (i.e., anytime the user requires it). For example, if an end user is completing a task with an automated system and experiences a system failure, a mobile tool could be utilized right then and there to guide the user through the steps necessary to mitigate the consequences of that failure. However, it is important to note that sometimes connectivity will be required to access certain content that does not reside on the mobile device itself. If training needs to occur at predetermined times and locations, it is likely that eLearning, CBT, face-to-face instruction, or another classroom-based method will be most appropriate. These instructional methods typically require students to learn during set times in specific locations. A mobile solution can certainly complement these approaches, with a blended approach.	**Yes:** While mobile could be used in a more constrained environment, it is very beneficial for situations where it can be used anytime and anywhere. Continue to next question. A score of 4 is attached to this response. **No:** Mobile may still be a viable option although it may not be completely necessary. Continue to next question. A score of 1 is attached to this response.
8. Will users be required or encouraged to contribute to the content of the learning?	Mobile can easily include user-generated content via the features of the mobile device, such as camera and global positioning system (GPS). For example, students enrolled in an art history class with both a lecture and a mobile component may be asked to take photographs in various cultural locations, such as museums, tag them with the geo-location, annotate them, and share them digitally with fellow users. The instructor can then highlight some of the user-generated content in the lecture portion of the course.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
9. Can the information be componentized and delivered as "nuggets" of information linked to tasks, questions, and conditions?	A mobile solution is appropriate when you can create bite-sized chunks of information, which is especially critical when using devices with very small screens (Stayton, 2011). Content from eLearning cannot simply be repurposed for a mobile device. The information and amount of information that will be presented to the end user will need to be condensed to make it more manageable for a mobile device format. For example, including a 10-page biomechanics paper may not be suitable for a mobile device because of its length and the complexity of information covered. However, the essay can be broken down into several key points and animations (if necessary); it still conveys the critical concepts found in the original paper but is more appropriate for an mLearning solution.	**Yes:** Continue to next question. A score of 9 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.

Question	Explanation	Responses & Scoring
10. Will your mobile solution require only **small** data transfers to move data/content to mobile platforms (via the Internet)?	Additional considerations about the types of devices and whether the mLearning solution will be BYOD will need to be addressed when the mLearning solution requires constant Internet connectivity, especially with large data transfers (e.g., high-volume video streaming, high-resolution graphics and images, and gaming). Many of the tablets purchased today are Wi-Fi only. For these devices, the mLearning solution is only accessible when there is a Wi-Fi connection. Although Wi-Fi is available in many places, such as homes, offices, hotels, airports, and coffee shops, the quality of connection and speed vary. Therefore, the mLearning solution may not function well in some situations. Smartphones and cellular-enabled tablets have lesser limitations on Internet connectivity. But with BYOD, users may incur additional costs for cellular data usage. Additionally, cellular data connection speed is generally slower than Wi-Fi, and that may impact the user experience of the mLearning solution. When Internet connection is not critical or the amount of data transferred is relatively small (i.e., you do not want users to spend hours downloading mobile content), mobile platforms offer a very reasonable option for delivering content. However, other alternatives, such as eLearning, web-based training (WBT), and instructor-led training (ILT) may also be considered.	**Yes:** Only small data transfers are necessary, or the Internet is not needed for this purpose. Continue to next question. A score of 9 is attached to this response. **No:** Large data transfers are necessary. Continue to next question. A score of 0 is attached to this response.

Question	Explanation	Responses & Scoring
11. Will the learning experience benefit from features that are unique to mobile devices?	A mobile solution has advantages over other forms of training because of features unique to the mobile device, such as GPS, camera, QR Codes, accelerometers, and text messaging. An mLearning solution can incorporate touch-, motion-, and visual/sensory-based interactions at the time and location that is best for learning to occur. Not all mobile devices have the same features, sensors, and capabilities. Mobile may still be suitable, even when these features are not critical to learning. It is important for IDs to first analyze requirements and then conduct research to determine what features would be best for the given project. This involves looking at use cases, real-world examples, and current mobile literature (see **Section 8.0** for helpful resources). The level of effort needed to use these features should also be examined. **Examples of appropriate use of mobile device features include:** • **GPS** refers to a global positioning system and tracks the position on earth of the mobile device. This feature is appropriate to use when location and mapping are critical concepts within a given task. For instance, a scavenger hunt may help users learn important locations in a new city. • **Accelerometers** are features that measure acceleration and movement of the mobile device. These are appropriate to use with games or simulations, where users can move their mobile devices in order to perform certain actions within a game. • **Text messaging** or SMS allow users to send short text-based messages to other users. This can be used when you want to engage learners who are not collocated, encourage interactions, and facilitate social learning. • Many mobile devices have built-in **cameras** that allow users to take pictures and record short movies. These can be used when you want to engage learners who are not collocated and when you want include user-generated content (images, videos). • **QR Codes** are tagged artifacts in a learning space that display pertinent information when read and decoded by the user's camera. With this feature, the user is able to quickly access a website (without having to type in a URL) to receive additional details about a product, person, or concept, or even to automatically dial a phone number.	**Yes:** This is a situation where mobile may offer exceptional benefits because of its unique features. Continue to **recommendation**. A score of 2 is attached to this response. **No:** Mobile may still be a viable option, even though unique features are not necessarily needed. Continue to **recommendation**. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
Recommendation	After all questions are answered, scores are tallied. The overall recommendation of whether to pursue a mobile solution is based on the range that the total score falls into.	**Range of scores**: 9–35 **Acceptable range for mobile**: 27–35 A higher score reflects a greater probability that a mobile solution would work well and be appropriate for the given situation. A low score suggests that you may want to explore other solutions.

Specific recommendations and guidelines for when it is most appropriate to pursue a mobile solution:

1. When your solution addresses the moments of need—especially trying to remember (Moment of Need 3), when things change (Moment of Need 4), or when something goes wrong (Moment of Need 5).
2. Consider mobile as part of a blended program for when the goal is to learn something new (Moment of Need 1) or wanting to learn more (Moment of Need 2).
3. When the training must happen anytime, anywhere with instantaneous and pervasive access to learning, and opportunities to review and practice. Prompting users with alerts, such as texts, at spaced intervals may help reinforce learning over time and lead to better transfer of knowledge, similar to the idea proposed by Thalheimer (2012) in his work on eLearning.
4. When users will be contributing to the content/adding content (social learning).
5. When information can be chunked into easily digestible bits of information. In other words, when the information that needs to be conveyed can be condensed into key points or summaries (for example) that take into account the amount of time a user will spend on a mobile device at one time, as well as the constraints of the device itself, such as screen size.
6. When the learning requires features unique to mobile devices (GPS location, etc.). Examples of appropriate uses of these features include:
    a. **GPS** refers to a global positioning system and tracks the position on earth of the mobile device. This feature is appropriate to use when location and mapping are critical concepts within a given task. For instance, a scavenger hunt may help users to learn where important locations are in a new city.
    b. **Accelerometers** are features that measure acceleration and movement of the mobile device. These are appropriate to use with games or simulations, where users can move their mobile devices in order to perform certain actions within a game.
    c. **Text messaging** or SMS allow users to send short text-based messages to other users. This can be used when you want to engage learners who are not collocated, encourage interactions, and facilitate social learning.
    d. Many mobile devices have built-in **cameras** that allow users to take pictures and record short movies. These can be used when you want to engage learners who are not collocated and when you want to include user-generated content (images, videos).
    e. **QR Codes** are tagged artifacts in a learning space that display pertinent information when read and decoded by the user's camera. With this feature, the user is able to quickly access a website (without having to type in a URL) to receive additional details about a product, person, or concept, or even to automatically dial a phone number.

The bottom line here is that training solutions do not need to be mobile to be successful. Not every type of training is best served by being delivered on a mobile device. Sometimes, mobile may be suitable (or nice to have) but not necessary. Additionally, the decision to pursue a mobile solution does not have to be an all-or-nothing proposition. Frequently now, mLearning is being blended with other types of learning. There may be trade-offs to consider, such as what the added costs may be to create and maintain mLearning platforms. We will demonstrate how this knowledge can be used in the sample projects, as a way to illustrate how these decision points can be applied in real circumstances. The full decision process for each of these sample projects can be found in **Section 5.0**.

4.2.1 Sample Project 1—Should We Pursue a Mobile Solution?

This project involved developing a mobile solution for annual employee *Information Awareness* training, which has been completed on a desktop up until this point. The ID must first look at the *Information Awareness* requirements (which included a specific requirement for a mobile solution) to verify that they align with justifications to pursue a mobile solution (see **Table 3**).

Table 3. The ID must answer the relevant questions to determine whether a mobile solution should be pursued.

Question	Responses & Scoring for Sample Project 1
1. Does your learning address Moment of Need 1: Learning something for the first time?	Yes. Some new employees will be learning this information for the first time. **Score: 1**
2. Does your learning address Moment of Need 2: Wanting to learn more?	No. **Score: 1**
3. Does your learning address Moment of Need 3: Trying to remember?	Yes. Some employees who have been with the company for longer than one year may have already received annual training. Consequently, this will be more like refresher training for them. **Score: 2**
4. Does your learning address Moment of Need 4: When things change?	No. **Score: 1**
5. Does your learning address Moment of Need 5: When something goes wrong?	No. **Score: 1**
6. Will the end users have to know the information and content by heart?	Yes. They should have a good understanding of the material so that they can keep it in mind as they do their jobs. **Score: 1**
7. Does training need to occur anytime/anywhere? Will it require more ready access by users?	Yes. Based on the requirements, training should be anytime, anywhere, which means a mobile solution would be appropriate. End users should be able to access it when there is time available to conduct the training. However, the organization requires compliance, which means training should be completed on a yearly basis. **Score: 4**
8. Will users be required or encouraged to contribute to the content of the learning?	No. **Score: 1**
9. Can the information be componentized and delivered as "nuggets" of information linked to tasks, questions, and conditions?	Yes. The information that needs to be delivered via training can be chunked into small, short, easily managed bits of information, and linked to key issues, tasks, and questions, which is appropriate for a mobile solution. **Score: 9**

Question	Responses & Scoring for Sample Project 1
10. How much data/content will need to be transferred to mobile platforms (via the Internet) as part of the mobile solution?	Wireless Internet access is not necessary all the time and the amount of data transferred is relatively small (i.e., just for updates to the content on occasion). A mobile solution can meet that need. **Score: 9**
11. Will the learning experience benefit from features that are unique to mobile devices?	No. This particular learning circumstance does not require specific features, but this does not mean that mobile is inappropriate. **Score: 1**
Recommendation	**Total Score: 31** **Acceptable range for mobile: 27–35** Based on the answers to these questions, a mobile solution is **suitable** to deliver *Information Awareness* Training. Having made this determination, the ID should now assess what type of mLearning he or she will create.

4.2.2 Sample Project 2—Should We Pursue a Mobile Solution?

In this project, the ID is responsible for designing a support solution to assist boarding officers in their job. There is no specific requirement to pursue a mobile solution, but the ID should conduct a complete analysis and examine the initial *Officer Boarding Support* requirements to determine whether there may be a justification to pursue a mobile solution. The following table details key questions that should help IDs decide whether mobile is an appropriate solution for their project (see **Table 4**).

Table 4. The ID must answer the relevant questions to determine whether a mobile solution should be pursued.

Question	Responses & Scoring for Sample Project 2
1. Does your learning address Moment of Need 1: Learning something for the first time?	No. Boarding officers should already have learned the procedures. This training will be support for them as they complete their complex tasking in the field. **Score: 1**
2. Does your learning address Moment of Need 2: Wanting to learn more?	No. **Score: 1**
3. Does your learning address Moment of Need 3: Trying to remember?	Yes. The job of boarding officers is complex and requires an external support mechanism to help them complete their tasks. **Score: 2**
4. Does your learning address Moment of Need 4: When things change?	Yes, to an extent. If protocol changes, then this solution can help support the boarding officers as they learn the changed procedures. **Score: 2**
5. Does your learning address Moment of Need 5: When something goes wrong?	Yes. This solution can be consulted when boarding officers find themselves in difficult situations, or when things go wrong. It can help them troubleshoot by offering support on how to do the tasks. **Score: 2**
6. Will the end users have to know the information and content by heart?	No. The support tool will help them to perform their jobs. The intention here is for the officers to always have access to the tool. **Score: 1**
7. Does training need to occur anytime/anywhere? Will it require more ready access by users?	Yes. Based on the requirements, PS should assist a boarding officer by providing anytime, anywhere information (in the field or in the office). Here, a mobile solution would be appropriate. Boarding officers should be able to pull up the tool whenever they need help. **Score: 4**
8. Will users be required or encouraged to contribute to the content of the learning?	At the current moment, no. However, stakeholders are thinking about the value of incorporating user-generated content in the future, in the form of Lessons Learned, Tactics, and Tips that users can contribute to. **Score: 1**

Question	Responses & Scoring for Sample Project 2
9. Can the information be componentized and delivered as "nuggets" of information linked to tasks, questions, and conditions?	Yes. The support information that needs to be delivered can be chunked into small, short, easily managed bits of information. **Score: 9**
10. How much data/content will need to be transferred to mobile platforms (via the Internet) as part of the mobile solution?	Wireless Internet access is not necessary all the time (i.e., just for reporting purposes), and the amount of data transferred is small when connected. **Score: 9**
11. Will the learning experience benefit from features that are unique to mobile devices?	No. This particular learning circumstance would not necessarily benefit from features specific to mobile. **Score: 1**
Recommendation	**Total Score: 32** **Acceptable range for mobile: 27–35** Based on the answers to these questions, a mobile solution is **suitable** to deliver *Officer Boarding Support*. Having made this determination, the ID should now assess what type of mLearning he or she will create.

4.3 *Mobile Learning Content Redesign and Mobile Learning for Performance Support*

mLearning exists in a variety of forms, from on-demand podcasts and videos to augmented reality applications. The ideal type of mLearning for any given situation is a function of the performance context—or how it works at work—the training goals, and the inherent characteristics of that particular type of mLearning (i.e., what it allows a user to accomplish).
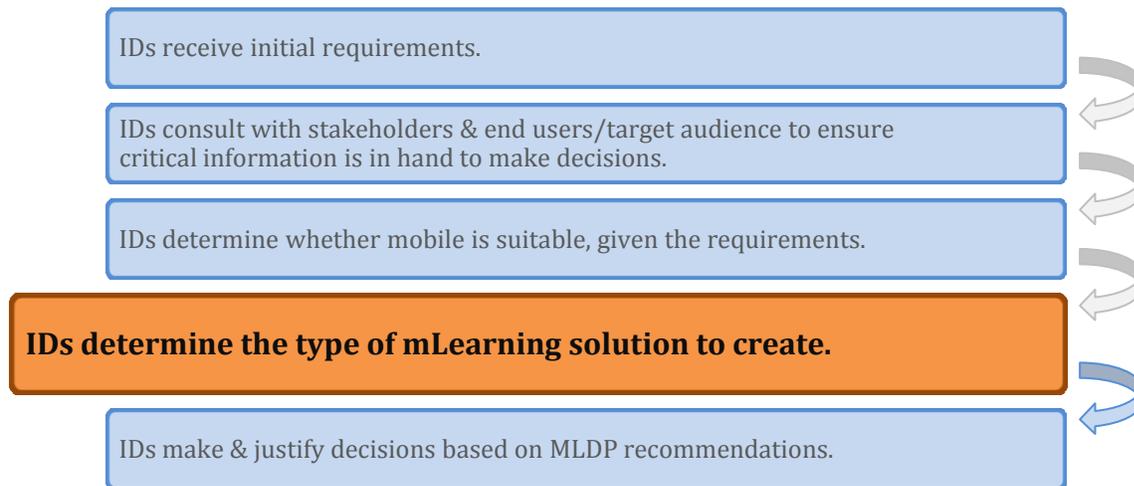
Figure 12. Current mLearning process – IDs determine the type of mLearning solution to create.

Within the scope of this effort and for the two sample projects defined in this document, an mLearning solution focuses on supporting the **acquisition** of knowledge, when an individual is learning something for the first time and expanding or refreshing on things that were learned previously. The purpose of general mLearning applications is to "help [users] remember and perform unaided; to alter the smart within our people; to develop them just in case they need it" (Rossett, 2010). In this document we also focus on mobile PS tools, one type of mLearning that puts an emphasis on meeting the needs of **application** of knowledge, including (1) when trainees need to remember or act on something that was previously learned, (2) when trainees need to solve problems that may arise or fix things that break or malfunction, and (3) when trainees need to change skills or change the way they perform (Haag, 2013). The purpose of PS is to "…create external resources that can be referred to as they are needed, when they are needed" (Rossett, 2010). This means that PS serves users when they are tackling a task. PS distinguishes itself by enriching the exterior environment for performance, by putting something in the hand of the user. Examples include job aids, quick reference cards, planners, and sidekicks. Learning, mobile or otherwise, enriches the interior of the performer, by moving content inside. **Table 5** (adapted from A. Rossett, personal communication, March 28, 2013) illustrates different purposes for mobile PS, a description of these purposes, and recommendations for usage.

Table 5. Purposes for performance support (PS) and recommendations for when to consider using PS for those purposes.

Purposes for Mobile Performance Support (PS)	Description	When to Consider Using PS for This Purpose
Assessments (self and organizational)	One way to use PS is to deliver assessments. Those assessments could then be used for planning, targeting needs, delivering assets, measuring competence, and linking to information resources, experts, and smart peers.	- When users require substantial guidance - When users are accustomed to working independently - When users know little about the topic - When the issue is that users are NOT motivated - When the content is basic and known to experts but not to users - When the content is nuanced, emerging - When compliance is the best way to describe what we're talking about - When supervisors do not know about or necessarily support this material
Asynchronous learning opportunities	Mobile PS can be used to provide asynchronous learning opportunities. This is an approach to learning that uses online resources to encourage information sharing among peers/instructors. Users can access learning materials any time and are not required to be online simultaneously with their peers/instructors. Some examples include: virtual libraries, email, discussion boards, social networking, blogs, wikis, and collaborative documents (e.g., a Google doc that is being edited by several different users).	- When users are committed to excellence - When users ARE motivated
Career information and resources	The mobile device can link users to information related to careers, such as sample job descriptions, people in the organization who already hold those positions, a checklist for readiness to assume such a role, related courses, etc.	When users know a lot about the topic

Purposes for Mobile Performance Support (PS)	Description	When to Consider Using PS for This Purpose
Challenge center, tracked	Mobile PS can be used to provide challenge center opportunities. A challenge center is a place where users go to engage in practice and to receive feedback on their performance. Mobile devices can serve up realistic problems and data, offering users opportunities to practice anytime, anywhere. Users tackle authentic cases and problems, and compare their efforts to experts'.	• When users are committed to excellence • When users are accustomed to working independently • When users know a lot about the topic • When the issue is that users are NOT motivated • When users need to know it by heart • When the content is basic and known to experts but not to users • When compliance is the best way to describe what we're talking about
Clear statements of expectations	Performance can be boosted via clarity of expectations. Use mobile devices to help people see what is expected of them as they tackle tasks and respond to challenges.	• When the issue is that users are NOT motivated
Coaching on demand	Coaching on demand allows users to get an explanation about a task or flaw or set of symptoms (for example). A mobile device can be used to reach out to a savvy peer, supervisor, or expert for a quick explanation, example, or recommendation.	• When users are accustomed to working independently
Competency plan/maps, linked growth opportunities	Performance can be boosted via clarity about the nature of high-quality performance and associated expectations. That's what competences are. Maps and plans present these to users. It helps them see where they should be taking their performance.	• When users are committed to excellence • When users are accustomed to working independently • When users know little about the topic • When the content is basic and known to experts but not to users • When the content is nuanced, emerging • When supervisors do not know about or necessarily support this material
Crowdsourcing	Use the mobile device to see what others recommend to handle a problem or to think in fresh ways about a situation. It's a swift and informal way to gather up many views. The benefits are obvious, but also consider the downside: do respondents know enough to deliver high-value recommendations?	• When the content is nuanced, emerging

Purposes for Mobile Performance Support (PS)	Description	When to Consider Using PS for This Purpose
Drill & practice exercises	Mobile PS can be used to provide drill and practice exercises. These exercises give users repetitive practice to increase skill levels and lead to more meaningful learning. Good exercises should always provide feedback to users.	• When users are accustomed to working independently • When users know little about the topic • When users need to know it by heart • When the content is basic and known to experts but not to users • When it is chaotic, fast paced, and even dangerous
Error identification exercises	Mobile PS can be used to present error-identification exercises. These exercises present a user with a process or document containing errors; the user must then identify the error(s).	• When users are accustomed to working independently • When users know little about the topic • When the content is basic and known to experts but not to users • When it is chaotic, fast paced, and even dangerous
Field guide	A book or manual that is designed to help a user identify any number of things, from objects critical to task completion to procedures to follow in the field.	• When users know little about the topic • When users are accustomed to working independently
Location services	Location identification is one of the convenient things that mobile devices can do for users. A mobile device might tell users about others who have been in a particular location. These devices might also point users to high-value sources of information, to danger, and to particular and relevant resources specific to the user's location.	• When users require substantial guidance • When users need to know location-specific information by heart, they may use location-enabled PS to improve their knowledge and competency • When users do not need to know the location-specific information by heart, they may use location-enabled PS as an aid
Mentor/coach via mobile device	Helps the user by (Rossett & Schafer, 2006): - Answering: "What should I keep in mind when performing the task?" - Answering: "Why should I perform the task?" - Communicating standards for performance - Encouraging dialogue and feedback	• When users require substantial guidance • When users know little about the topic • When the issue is that users are NOT motivated • When the content is new to users • When the content is nuanced, emerging • When the material is complex, even controversial

Purposes for Mobile Performance Support (PS)	Description	When to Consider Using PS for This Purpose
Planner PS	Helps users plan for tasks or events by providing reminders and guidance for preparing for the tasks, and by highlighting considerations to take into account (Rossett & Schafer, 2006). It provides support to the user prior to or after the task. An example is a scheduling assistant that prompts the user with to-do lists prior to planned events. Another example is a checklist of attributes associated with culturally sensitive interviews. See policy and practice reference below.	• When users are committed to excellence • When users ARE motivated • When users need to know location-specific information by heart, they may use location-enabled PS to improve their knowledge and competency • When users do not need to know the location-specific information by heart, they may use location-enabled PS as an aid • When the content is nuanced, emerging • When it is chaotic, fast paced, and even dangerous • When Internet access is not reliable
Podcasts and vodcasts	Digital audio and video files that can be subscribed to and downloaded or streamed to a device.	• When the issue is that users are NOT motivated • When the content is nuanced, emerging • When the material is complex, even controversial • When compliance is the best way to describe what we're talking about
Policy and practice references	The user wants to make culturally sensitive decisions, has been to a class on the matter, but doesn't always remember what to do. Policy and practice reminders have the potential to focus and boost performance. Some might call these planner PS tools.	• When users are committed to excellence • When users require substantial guidance • When users know little about the topic • When users ARE motivated • When users do not need to know it by heart; they may perform in aided fashion • When Internet access is not reliable • When supervisors do not know about or necessarily support this material
References, information, and other tagged resources	The mobile device provides a rich array of resources to which users refer at the moment of need. Users "pull" what they want and need, assuming that assets that are of use to them have been collected.	• When users are accustomed to working independently

Purposes for Mobile Performance Support (PS)	Description	When to Consider Using PS for This Purpose
Delivery of information, policies, and guidelines in the workflow	Here users are given what they need based not on what they ask for, but rather on where they are and what task they are performing. For example, given their place in the acquisition cycle and reliance on acquisition software, users are "pushed" advice.	• When users require substantial guidance
RSS (Really Simple Syndication)	Web syndication that publishes lists of frequently updated online resources, such as blogs, news headlines, audio, video, journal articles.	• When users ARE motivated • When the content is nuanced, emerging • When the material is complex, even controversial • When Internet access is not reliable
Sidekick support that is embedded in the task	Assists users at the moment of need, providing support during task performance; these tools "…coax, remind, direct, and inform" (Rossett & Schafer, 2006). Examples include GPSs that display satellite images to assist sailors with navigation, and interactive maps for drivers navigating on the ground. Another great example is MS Word® and the way it underlines misspelled words.	• When users ARE motivated, sidekick support could inform users of what to do next • When users are NOT motivated, sidekick support could remind user what to do next • When users do not need to know it by heart; they may perform in aided fashion • When Internet access is not reliable
Simulations	Realistic, versatile environment where students interactively learn new information and can directly apply this information in context.	• When users are accustomed to working independently
Social network	Modes of interacting with peers online, including mobile access to Twitter, Facebook, and equivalents.	• When users are accustomed to working independently • When users know a lot about the topic • When users ARE motivated • When the content is new to users • When the content is nuanced, emerging • When the material is complex, even controversial • When Internet access is not reliable • When supervisors do not know about or necessarily support this material

Purposes for Mobile Performance Support (PS)	Description	When to Consider Using PS for This Purpose
Synchronous experiences	Represent learning experiences in which everyone takes part in the same place and at the same time, involving real-time classroom involvement (virtual or face-to-face). Some examples include: lecture, peer communication (text, voice), video and web conferencing, and collaborating in virtual worlds.	• When the issue is that users are NOT motivated
Texting messages	Allows peers/instructors to send text electronically, enhancing social interaction. Texts can be used to send users tips and to assess knowledge.	• When users require substantial guidance • When the issue is that users are NOT motivated • When it is chaotic, fast paced, and even dangerous
Tracking activity	The mobile device keeps track of effort, participation, activity, and performance (when assessments are involved). A dashboard is provided that links all this to expectations, offering value to the individuals, managers, and the unit.	• When the issue is that users are NOT motivated

PS is wonderful on its own or as part of a larger learning program. IDs should keep in mind, however, that the essence of PS is that it exists outside the user, which creates vulnerability (A. Rossett, personal communication, March 28, 2013). If the system fails, the Internet is down, or the device or software has been harmed by rough handling, mobile PS cannot do its job. An ID should anticipate such risks and identify ways to mitigate them. IDs should consider the benefits of a blended approach, where both a mobile PS tool and mLearning are used. It does not always have to be an "either/or" decision (see Rossett, 2012). Rossett (2012) used the metaphor of a marriage to talk about the power of bringing training and support together, through mobile devices and in other ways.

Another consideration for mobile solution projects is how to determine the content (i.e., materials and information to be conveyed to the user), regardless of the type of mLearning that IDs are creating. First, mobile solutions can be created entirely from scratch, when addressing a brand-new training need. Second, content from existing training materials can be modified to make them more "mobile friendly." Third, content from existing training materials can be redesigned from scratch to make them suitable for mobile. The third is what we focus on in this document—mLearning Content Redesign. Traditional training typically gives a lot of detailed information, but it is important to only translate bare essentials to mobile for most users. Existing content needs to be redesigned to avoid overwhelming users with too much information (Udell, 2012).

The following decision path (see **Table 6**) helps IDs determine (1) whether their solution should be a general mLearning solution or a PS tool, and (2) whether the solution will involve content redesign, based on the requirements that the IDs have received.

Table 6. Is mLearning sufficient? Is Performance Support sufficient? Do we require a combination?

Question	Explanation	Responses & Scoring
1. Will target users be learning the information for the first time (including changes to previous procedures/things they have learned)?	When designing mLearning content to deliver new knowledge, IDs should consider providing all related materials, including background information, without assuming that users can already perform or are performing the task at a certain level. The goal and outcome are to deliver the knowledge.	**Yes**: This suggests that an mLearning solution would be sufficient. Skip to question 5. **No**: Go to next question.
2. Will target users need help recalling or remembering information they have previously learned?	When on the job or performing a task, not all users, even the experienced ones, can recall or remember all the details learned during training. When designing an mLearning solution to help users perform a task better, IDs should consider the best way to effectively and seamlessly provide just-in-time and targeted information without bogging down users with unnecessary information. The goal and outcome are to assist users in performing the task at hand, not to retrain the entire process.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.
3. Will target users need quick access to it to perform everyday tasks or at the time of need?	A tool is an instrument used to perform a certain task or to help a user do a better job. An mLearning PS solution is a tool to help users perform a one-time task or an everyday job better, easier, or faster. A PS tool should be easy to access, available when and where it is needed, and work and be helpful every time.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.
4. Will the target users require this solution when they encounter an error or a failure during performance?	When users make mistakes or fail a task after they have applied all the knowledge they have learned, they need assistance to identify the causes and to correct them. An mLearning PS solution can provide just-in-time information to refresh users on relevant information, reinforce procedures, provide alternatives, and suggest possible solutions to improve user performance.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Continue to next question.
5. Does content material already exist in another format (e.g., WBT manuals, paper-based training)?	As a part of the analysis process for an mLearning solution, IDs should gather all the existing relevant information and content. If relevant materials exist, IDs should evaluate the materials to ensure they are current, correct, and complete. Designing a mobile solution based on existing materials can save time and resources over designing a solution from scratch, which may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: Continue to next question. **No**: This suggests that you will need to start designing content from scratch to include in the mobile solution.

Question	Explanation	Responses & Scoring
6. Is the existing content material high quality?	The quality of content will definitely impact the quality of a learning solution, including an mLearning solution. When analyzing existing content for its quality, IDs should pay special attention to determine whether it is suitable for use in designing an mLearning solution. The existing content may have to be redesigned (i.e., reducing the amount of information conveyed, as well as formatting) and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to next question. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to improve the quality of the content in the process. Continue to next question.
7. Is the existing content material up to date?	The existing content may have been created some time ago and may be outdated. When designing an mLearning solution, IDs should examine the existing content to make sure that it is up to date and accurate. Creating a learning solution with out-of-date information cannot achieve the desired learning outcomes. If the existing content is out of date, IDs will need to update the content, and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to **Recommendation**. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to make sure to update the content in the process. Continue to **Recommendation**.
Recommendation	Based on responses to the questions here, an ID can receive guidance on whether PS is appropriate, and considerations to think about when an mLearning solution will require content redesign.	**You should create a PS tool if:** You answered "yes" to questions 2, 3, or 4. **You have taken into account necessary considerations for mobile content redesign if:** You answered "yes" to questions 6 and 7. You already have high-quality content that is ready to be redesigned for your mobile solution. **You should do further analysis if:** You answered "no" to questions 5, 6, or 7. You should do further analysis because it seems that you may need to either create new material or heavily update the quality and information in material before starting the mLearning project.

4.3.1 Sample Project 1—Determining Type of Mobile Solution

This project involved developing a mobile solution for annual employee *Information Awareness* training, which has been completed on a desktop up until this point. The ID must refer back to the *Information Awareness* training requirements to determine the type of mobile solution that is needed (see **Table 7**).

Table 7. The ID must refer back to the *Information Awareness* requirements to determine the type of mobile solution that is needed.

Question	Responses & Scoring for Sample Project 1
1. Will target users be learning the information for the first time (including changes to previous procedures/things they have learned)?	No. Some will, others will be using this mobile solution as a refresher.
2. Will target users need help recalling or remembering information they have previously learned?	No. They should know it by heart and have a good understanding of the content after the training.
3. Will target users need quick access to it to perform everyday tasks or at the time of need?	No. The training is primarily for awareness purposes and will not necessarily need to be re-referenced every day.
4. Will the target users require this solution when they encounter an error or a failure during performance?	No. Perhaps, but not likely.
5. Does content material already exist in another format (e.g., WBT manuals, paper-based training)?	Yes. There is already desktop training that exists, and this material is what the mobile solution will be based on.
6. Is the existing content material high quality?	Yes. It is what the mobile solution content will be based on.
7. Is the existing content material up to date?	Yes, there are no significant updates.
Recommendation	**You have taken into account necessary considerations for mobile content redesign:** You answered "yes" to questions 6 and 7. You already have high-quality content that is ready to be redesigned for your mobile solution. **Note:** Simply shrinking existing eLearning screens to fit mobile devices is not a good idea (e.g., it will make it difficult to read content and/or navigate). Instead, the existing content should be split into smaller but meaningful pieces that can also fit within the constraints of the mobile device. This means that the amount of information to be conveyed should be reduced.

4.3.2 Sample Project 2—Determining Type of Mobile Solution

In this project, the ID is responsible for building a mobile solution to assist boarding officers in their jobs. The ID must refer back to the *Officer Boarding Support* requirements to determine the type of mobile solution that is needed (see **Table 8**).

Table 8. The ID must refer back to the *Officer Boarding Support* requirements to determine the type of mobile solution that is needed.

Question	Responses & Scoring for Sample Project 2
1. Will target users be learning the information for the first time (including changes to previous procedures/things they have learned)?	No, they need support for things they have already learned but not necessarily memorized.
2. Will target users need help recalling or remembering information they have previously learned?	Yes, they will use the mobile solution to support their performance of tasks in the field, so there is not a need to memorize every detail of the content.
3. Will target users need quick access to it to perform everyday tasks or at the time of need?	N/A
4. Will the target users require this solution when they encounter an error or a failure during performance?	N/A
5. Does content material already exist in another format (e.g., WBT manuals, paper-based training)?	N/A
6. Is the existing content material high quality?	N/A
7. Is the existing content material up to date?	N/A
Recommendation	**You should create a PS tool:** You answered "yes" to questions 2, 3, or 4. You should explore building a PS tool.

4.4   *Recommendations for Mobile Learning Solutions*

Once the decision for either mLearning content redesign or PS (or a combination) has been made, IDs will need to make additional decisions about how to deliver content and provide justifications for those decisions.

IDs receive initial requirements.

IDs consult with stakeholders & end users/target audience to ensure critical information is in hand to make decisions.

IDs determine whether mobile is suitable, given the requirements.

IDs determine the type of mLearning solution to create.

IDs make & justify decisions based on MLDP recommendations.
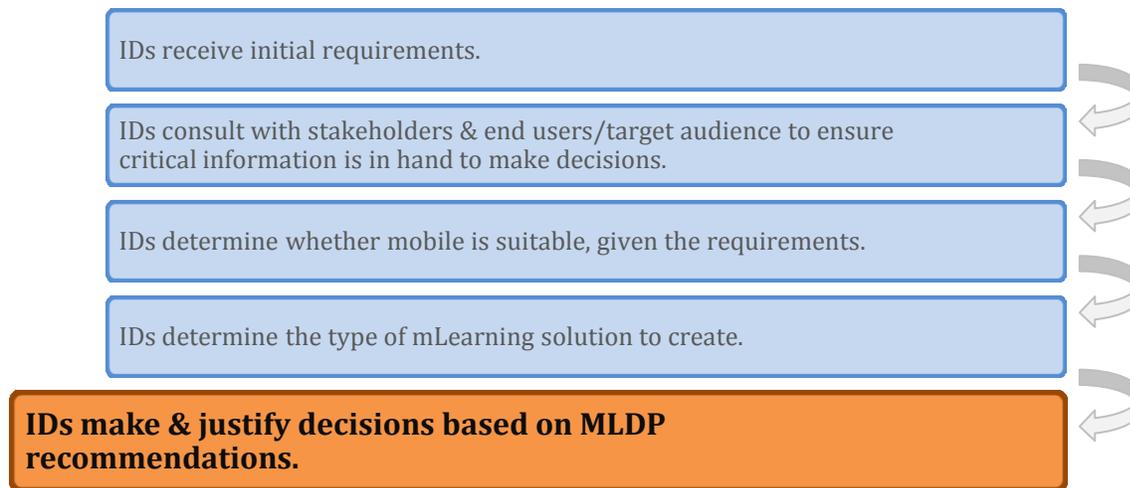
Figure 13. Current mLearning process – IDs make and justify decisions on reconnemdations.

IDs considering a mobile solution will find this section helpful, as it guide readers through considerations for the design and delivery of training content, such as videos, into mLearning redesign and mLearning for PS. We also consider factors involved in deciding what type of mobile app to use. The following questions are divided into different sequences of questions, focused on:

1. Video (see **Table 9**)
2. Audio (see **Table 10**)
3. Graphics (see **Table 11**)
4. Animation (see **Table 12**)
5. Social learning components (see **Table 13**)
6. Electronic books (e-books) (see **Table 14**)
7. Mobile games (see **Table 15**)
8. Augmented reality (see **Table 16**)
9. Different types of mobile apps (see **Table 17** and **Table 18**)

Table 9. Questions to consider for including video in mLearning.

Question	Explanation	Responses & Scoring

1. Do you plan to use video in the mLearning solution?	Video is a familiar format. Using videos in a mobile solution may require some special considerations. Those include:
	• Size of the videos. The size of the videos impacts an mLearning solution in two ways:
	    ○ The amount of memory taken by videos on a mobile device
	    ○ The connection throughput and data usage
	• Mobile device screen size. Mobile devices, especially smartphones, have limited screen size. Videos showing small details may be difficult for learners to see clearly.
	• Videos will also not be appropriate in all learning environments (e.g., environments prone to distractions).
	
	Will video be the best way to show the information? Video may be appropriate when:
	• Users are not motivated
	• The content is nuanced, emerging
	• Details of motion sequences (e.g., machinery in operation) need to be shown, which still images cannot properly convey
	• The material is complex, even controversial
	• The organization needs compliance
	
	Videos are **not** appropriate and a waste of resources when:
	• The video is just a "talking head," which does not add value to the solution (unless it is for inspiration, coming from a highly respected authority figure; P. Berking, personal communication, April 19, 2013).
		Yes: Continue to next question.
		
		No: Stop here. Go to next sequence of questions on audio (**Table 10**).

2. Will you be designing mLearning or PS?	Some PS may not be ideal for videos because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch a video).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the environment will allow users to view videos effectively. Proceed to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
3. Will the end users be provided with a device to use?	If people will be using their own devices (BYOD), there will be a lot of variety in devices. Although most mobile devices today have video playback capabilities, ensuring the video format used in the mLearning solution works on all mobile devices requires a huge amount of work. Consequently, video formats may not work well for all users.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
4. Will you be using/redesigning existing training content?	If there are existing video clips designed for computer-based eLearning, questions five through eight in this table should be asked when considering using existing videos in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are designing videos from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.
5. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing video content, IDs should evaluate the videos to see whether they can be divided into smaller units. More redesign efforts should be given when video reproduction is needed in order to divide existing videos into smaller and shorter clips. Mobile learners expect short, focused answers to problems. If videos are used, five-to-ten-minute clips should be more than sufficient to convey the content and pose fewer bandwidth issues. Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible (Udell, 2012).	**Yes:** Continue to next question. A score of 6 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.

Question	Explanation	Responses & Scoring
6. Are existing videos in proper format already?	Videos for computer-based eLearning content may have been produced with high resolutions and high-quality audio without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, videos should have a resolution and audio quality that is proper for the content and mobile devices. IDs should consider lowering the video and audio quality (within the limits of the design requirements) to reduce the size. Videos should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP4. When including videos in a Web App, another suggestion is to include video in two formats: MP4 (which Android users will be able to view), and Quicktime (which iPhone/iPad can recognize and play) (see Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
7. Does the existing content contain Adobe Flash multimedia components?	The current situation is that many mobile devices do not support Adobe Flash content. Adobe announced that it would not no longer develop or support on any mobile platform. If the existing videos are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Videos may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.
8. Are existing videos included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing videos are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If videos are streamed, a constant data connection is required to deliver these videos to mobile devices. Users are more likely to abort mobile apps if they take more than five seconds to load. For heavy content like video, the mobile device could either allow users an option to download and view the content later, or reduce the resolution of the video for faster download (Training Partners, ND).	**Yes, part of the learning content:** It is easier to package videos into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, streamed in real time:** Videos may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
Video Recommendation	The aggregated scores will tell the ID how challenging it may be to include video in the mLearning solution, based on the responses to the questions.	**Range of scores**: 6–17 **Acceptable range for including videos in mLearning**: 12–17 Lower scores suggest that it may be challenging (and possibly inappropriate) to incorporate video in your mLearning solution.

Specific Recommendations and Guidelines for Including mLearning Video:

1. Beware of Flash and other closed formats that are not compatible on many mobile platforms (e.g., iPhone is not compatible with Adobe Flash and most interaction will be limited to HTML; Martin et al., 2012).
2. Some devices prefer different default video file formats. Some video formats will not play on some devices.
3. Optimize the size of the files for mLearning; mobile devices have much smaller disk capacity and computer memory allotment than traditional eLearning technologies (Udell, 2012).
4. Do not automatically download video files until requested, for bandwidth savings.
5. Do not auto-play because it can annoy the user.
6. Keep it short (five minutes or less); keep it visually simple; keep camera movement to a minimum; keep it close (viewers cannot pick out detail on small mobile device); make sure shots are well lit to avoid dark and grainy video on the small mobile screen; make sure audio is of good quality for the target platform; bigger text/graphics are better; video needs to work well on whatever device it will be viewed on (Williams, 2012).

Table 10. Questions to consider for including audio in mLearning.

Question	Explanation	Responses & Scoring
1. Do you plan to use audio in the mLearning solution?	There are several considerations for including audio in the mLearning solution. The contextual learning environment and the end users must be taken into account to determine whether audio is an appropriate feature to use. Audio may be appropriate when: • The user will be multi-tasking (i.e., "travel time" learning, where modules can be taken while riding the metro bus or multi-tasking) • Users are not motivated • The content is nuanced, emerging • The material is complex, even controversial • The organization needs compliance	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on graphics (**Table 11**).
2. Will you be designing mLearning or PS?	Some PS may not be ideal for audio because of the nature of the learning environment (e.g., a Soldier consulting PS tool in the field may not be able to hear audio).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the user environment will allow users to hear audio effectively. If so, then proceed to next question. A score of 1 is attached to this response.
3. Will users be using mLearning in environments that are free from a lot of distractions or external noise?	Make sure that if users cannot hear the sound (technology issues, or external noise in the environment), it will not severely impact their training of the task.	**Yes:** Continue to next question. A score of 3 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
4. Do you have a small set of sound effects associated with actions in the mLearning solution (e.g., button clicks, buzzers)?	It is important not to have too many competing sound effects (i.e., between the environment and the mLearning). This can be distracting and obnoxious. Select a few of the most important actions that will have sound effects associated with them for good feedback.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
5. Do you intend to use music in your mLearning solution?	Adding music to your mLearning has the potential to be distracting, and can also cause some processing issues depending on the mobile device being used and the necessary connectivity. IDs should carefully consider the effects of music when designing the solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
6. Have you taken precautions to make sure that music will not be played on a loop?	Be cautious about adding continuous or looping background music in your mLearning content. This may be distracting to the learning process. It also increases the processing requirements for the mobile device, especially if the music is streaming. It may be more effective to present intermittent music in conjunction with your other mLearning content.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
7. Do you intend to incorporate verbal feedback in your mLearning?	Verbal feedback may not be appropriate in environments that are very distracting. If you want to use verbal feedback, make sure that it is short and simple.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
8. Will the verbal feedback be short and brief?	Utilizing verbal feedback can be effective, as long as it is chunked appropriately. Extended verbal feedback is not advised.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.
9. Will you be using/redesigning existing training content?	If there are existing audio clips designed for computer-based eLearning, questions ten through thirteen in this table should be asked when considering using existing audios in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating audio from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.
10. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially in an environment where audio content is not well received. Therefore, it is recommended to design learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing audio content, IDs should evaluate the audio to see whether they can divide it into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when audio reproduction is needed in order to divide existing audio into smaller and shorter clips.	**Yes:** Continue to next question. A score of 10 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.

Question	Explanation	Responses & Scoring
11. Are existing audio files in proper format already?	Audio files for computer-based eLearning content may have produced with high-quality stereo audio without compression. Although they play very well on a computer, they may have large file sizes, need more processing power for playback, and/or be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, audio should have a quality that is proper for the content and mobile devices. IDs should consider (within the limits of the design requirements) lowering the audio quality and removing stereo sound (many smartphones do not have stereo speakers) to reduce the size. Audio should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP3, and it should be tested to make sure the files will actually work on the target mobile device(s) (Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
12. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing audio is contained in a multimedia Flash object, IDs have to redesign it for mobile delivery.	**Yes:** Audio may still be used, but it will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.
13. Is the existing audio included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing audios are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The audio is still available to a mobile user even when the device is not online. If audio is streamed, a constant data connection is required to deliver it to mobile devices.	**Yes, part of the learning content:** It is easier to package audio into a mobile solution when it is part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Audio may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
Audio Recommendation	The aggregated scores will tell the ID whether audio is appropriate for the mobile solution, based on the responses to the questions.	**Range of scores**: 10–29 **Acceptable range for including audio in mLearning**: 20–29 Higher scores suggest that audio may be appropriate for the mobile solution. Lower scores suggest that including audio may be challenging and/or inappropriate. Regardless of score, you should also consider the context of use, such as where/when users will be accessing the mobile solution.

Specific Recommendations and Guidelines for Including mLearning Audio:

1. Make sure that the learning environment is appropriate for audio—for example, a very distracting environment with loud noises is not suitable for audio.
2. Beware of Flash and other closed formats that are not compatible on some devices.
3. Some devices prefer different default audio file formats. Some audio formats will not play on some devices.
4. Optimize the size of the files.
5. Do **not** automatically download audio files until requested, for bandwidth savings.
6. Do **not** auto-play because it can annoy the user.
7. Mobile devices have much smaller disk capacity and computer memory allotment than traditional eLearning technologies; optimize media and file size for mLearning (Udell, 2012).

Table 11. Questions to consider for including graphics in mLearning.

Question	Explanation	Responses & Scores
1. Do you intend to use icons/clip-art in your mLearning?	IDs might choose to use icons from existing materials, websites, existing CBT, and other applications (e.g., Microsoft Word®). However, the IDs need to take into account how well these icons will translate to smaller mobile devices.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 3. A score of 1 is attached to this response.
2. Are the icons familiar to the user and simple?	Icons should be familiar and should not be complex. They should be simple enough to translate onto small mobile devices while identifiable. For example, you don't want to use an intricate icon that is only fully visible on a 15-inch laptop monitor. Also, be aware that different mobile devices may display colors differently. However, icons should not save space at the expense of user understanding.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
3. Do you intend to use photographs in your mLearning?	IDs need to take into account how well photographs will translate to smaller mobile devices, which may limit how well a user is able to see details, complexities, etc.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 5. A score of 1 is attached to this response.
4. Are the photos lower resolution with no or minimal small details?	If you intend to use high-resolution photographs, keep in mind several things: (1) the screen sizes of the devices that may potentially be accessing the mLearning content; (2) the added processor requirements necessary to store and utilize photos that are large in data size. Details in photos that can be detected on a laptop screen may be hard to see on smaller mobile devices. Make sure no critical content is contained within images that could be hard to see on smaller devices. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution photo: (1) is there value in including high-resolution photos, and (2) what is the target platform for delivery? Only include high-resolution photos when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in photos.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
5. Do you intend to have background images in your mLearning?	IDs need to take into account how well backgrounds will translate to smaller mobile devices. Use of backgrounds may not be preferable if it proves to be a distraction. Make sure that background art is not distracting from the main mLearning content. On smaller mobile devices, it may not be necessary to use background art, as the screen size is a very limiting factor when presenting the critical instructional content of the mLearning.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 7. A score of 1 is attached to this response.

Question	Explanation	Responses & Scores
6. Is your background image lower resolution with few small details?	When working with a small screen, large CSS (Cascading Style Sheet) background images or infographics can be problematic. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution background: (1) is there value in including high-resolution backgrounds, and (2) what is the target platform for delivery? Only include high-resolution backgrounds when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in images.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.
7. Will you be using/redesigning existing training content?	If there are existing graphics designed for computer-based eLearning, questions eight and nine in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating graphics from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing graphics, IDs should evaluate the graphics to see whether they can be divided into smaller units. Simply reducing the size of a graphic may make it hard to read. More redesign efforts should be given when graphics re-creation is needed in order to divide or restructure existing graphics into smaller parts. Cropping and scaling are two methods used to reduce the size of an existing image. To get the right combination of image size and display area, these two methods can be used together to achieve a good result. This technique is called "Relevance-Enhanced Image Reduction" (for more detail, see Nielsen, 1996).	**Yes:** Continue to next question. A score of 5 is attached to this response. **No:** Continue to next question. A score of 0 is attaché to this response

Question	Explanation	Responses & Scores
9. Are existing graphics in proper format already?	Graphics for computer-based eLearning content may have been produced with high resolution and color depth without compression. Although they display very well on a computer, they may have large file sizes, need more processing power for playback, be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers), or require separate software to open. To be more suitable for mLearning, graphics should have a quality and color depth that is proper for the content and mobile devices. IDs should consider lowering the graphics resolution and color depth (within the limits of the design requirements) to reduce the size. Graphics should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as JPG/JPEG.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.
Graphics Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding graphics to mLearning.	**Range of scores**: 7–16 **Acceptable range for including graphics in mLearning**: 12–16 Higher scores suggest that you have adequately addressed aspects of including graphics in your mLearning solution and that they may be appropriate to use. Lower scores suggest that there are still things you should consider and address before trying to incorporate graphics in your mobile solution.

Specific Recommendations and Guidelines for Including mLearning Graphics/Images:

1. Mobile devices have much smaller disk capacity and computer memory allotment than traditional eLearning technologies; optimize media and file size for mLearning (Udell, 2012).
2. Carefully consider file size and format of images and take into account any limitations of the mobile device you are planning to use to deliver content (Training Partners, ND).
3. Small images should be cropped and zoomed differently than large images to emphasize salient details. Do **not** simply rescale a single image to fill the available space for a given screen size (Nielson, 2012).

Table 12. Questions to consider for including animation in mLearning.

Question	Explanation	Responses & Scoring
1. Do you intend to use animations of any kind in your mLearning?	If you are using animations, you need to consider their length, complexity, and frequency when developing your solution. There are many reasons to use animation (P. Berking, personal communication, April 19, 2013): • Show continuity in transitions • Indicate dimensionality in transitions • Illustrate change over time • Show how elements combine or interact dynamically • Multiplex the display • Enrich graphic representations • Visualize three-dimensional structures • Attract attention	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on social learning components (**Table 13**).
2. Will you be designing mLearning, or PS in particular?	Some PS may not be ideal for animations because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch and understand an animation).	**mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS tool:** Carefully consider whether the use environment will allow users to view animations effectively. Continue to next question. A score of 1 is attached to this response.
3. Have you created short animations that are easily digestible?	It is preferable to utilize shorter animations to show trainee status (e.g., sending email, turning a page), provide useful feedback, enhance the sense of direct manipulation of the app, or to help people visualize the results of their actions (Dannen & White, 2011). Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible, (Udell, 2012).	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.
4. Have you simplified the animations that you will be using?	Added complexity in animations can confuse trainees, and it can also place added processing power requirements on the mobile device. Keep animations as simple as possible to convey the necessary information.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
5. Do you plan to use animations conservatively?	Use animations conservatively because they have the tendency to be annoying if used frequently. Also, make animations consistent with other animations incorporated into the app (Dannen & White, 2011).	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.
6. Will you be using/redesigning existing training content?	If there are existing animations designed for computer-based eLearning, questions seven through eleven in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating animations from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.
7. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing animations, IDs should evaluate the animations to see whether they can divide the animations into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when animation reproduction is needed in order to divide or restructure existing animations into smaller units.	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.
8. Are existing animations in proper format already?	Animations for computer-based eLearning content may have been produced with high resolutions and high frame rates without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, animations should have a resolution and frame rate that is proper for the content and mobile devices. IDs should consider lowering the resolution and frame rate (within the limits of the design requirements) to reduce the size. Animations should be in a format that is widely accepted on most mobile devices.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
9. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing animations are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Animations may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.
10. Does the existing content contain programmed interactions that use rich media-like animations?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries from those for computers. Animations developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing animations in an mLearning solution, IDs need to examine existing animations closely, then redesign or reproduce them for mobile devices. In addition to using the right technologies for producing the animations, IDs need to pay attention to UI and User Experience (UX) design because mobile devices use different input methods.	**Yes:** Rich animations can be used in mobile, but they are more challenging to design. Continue to next question. A score of 1 is attached to this response. **No:** Simpler animations are easier to include in mobile solutions. Continue to next question. A score of 2 is attached to this response.
11. Are existing animations included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing animations are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If animations are streamed, a constant data connection is required to deliver these videos to mobile devices.	**Yes, part of the learning content:** It is easier to package animations into a mobile solution when they are part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Animations may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
Animation Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding animation to mLearning solutions and the appropriateness of animations for the mobile solution.	**Range of scores**: 7–27 **Acceptable range for including animations in mLearning**: 21–27 Higher scores suggest that you have addressed important considerations and it may be appropriate to include animations in the mobile solution. Lower scores suggest that there are still things you should consider before trying to incorporate animations in your mobile solution.

Specific Recommendations and Guidelines for Including mLearning Animation:

1. Animations work better than videos for keeping the audience engaged, and content retention is higher (even for serious topics) (Griffin, 2011).
2. **Pros:** Multiple representations of a concept—for example, in diagrams, animations, or physical activities—contribute to a richer understanding of the concept.
3. **Cons:** Can become confusing if they are too complicated. Can be distracting if not used properly.
4. **Considerations:**
    a. Mobile devices have much smaller disk capacity and computer memory allotment than traditional eLearning technologies; optimize media and file size for mLearning (Udell, 2012).
    b. Cognitive approach: passively receiving information; linear, structured, sequenced approach.
    c. Low skill level of audience—they just view the animations.

Table 13. Questions to consider for including social learning components in mLearning.

Question	Explanation	Responses & Scoring
1. Are you aware of the existing social learning components that can be used as part of mLearning solutions?	There are many different ways to incorporate social aspects of learning into an mLearning solution, including: • Email (including group lists) • Whiteboarding and learner-to-learner whiteboard (i.e., not just instructor to learner) • Chat/Instant messenger (IM), text messaging, and multimedia messaging • Blogs, microblogs, and journals • File and desktop sharing • Threaded discussion (aka forums or discussion boards) • Community calendar • Social networking (e.g., Facebook, Twitter, LinkedIn) • Student-created and posting of personal webpages, wikis • Communities of practice (CoPs) or dedicated team spaces. Members/teams can comprise either learner cohorts taking the same course, or functional teams within the organization. • Surveys • Peer rating of content • Webcasting, with the ability for learners to initiate sessions among themselves (i.e., not just one-way, instructor-to-learner webcasting)	**Yes**: Continue to next question. **No**: Stop here and familiarize yourself with the common social learning components listed here. For more information on each, please consult the resources listed in **Section 8.0** of this document. Then continue to next question.
2. Do you plan to use any social learning components in your mLearning (e.g., having students create content, or having them communicate with their peers)?	If planning to use social learning components, there are some considerations that IDs should be aware of. Some of these considerations are highlighted here. In general, social learning is better for higher-order learning outcomes and problem-based, project-based, or team-based learning. Social learning may be appropriate when: • Users are motivated • They know a lot about the topic • They are accustomed to working independently • The content is nuanced, emerging • The material is complex, even controversial • Internet access is not reliable • Supervisors do not know about or necessarily support this material	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on e-books (**Table 14**).

Question	Explanation	Responses & Scoring
3. Have you weighed the **pros** and **cons** of including social learning components in your solution?	IDs must understand the benefits and drawbacks of using social learning components as part of their mobile solution. Some examples of pros and cons are outlined here. **Pros (Osborne, 2012):** • Familiar tool with most students and appeals to wide range of learners • Virtually limitless amounts of information available online for students to consult • Can improve students' abilities to do online research • Can improve student/instructor communication • Students learn how to leverage social media in everyday life • Digital citizenship: students learn about appropriate online presence and behavior • Can engage students: especially Generation Y and younger • Encourages user-generated content, and learning materials can be easily shared • Encourages active participation, and shy students may become more involved when they interact virtually • Supports collaborative activities **Cons (Osborne, 2012):** • Can become a waste of time if it doesn't relate directly to a learning objective (incorporating it because it is available, not because it enhances learning) • Students may get distracted more easily • There is a risk of cyber-bullying • Face-to-face interaction is limited • Tracking student contributions and learning with social media can be difficult • Mobile platforms are constantly changing • Potential for sharing of inappropriate content • Need for Internet access for some social media • Potential privacy violations can occur	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
4. Do you intend to use text messaging or instant messaging capabilities in your mLearning?	SMS is a way to deliver content very simply. Texting is cheap and almost universally accessible. It can be designed to not only give information but to collect information (Elias, 2011). SMS applications can work on any mobile devices nearly instantaneously (e.g., for sending timely alerts). However, they're typically limited to 160 characters, provide a limited text-based experience, and can be very expensive (Fling, 2009). Users may also interact with each other using instant messaging programs on devices that are connected to the Internet.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
5. Do you intend to use multimedia messaging capabilities in your mLearning?	Multimedia messaging capabilities (e.g., audio/visual recording capabilities) are required. The mobile device must be able to read and decode the format that the images/video/audio messages are in to be of any use to the end user.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
6. Do you intend to use blogs, micro-blogging, discussion forums, white boards, or wikis in your mLearning?	These social learning components encourage users to be active learners and to participate in collaborative activities. Users contribute to the content of training, or a course, by sharing personal insight, having discussions with peers, and collaborating with others. Using this type of social learning activity encourages users to have open discussions from various perspectives.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
7. Do you intend to use email in your mLearning?	Email requires access to the Internet and requires users to be familiar with email on their mobile devices. Email is easy to use, fast, and practical to use for communication. However, email is also impersonal and can have security issues when content is sensitive.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
8. Do you intend to use social networking features in your mLearning?	Social networking apps require access to the Internet, and they also require users to be familiar with how they work. Some examples include Facebook, Twitter, and LinkedIn. Also, community calendars and CoPs provide networking functions. Users can share information, collaborate on research with similar-minded individuals, and interact with others.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
9. Will users be creating content?	Users are able to generate content to add to the mLearning solution via the features on their mobile devices. For example, users can take pictures, make videos or webcasts, create and post websites, share files, complete surveys, and even rate the content of an mLearning solution. The content from users can create a much richer, more meaningful learning experience because users take more responsibility for their learning and feel as though they are contributing in unique ways. However, it is also possible that some users may attempt to add inappropriate content. Thus, it would be a good idea to have someone monitoring the user-generated content for quality assurance.	**Yes:** Continue to next question. A score of 2 is attached to this response. Mobile platforms are especially useful in this context. **No:** Continue to next question. A score of 1 is attached to this response.
10. Will you be using/redesigning existing training content?	If there are existing social learning components designed for computer-based eLearning, questions eleven through thirteen in this table should be asked when considering using existing social learning components in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating social components from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.
11. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing social learning components are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Social components may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.
12. Does the existing component contain programmed interactions?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Social learning components developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing components in an mLearning solution, IDs need to examine existing social learning functions closely, and to redesign and reproduce them for mobile devices and mLearning behaviors. In addition to using the right technologies for producing the functions, IDs need to pay attention to UI and UX designs because mobile devices use different input methods and users use mobile devices differently than they use computers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.

Question	Explanation	Responses & Scoring
13. Is it reasonable to only use social learning components with online capabilities?	Social learning requires users to be online, but not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When redesigning social learning components for mLearning, IDs need to be aware that not all mobile devices are online everywhere, all the time.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.
Social Learning Components Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding social learning components to mLearning solutions and the appropriateness of social learning components for the mobile solution.	**Range of scores**: 11–15 **Acceptable range for including social learning components in mLearning**: 11–15 You may find that you need to do some additional research on social learning components before making a decision to include them in the mLearning solution. However, you may find that you have adequately considered aspects of social learning components and have a good understanding of what is involved. Higher scores suggest that you have addressed important considerations and it may be more appropriate to include social learning components in the mobile solution.

Specific Recommendations and Guidelines for Including mLearning Social Learning Components:

1. **Pros (Osborne, 2012):**
   a. Familiar tool with most students and appeals to wide range of learners
   b. Virtually limitless amounts of information available online for students to consult
   c. Can improve student's abilities to do online research
   d. Can improve student/instructor communication
   e. Students learn how to leverage social media in everyday life
   f. Digital citizenship: students learn about appropriate online presence and behavior
   g. Can engage students: especially Generation Y and younger
   h. Encourages user-generated content (which can make the body of knowledge much more comprehensive), and learning materials can be easily shared
   i. Encourages active participation instead of simply passively incorporating knowledge; shy students may become more involved when they interact virtually
   j. Supports collaborative activities
2. **Cons (Osborne, 2012):**
   a. Can become a waste of time if it doesn't relate directly to a learning objective (incorporating it because it is available, not because it enhances learning)
   b. Students may get distracted more easily
   c. There is a risk of cyber-bullying
   d. Face-to-face interaction is limited
   e. Tracking student contributions and learning with social media can be difficult
   f. Mobile platforms are constantly changing
   g. Potential for sharing of inappropriate content
   h. Need for Internet access for some social media
   i. Potential privacy violations can occur
3. **Considerations:**
   a. Appropriate to address skill or performance deficiency
   b. Users have to be familiar with the technology and social media interactions
   c. Constructivist approach: takes advantage of social learning theory

Table 14. Questions to consider for including e-books in mLearning.

Question	Explanation	Responses & Scoring
1. Will you include an e-book in your solution?	Creating an e-book requires specific considerations. These include (Koeller, 2012; JISC Digital Media, 2013): **Design considerations:** • Structure and layout • Navigation through pages (linear format vs. allowing multiple reader "journeys" through the content) • Graphic design requirements **Digital content considerations**: • Format (e.g., basic text, files that use ePub and Adobe PDF standards) • Interactivity, hyperlinking, inclusion of multimedia • Editorial requirements • Quality assurance and focus group testing **Development considerations:** • Level of technical expertise required • Degree of review • Conversion and production **Publishing and distribution considerations:** • E-book delivery: email, downloaded, part of an app, retrieved from a virtual library • Digital content preparation • Submission and content updates	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on mobile games (**Table 15**).

Question	Explanation	Responses & Scoring
2. Do you intend to create an e-book from existing materials?	It is relatively easy to translate from existing manuals/books, as long as it is mostly text based. Images may be taxing to the system if the book contains a lot of them. If you are creating a new book (from scratch) for this purpose, it could be a time-consuming process. One of the ways that e-book content differs from paper books is that e-books can include multimedia to enhance the user experience; it is important to note that the type, format, and sizing of the multimedia components depends on which format the e-book will be produce in, as well as what mobile platforms will be accessing it (JISC Digital Media, 2013). Consider that: • Cover images can be added • Illustrations, diagrams, and videos can be included to provide additional context for the user • Audio for "text to speech" can be a feature • Audio versions of the e-book can be created	**Yes:** Continue to next question. No score is attached to this response. **No:** Even if you are creating an e-book from scratch, the same factors should still be considered. Continue to next question. No score is attached to this response.
3. Do you intend to have the e-book be the primary mLearning component?	If the e-book is the primary component, make sure that it is not too long, which can be boring for users. Present information in well-formed and chunked chapters/sections. If the e-book is a supplement, make sure that it adequately supports the primary content.	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.
E-book Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of e-books that can impact how you choose to incorporate them into mLearning solutions.

Specific Recommendations and Guidelines for Including mLearning e-Books:

1. Take into account the design, digital content, development, and publishing/distribution considerations that are unique to e-books.
2. Although e-book format is dynamic and the content will adjust automatically to the screen size, IDs still need to pay attention to the page layout design so it will work well for both smartphones with screen sizes normally under five inches and tablets with screen sizes normally larger than seven inches. Tablets can handle various e-book layouts without major problem. For smartphones, people can read books with a linear plot that's easy to follow. Reading business-oriented content and other non-fiction requiring high levels of cognitive processing is more difficult on smaller screens (Nielson, 2012).
3. Carefully evaluate how you will be using multimedia as part of the e-book.
4. Take into account the distractions that will be present in mLearning environments that are not in eLearning or traditional learning environments (Udell, 2012).
5. Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible, (Udell, 2012).

Table 15. Questions to consider for including mobile games in mLearning.

Question	Explanation	Responses & Scoring
1. Do you intend to use games in your mLearning?	Games may be appropriate when users are not motivated, or for Generation Y individuals who play a lot of video games.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on augmented reality (**Table 16**).
2. Will you be designing general mLearning or PS?	PS may not be ideal for games because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to play a game). People want quick access to a PS tool (just enough information, just in time, just for "me"). They do not want (or have time to) play a game to get the information that they need.	**General mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS Tool:** Game is not suitable. A score of 0 is attached to this response. Go to next sequence of questions on augmented reality (**Table 16**).
3. What level of fidelity do you want to include in your mobile game?	May not need a high level of fidelity for students to learn effectively. Only use the necessary level of fidelity, as increased fidelity may cost additional time, resources. Furthermore, a high level of fidelity can take up valuable processing resources. It may force you to design the game to be significantly shorter and less complex in content. Some devices may not be able to fully support high-fidelity games.	**Low:** Continue to next question. A score of 2 is attached to this response. **Mid to High:** Games with higher fidelity are more challenging to incorporate into mobile solutions. Continue to next question. A score of 1 is attached to this response.
4. How interactive will your mobile game be?	Minimal interaction: This means you will be taking a more cognitive approach in that the student will be passively learning more than actively participating. Very interactive: Constructivist approach where users actively construct their own knowledge.	**Low:** Continue to next question. A score of 1 is attached to this response. **High:** Continue to next question. A score of 1 is attached to this response.
5. Do you intend to include quiz games?	Quiz games (periodic knowledge checks). Make sure to keep the quizzes short and to give immediate feedback on the answers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
6. Do you intend to include surveys in your game?	Make sure to keep the surveys short and to give immediate feedback on progress through the survey.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
7. Will you be using/redesigning existing training content?	If there are existing games designed for computer-based eLearning, questions eight through 13 in this table should be asked when considering using existing games in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating a game from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing games, IDs should evaluate the games to see whether they can be divided into smaller units or levels to reduce the amount of information conveyed. More redesign efforts should be given when game redesign and reproduction are needed in order to divide existing games into smaller units or levels. Game play should be modified and simplified to be suitable for mobile platforms. For example, the games designed for PC are traditionally played using a mouse and a keyboard. Mobile devices do not have these physical components, and so different types of interactions are required to play games on mobile platforms.	**Yes:** Continue to next question. A score of 8 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.
9. Is the existing game in HTML format already?	Most mobile devices today come with mobile browsers pre-installed or as a part of the mobile OSs. That makes the delivery of HTML-based games possible and easier on mobile devices. Special considerations should still be given to the following when using/redesigning existing games for an mLearning solution: • Do existing games require plug-ins? Many plug-ins made for computer OSs will not work on mobile devices or don't have a mobile equivalent. • Do existing games require a large display? With high processing power and graphics capabilities on today's computers, games display large amounts of detail. When this detail is displayed on a mobile device, it becomes hard to see. • Do existing games require changes in interface and control? Mobile devices largely use touchscreen input. Game interfaces and interactions design for mouse and keyboard on a computer may not function as well on a mobile device.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
10. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing games are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Games may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.
11. Can existing game's code be recompiled for mobile OSs without major recoding?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Games developed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing games in an mLearning solution, IDs need to examine existing games closely, and to redesign and reproduce them for mobile devices. Some game engines are capable of producing games on multiple platforms, including mobile, by simply recompiling the game. In addition to using the right technologies for producing games, IDs need to pay attention to UI, UX, and game content design because mobile devices use different input methods and a much smaller display.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.
12. Are existing games stand alone and included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing games are stand alone and included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The games are still available to a mobile user even when the device is not online. If these are online games, a constant data connection is required to deliver them to mobile devices.	**Yes, part of the learning content:** It is easier to package games into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, online:** Games may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.
13. Are IDs ready to change assessment methods?	Owing to the changes in interface, navigation and control, and display size, and details mentioned above, assessments (scoring) designed in the existing games for computers might not be accurate or correct once the games are redesigned and deployed in the mobile form. Assessments (scoring) need to be redesigned while redesigning games or to match the redesigned games.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.

Question	Explanation	Responses & Scoring
Mobile Games Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding games to mLearning solutions and the appropriateness of games for the mobile solution.	**Range of scores**: 0–25 **Acceptable range for including games in mLearning**: 18–25 Higher scores suggest that there is a greater likelihood that games can be more easily incorporated in your mobile solution Lower scores suggest that it will be more challenging to incorporate games, and there may be considerations that you need to re-assess.

Specific Recommendations and Guidelines for Including mLearning Mobile Games:

1. The mLearning solution should support spatial mobility and also temporal mobility (i.e., giving users an opportunity to stop and resume a session) (George & Serna, 2011).
2. **Pros (Fling, 2009):**
   a. Can engage learners and encourage motivation to complete training/task.
   b. Can offer faster feedback to trainees than if they were in classroom environment.
   c. They provide a simple and easy way to create an immersive experience.
   d. They can be ported to multiple devices relatively easily.
3. **Cons (Fling, 2009):**
   a. Can be time consuming and costly to plan and/or create as an original game title.
   b. It is possible only to build "bite-sized" training activities into the games, as mobile apps cannot currently support larger, more complex games.
   c. They cannot easily be ported to the mobile Web.

Table 16. Questions to consider for including augmented reality in mLearning.

Question	Explanation	Responses & Scoring
1. Are you planning on using some form of augmented reality (AR) in your mLearning solution?	**YES:** You must ALWAYS be connected to the Internet; technology is in early stages and does not have full capabilities yet; high cost of development; software design/development is complex and difficult; requires a lot of battery life, computational power, cameras, and tracking sensors (hardware); requires sophisticated AI (artificial intelligence) and 3D modeling applications (software); smartphones provide limited screen space for displaying AR; slow network speeds can be a problem; app developers lack easy authoring tools for creating mobile AR content. Users have to be comfortable and familiar with technology. An AR system must be able to recognize what users are looking at (ARTags, GPS, etc.), and acquire and overlay the appropriate virtual graphics. AR requires a high-end video-capable phone or smartphone/device as well as a fairly high amount of processing power.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on what type of app to use (**Table 17**).
2. Do you intend to include virtual overlays using GPS/location tracker?	While this can help students get real-time help and support, GPS may not work well indoors, which could cause misaligned visual representation of data.	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response. This is a consideration that is dependent on context of use.
3. Do you intend to use AR games?	AR games can be very time consuming and complex to create. Many factors need to be considered, including (Herbst et al., 2008): • Understanding how to keep user attention • Simplifying the interaction scheme • Understanding user safety during use • Understanding the environment of use • Understanding when and how to involve interaction with others • Creating a seamful design that accounts for technology related errors • Understanding how to use both real and virtual objects • Understanding how to maintain constant gameplay	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response.

Question	Explanation	Responses & Scoring
4. Do you intend to include virtual overlays with QR Codes?	QR Code is a 2D code and ISO (International Organization for Standardization) standard that can encode information (e.g., text, URLs and other data) (Yoon et al., 2011). Some of advantages of using QR Codes are: • Low computational complexity allows much faster decoding; data are self-contained, and encoded data capacity is high; suitable for mobile environments; robust and scalable; easily created and deployed • QR Codes are useful now for delivering information and wayfinding, but as computer vision improves, QR Codes will essentially become unnecessary (Udell, 2012).	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.
Augmented Reality Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of augmented reality that can impact how you choose to incorporate it into mLearning solutions. Context of use becomes very important here.

Specific Recommendations and Guidelines for Including mLearning Augmented Reality:

1. Guidelines for GPS Location Tracker (Cooper, 2011):
   a. Make sure to provide environmental context. Placing a dot on a screen to show location doesn't provide any information about distance or relative proximity to points of interest.
   b. Principle of layering and states: The user should be able to tell what content is most important and what content is not as important. You can establish a visual hierarchy for this purpose to emphasize important things.
2. Guidelines for AR Games: (Herbst et al., 2008)
   a. **Understand attention allocation:** Elements of AR will draw people's attention. Make sure to remain aware of how the content will impact a user's attention. You don't want the user to become completely unaware of reality or other game-based details.
   b. **Simplify interaction scheme:** Avoid designing overly complex UIs and interaction schemes. It is best to keep the number of mobile devices and interaction types low.
   c. **User safety:** Consider the context of use and the external environment (e.g., will a user be using the AR near busy traffic intersections?). User safety should be a priority.
   d. **Design appropriate paths through the environment:** Take advantage of any underlying environmental structure when determining where and when to place AR content.
   e. **Understand the locale:** IDs need to understand what happens in the real environment where the AR will be used. Are there certain things that could be incorporated into the AR? Are there other things that should be avoided?
   f. **Interaction with others:** Determine how and when the user should interact with other people who are not part of the AR.
   g. **Seamful design:** Take into account potential errors and technical problems when designing AR. If possible, try to incorporate those into the AR experience (e.g., limited GPS signal).
   h. **Use a combination of real and virtual objects:** Try not to limit yourself to using only virtual objects.
   i. **Provide a continuous experience:** Make sure to keep people interested and motivated to learn by maintaining a constant gameplay. Also avoid making the AR experience so time consuming that people will not want to complete it (e.g., requiring people to walk long distances).

Table 17. Questions to consider for determining what type of app to use.

Question	Explanation	Responses & Scoring
1. What is a Mobile Web App?	**WHAT IS IT?** A website that you access from your device's browser, but that is made to resemble an app rather than a traditional webpage. It can be accessed by any mobile device with a browser. HTML5, CSS3, and JavaScript are being used for this purpose.	Continue to Question 2
2. What is a Native App?	**WHAT IS IT?** A native mobile app is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices.	Continue to Question 3
3. What is a Hybrid App?	**WHAT IS IT?** It is built using web technologies, then wrapped in a platform-specific shell that allows it to be installed as a Native App. It is a native, downloadable app that runs all or some of its UI in an embedded browser component. Instead of rewriting app from scratch for each mobile OS, developers write at least some of their app code in HTML, CSS, and JavaScript and reuse it across devices (Jones, 2012).	Continue to Question 4
4. Do you need a mobile solution that has cross-platform compatibility?	Mobile platform independence is important when a lot of different mobile devices will be accessing the mLearning content. It directly ties to BYOD preferences: if the mobile solution is BYOD, then you will need an app that allows platform independence. Mobile Web Apps are easy to deploy across multiple devices (ADL, 2012). IDs must also consider the mobile platforms that collaborating or partnering organizations will be using. In particular, this should be considered when: • The mobile project is part of a **joint-project initiative**, where multiple agencies collaborate to jointly develop the solution which will then be used across agencies, or • The mobile project is developed by one agency with the intent that the mLearning solution will deploy across **multiple agencies**.	**Yes:** You must use either Hybrid Apps or mobile Web Apps. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +0 **No:** Any app may be appropriate. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1

Question	Explanation	Responses & Scoring

5. Does your solution require the use of internal features of the mobile device (e.g., camera, GPS)?	Only certain apps (hybrids and Native Apps) allow users to access internal features of the mobile device. However, a Hybrid App's performance is dependent on the device's browser capabilities.
	
	Web Apps do not have the same access to the device's hardware and OS features, and don't have full access to all the methods exposed by the device's OS compared to a Native App, meaning you are limited to the APIs made available by the browser (Jones, 2012).
		Yes: You must use either Hybrid Apps or Native Apps. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +1
		
		    Native App: +1
		
		No: Any app may be appropriate. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1

Question	Explanation	Responses & Scoring

6. What is your relative budget for developing and implementing the mobile solution?	Certain apps require more resources to develop. Your estimated budget will constrain what you can do.
	
	A native mobile application is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices. Deloitte estimates the cost of developing for two OSs is 160 percent of the cost of developing for one (ADL, 2012).
	
	Costly to develop. Industry analysts provide cost estimates that range from $20,000 to build a simple mobile app, to $150,000 or more for a complex app. These costs are largely replicated for each mobile OS the app must support (Sybase, Inc., 2012).
	
	Mobile Web Apps are low-cost solutions in comparison, especially when designing for more than one mobile device.
	
	Hybrid Applications can be built by web developers familiar with HTML, CSS, and JavaScript. Many companies already have web developers in house. It becomes a low-cost solution to create a team of in-house Hybrid App builders (Sybase, Inc., 2012).
	
	Note: Those IDs developing mobile for internal training may see different costs than those IDs developing mLearning for wide use.
		*Low budget: <$20k (mobile Web App is likely to fall into this budget). Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +0
		
		    Native App: +0
		
		*Medium budget: $20k-$150k (mobile Web App, Hybrid App, and possibly Native App). Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +0
		
		*High budget: >$150k (you can likely build any type of app with this budget). Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
		
		*These estimates are based on information obtained from Sybase (2012). These are recommendations. Actual budget required to develop is based on nature of project and learning outcome to be achieved.

Question	Explanation	Responses & Scoring

7. What level of design and programming expertise can your organization support?	Some apps require more complex programming. If these skills are not available in house, you will need to consider using external software engineers to program certain types of apps.
	
	Mobile Web Apps use basic HTML, CSS, and JavaScript, which are arguably easier to learn than native languages such as Objective-C or Java. "Using basic HTML via Adobe Dreamweaver to develop a mobile website is easier for the average user, as they do not need to understand advanced programming and can focus on design rather than programming" (Martin et al., 2012). Mobile Web Apps can be challenging (but not impossible) to support across multiple browsers (ADL, 2012).
	
	Hybrid Apps can also be somewhat complex to build: Mobile developers need to know HTML, and web developers need to know mobile phone APIs. People who build hybrids need to know both (Jones, 2012).
	
	Native Apps: More difficult programming. In general, developing a Native App from the ground up using native code for a mobile OS requires in-depth knowledge of that particular mobile platform, higher programming experience and skills, and longer development time.
	
	Building Native Apps requires specific development skills associated with the targeted mobile platforms. Developing a mobile solution that can be deployed to multiple mobile platforms not only requires in-depth knowledge of all targeted platforms, but also design considerations that will minimize the differences between mobile platforms so the solution will function similarly to achieve the same learning outcomes.
	
	Many companies cannot justify the cost of building large teams of these specialists in house, so they outsource this work to high-cost contractor resources (Sybase, Inc., 2012).
		Simple programming: A Web App can be created. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +0
		
		    Native App: +0
		
		Mid-level programming: A Web App, and maybe a Hybrid App in some cases. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +0
		
		High level, complex programming: Can support Web App, Hybrid App, and Native App. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1

Question	Explanation	Responses & Scoring

8. Are you on a quick timeline to develop and implement the mobile solution?	Native Apps take a longer time to develop and implement than Mobile Web Apps and Hybrid Apps, which is important to consider if you have strict time constraints for the project.
	
	A typical Native App takes three to six months to build (Gill, 2012). Because the codebase needs to be reworked for each OS, the time to build an app for multiple devices can also be extensive (Jones, 2012).
		Yes: Use Web App or Hybrid App. Continue to next question.
		
		Scoring:
		    Web App: +1
		    Hybrid App: +1
		    Native App: +0
		
		No: Native App can be an option, but it takes longer to build. Hybrid Apps and Web Apps are options too. Continue to next question.
		
		Scoring:
		    Web App: +1
		    Hybrid App: +1
		    Native App: +1

9. Will users need to access materials offline?	Connectivity: Mobile Web Apps have to be online in order to access information. IDs need to take the online requirement of a Web App into consideration when it is going to be deployed in a BYOD setting, since users may incur additional costs for using additional mobile data.
	
	If there is a chance that people need to access material offline, a Native App is probably "safer" to use, since all material can be accessed without an Internet connection. If people will definitely need access to content offline, you should probably use a Native App. However, a Hybrid App is also able to access some content offline.
		Yes: Native App is best option. Continue to next question.
		
		Scoring:
		    Web App: +0
		    Hybrid App: +0
		    Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		    Web App: +1
		    Hybrid App: +1
		    Native App: +1

Question	Explanation	Responses & Scoring
10. Does the app need to be particularly fast?	The speed of different types of apps varies. For a given set of features and functions, if you require a fast app, then a Native App may be ideal. If the speed of the app is not the primary concern (as long as it is an acceptable speed), then a Mobile Web App or a Hybrid App may be sufficient. Native Apps have better performance (at least for now), snappier animations and transitions, and faster load times. The performance difference between Native and Web Apps is far more pronounced on slower devices (e.g., iPhone 3G running iOS4) (Jones, 2012). This is due to different techniques and technologies used in developing the apps. A Web App uses web programming technologies, meaning that it uses interpreted code as opposed to compiled code used in Native Apps. Technically, interpreted code used for Web Apps will always be slower than compiled code used in Native Apps on the same mobile device (Jones, 2012). Additionally, a Native App's performance is dependent on the mobile device's local resources, such as processing power. For a given device, local resources remain constant. Therefore, the performance of a Native App remains relatively constant. As for a Web App or a Hybrid App, its performance is affected by the Internet connection speed. A slow Internet connection will reduce the performance for a Web App or a Hybrid App.	**Yes:** Native App offers faster performance. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +0 Native App: +1 **No:** Any type of app may be appropriate. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1
11. Does your mLearning solution require advanced graphics?	Native and Hybrid Apps deliver more advanced graphics than a Mobile Web App. For this reason, a Mobile Web App is not recommended for game development. If your goal is to create a mobile game, then you need to create a Native App. It can be ported to other devices fairly quickly (Fling, 2009).	**Yes:** Native and Hybrid Apps are preferable. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +1 Native App: +1 **No:** Any type of app will work. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1

Question	Explanation	Responses & Scoring

12. Does your mobile solution require push/pull features?	**Push**: New events, messages, or data are sent to the mobile device as they occur without the user of the device first requesting them.
	
	Pull: The user of the mobile device makes a request for data or events.
	
	The Push/Pull design should also take into account whether users are allowed to provide input, such as file upload.
	
	A Native App allows both push and pull.
	
	Pull benefits: Client and server are both simpler to engineer. It allows user to determine when the action occurs and when bandwidth is used (AT&T, 2007).
	
	Push benefits: The user is notified in near real time when an event occurs; can reduce bandwidth consumption if events are infrequent; significantly more complex to engineer (AT&T, 2007). Resist the temptation to put everything into push-mode because this can discourage people from learning how to search the content to find the answers they need and from being self-reliant (Griffin, 2011).
	
	In addition to the technical differences described above, IDs need to consider how the push and pull features will help serve and achieve desired learning outcomes. The pull feature is better for users to search and retrieve information when they are ready and need the information. Users have control of what to receive and when. The push feature may be better used for prompting users with feedback, such as texts, at spaced intervals, which may help reinforce learning over time, prevent skill decay, and lead to better transfer of knowledge.
		Yes: Native App or Hybrid App has this capability. Continue to next question.
		
		Scoring:
		
		   Web App: +0
		
		   Hybrid App: +1
		
		   Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		   Web App: +1
		
		   Hybrid App: +1
		
		   Native App: +1

Question	Explanation	Responses & Scoring

13. Is the solution for commercial release (for sale)?	A Native App and a mobile website solution use totally different distribution methods. This impacts how the solution is delivered and how much control the organization has on the distribution. A Native App type of solution is much easier for public, commercial distribution and accounting than a mobile website type of solution.
	
	A Native App and a Hybrid App are normally distributed from a third-party distribution service, such as Apple App Store or Google Play Store, so the organization does not need to manage and track the distribution. This is easier for commercial release.
	
	A Web App is like a website. Users use a URL to launch the app, making it harder to manage and track the distribution.
		Yes: A Native App is applicable here. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +1
		
		No: Any type of app would work. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1

14. Will the mobile device have constant Internet access while being used for mLearning?	A mLearning solution with the need of having constant data connectivity defines the target mobile devices, especially when allowing BYOD, and the availability of the solution. Today, a large portion of tablets purchased is Wi-Fi only. Those devices will only be able to use the solution when they are connected to a Wi-Fi network. Even with the Wi-Fi networks getting more and more accessible, they are still far less than "anywhere, anytime."	**Yes**: Any type of app would work. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
		
		No: Native Apps do not require constant Internet connectivity. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +1

Question	Explanation	Responses & Scoring
15. Does your client/organization have policies that govern both Web and App publications?	A Native App and a mobile website solution use totally different distribution methods. With the long history and good understanding of publishing content on websites, most organizations have policies, process/procedures, and dedicated resources managing website content. App publications and releases are still relatively new. Many organizations do not have policies and process/procedures in place to manage that. This may raise certain issues, such as security.	**Yes:** You should research the existing policies that your organization has so that you can create a mobile solution that aligns with these policies. Continue to next question. **Scoring:** Web App: +1 (if policy exists) Hybrid App: +1 (if policy exists) Native App: +1 (if policy exists) **No:** You should approach the leadership of your organization about creating policies to guide future mobile projects. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +0 Native App: +0
Recommendation for Type of App	The ID should have a better understanding of the factors involved in making decisions about what type of app would be most appropriate for his or her mobile solution. **Table 18** below can provide more guidance. A frequency count will be given for the number of times a Native App, Hybrid App, and Web App applied to a user's response to questions 4, 5, 7, 8, 9, 10, 11, 12, 13, and 14. For example, the user answers "no" and discovers that in that particular instance, a Hybrid App would be the best option. The frequency counts will be listed here so that users can see what type of app has the highest/lowest frequencies, which may suggest what type of app(s) the user may want to explore further for his or her mobile solution, and which type of app(s) the user may want to avoid (i.e., the one with the lowest frequency).	**Frequency count for response:** Mobile Web App: # Hybrid App: # Native App: # The type (or types) with the highest frequency count(s) may be best suited for your needs.

Table 18. Specific guidelines for choosing the appropriate type of app for mLearning.

	Mobile Web App	Native App	Hybrid App
Cross-platform compatibility/platform independence	✓	✗	✓
Can access the device's hardware and OS features (see **Table 19**)[6]	✓	✓	✓
Does not require connectivity to run the app[7]	✗	✓	✓
Has capability for advanced graphics performance[8]	✗	✓	✓
Programming is relatively easy[9]	✓	✗	✗
Can enable very high speed apps[10]	✗	✓	✗
Recommended for games	✗	✓	✗
Development cost is expensive[11]	✗	✓	✗
Quick to build and market (short project lifecycle)	✓	✗	✓
Can use videos	✓	✓	✓
Can use audios	✓	✓	✓
Can use graphics	✓	✓	✓
Can use animations	✓	✓	✓
Can use social learning components	✓	✓	✓
Recommended for augmented reality	✗	✓	✗

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[6] The ability to access device's hardware and OS features may be limited compared to a Native App or a Hybrid App because a Web App is essentially a webpage with additional functions implemented within the page.

[7] Both Native and Hybrid Apps are installed locally on the mobile device. Therefore, these apps can be executed locally without requiring an Internet connection.

[8] Both Native and Hybrid Apps are installed and executed locally on the mobile device. Therefore, these apps can access and take full advantage of the device's graphics capability for the best graphics performance.

[9] IDs should take the programming effort into account when designing an mLearning solution because it impacts the resources, such as technical expertise available, needed to develop the solution. Web programming in general is easier than programming native code.

[10] A Native App is built from the ground up with all native code for a mobile OS. Therefore, it offers the best performance.

[11] In general, developing a Native App from the ground up using native code for a mobile OS requires in-depth knowledge of that particular mobile platform, higher programming experience and skills, and longer development time. Therefore, a Native App normally cost more to develop.

Table 19. Examples of key features of mobile devices and their applications.

Features	Applications
GPS	GPS refers to a global positioning system and tracks the position on earth of the mobile device. This feature is appropriate to use when location and mapping are critical concepts within a given task. For instance, a scavenger hunt may help users learn important locations in a new city.
Accelerometer	An accelerometer is a feature that measures acceleration and movement of the mobile device. It is appropriate to use with games or simulations, where users can move their mobile devices in order to perform certain actions within a game.
Camera	A camera is very much a standard feature on mobile devices. It allows users to take pictures and record short movies. These can be used when you want to engage learners who are not collocated and when you want to include user-generated content (images, videos).
Text Messaging	Text messaging or SMS allow users to send short text-based messages to other users. This can be used when you want to engage learners who are not collocated, encourage interactions, and facilitate social learning.
QR Code	QR Codes are tagged artifacts in a learning space that display pertinent information when read and decoded by the user's camera on a mobile device. With this feature, the user is able to quickly access a website (without having to type in a URL) to receive additional details about a product, person, or concept, or even to automatically dial a phone number.

4.4.1 Sample Project 1—Recommendations for Mobile Learning Content Redesign

This project involved developing a mobile solution for annual employee *Information Awareness* training, which has been completed on a desktop up until this point. The ID must refer back to the *Information Awareness* requirements to determine how content should be delivered on the mobile device (see **Table 20**).

Table 20. The ID must refer back to the *Information Awareness* requirements to determine how content should be delivered on the mobile device.

Question	Response for Sample Project 1
VIDEO	
1. Do you plan to use video in the mLearning solution?	Yes.
2. Will you be designing mLearning or PS?	mLearning—this is annual training that is required, but not necessarily essential to refer back to during daily performance of tasks. **Score: 2**
3. Will the end users be provided with a device to use?	No. This is BYOD. **Score: 1**
4. Will you be using/redesigning existing training content?	Yes. We will be redesigning existing content for mobile purposes. **Score: 1**
5. Is the existing content easily "chunk-able"?	Yes. The content can be segmented appropriately. **Score: 6**
6. Are existing videos in proper format already?	Yes. The resolution and size of the MP4 videos are appropriate for mobile. **Score: 2**
7. Does the existing content contain Adobe Flash multimedia components?	Yes. It will need to be redesigned for mobile delivery. **Score: 1**
8. Are existing videos included as a part of the learning content?	Yes. Only short, low-resolution videos that can run even on slow networks will be used. **Score: 2**
Video Recommendation	**Score:** 15 **Acceptable range for including videos in mLearning**: 12–17
AUDIO	
1. Do you plan to use audio in the mLearning solution?	No.
GRAPHICS	
1. Do you intend to use icons/clip-art in your mLearning?	Yes. **Score: 1**

Question	Response for Sample Project 1
2. Are the icons familiar to the user and simple?	Yes. They will be navigational icons primarily. **Score: 2**
3. Do you intend to use photographs in your mLearning?	Yes. **Score: 1**
4. Are the photos lower resolution with no or minimal small details?	Yes. **Score: 2**
5. Do you intend to have background images in your mLearning?	No. **Score: 1**
6. Are your background images lower resolution with few small details?	N/A
7. Will you be using/redesigning existing training content?	Yes. The icons and the photos will be pulled from existing training materials. **Score: 1**
8. Is the existing content easily "chunk-able"?	Yes. The larger images can be easily broken down into smaller components. **Score: 5**
9. Are existing graphics in proper format already?	Yes. **Score: 2**
Graphics Recommendation	**Score:** 15 **Acceptable range for including graphics in mLearning**: 12–16
ANIMATION	
1. Do you intend to use animations of any kind in your mLearning?	No.
SOCIAL LEARNING COMPONENTS	
1. Are you aware of the existing social learning components that can be used as part of mLearning solutions?	Yes.
2. Do you plan to use any social learning components in your mLearning (e.g., having students create content, or having them communicate with their peers)?	No.
E-BOOKS	
1. Will you include an e-book in your solution?	No.
MOBILE GAMES	
1. Do you intend to use games in your mLearning?	No.
AUGMENTED REALITY	
1. Are you planning on using some form of AR in your mLearning solution?	No.

Question	Response for Sample Project 1
TYPE OF MOBILE APP	

4. Do you need a mobile solution that has cross-platform compatibility?	Yes. This will be a BYOD training solution.
	
	Score:
	
	  Web App: +1
	
	  Hybrid App: +1
	
	  Native App: +0

5. Does your solution require the use of internal features of the mobile device (e.g., camera, GPS)?	No.
	
	Score:
	
	  Web App: +1
	
	  Hybrid App: +1
	
	  Native App: +1

6. What is your relative budget for developing and implementing the mobile solution?	Relatively low budget at $15k. The ID estimates that this will be the budget to develop this particular sample project.
	
	Score:
	
	  Web App: +1
	
	  Hybrid App: +0
	
	  Native App: +0

7. What level of design and programming expertise can your organization support?	Low levels of design and programming expertise within the organization.
	
	Score:
	
	  Web App: +1
	
	  Hybrid App: +0
	
	  Native App: +0

8. Are you on a quick timeline to develop and implement the mobile solution?	Yes. This solution needs to be completed within the next six months.
	
	Score:
	
	  Web App: +1
	
	  Hybrid App: +1
	
	  Native App: +0

9. Will users need to access materials offline?	No. It would be nice if they could, but not required to perform their job.
	
	Score:
	
	  Web App: +1
	
	  Hybrid App: +1
	
	  Native App: +1

Question	Response for Sample Project 1
10. Does the app need to be particularly fast?	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
11. Does your mLearning solution require advanced graphics?	No, but it should be able to play short videos and display lower-resolution images. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
12. Does your mobile solution require push/pull features?	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
13. Is the solution for commercial release (for sale)?	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
14. Will the mobile device have constant Internet access while being used for mLearning?	No. **Score:** Web App: +0 Hybrid App: +0 Native App: +1
15. Does your client/organization have policies that govern both Web and App publications?	No. **Score:** Web App: +0 Hybrid App: +0 Native App: +0

Question	Response for Sample Project 1
Recommendation for Type of App	**Score:** 　Web App: +10 　Hybrid App: +8 　Native App: +7 Based on the responses here, a mobile Web App may be most appropriate for this mobile solution.

4.4.2 Sample Project 2—Recommendations for Mobile Performance Support

In this project, the ID is responsible for building a mobile solution to assist boarding officers in their jobs. The ID must refer back to the *Boarding Officer Support* requirements to determine how content should be delivered on the mobile device (see **Table 21**).

Table 21. The ID must refer back to the *Boarding Officer Support* requirements to determine how content should be delivered on the mobile device.

Question	Response for Sample Project 2
VIDEO	
1. Do you plan to use video in the mLearning solution?	No.
AUDIO	
2. Do you plan to use audio in the mLearning solution?	No.
GRAPHICS	
1. Do you intend to use icons/clip art in your mLearning?	Yes. **Score: 1**
2. Are the icons familiar to the user and simple?	Yes. They will be navigational icons primarily. **Score: 2**
3. Do you intend to use photographs in your mLearning?	Yes. **Score: 1**
4. Are the photos lower resolution with no or minimal small details?	Yes. **Score: 2**
5. Do you intend to have background images in your mLearning?	No. **Score: 1**
6. Are your background images lower resolution with few small details?	N/A
7. Will you be using/redesigning existing training content?	Yes. The icons and the photos will be pulled from existing training materials. **Score: 1**
8. Is the existing content easily "chunk-able"?	Yes. The larger images can be easily broken down into smaller components. **Score: 5**
9. Are existing graphics in proper format already?	Yes. **Score: 2**
Graphics Recommendation	**Score:** 15 **Acceptable range for including graphics in mLearning**: 12–16
ANIMATION	
1. Do you intend to use animations of any kind in your mLearning?	No.

Question	Response for Sample Project 2
SOCIAL LEARNING COMPONENTS	
1. Are you aware of the existing social learning components that can be used as part of mLearning solutions?	Yes.
2. Do you plan to use any social learning components in your mLearning (e.g., having students create content, or having them communicate with their peers)?	No.
E-BOOKS	
1. Will you include an e-book in your solution?	No.
MOBILE GAMES	
1. Do you intend to use games in your mLearning?	No.
AUGMENTED REALITY	
1. Are you planning on using some form of AR in your mLearning solution?	No.
TYPE OF MOBILE APP	
4. Do you need a mobile solution that has cross-platform compatibility?	No. End users will be supplied with the same type of device. The information designed into this tool is so specific to boarding officers that it will only remain available to that group of users. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
5. Does your solution require the use of internal features of the mobile device (e.g., camera, GPS)?	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
6. What is your relative budget for developing and implementing the mobile solution?	Relatively large budget at $150k. The ID estimates that this will be the budget to develop this particular sample project. **Score:** Web App: +1 Hybrid App: +1 Native App: +1

Question	Response for Sample Project 2
7. What level of design and programming expertise can your organization support?	High levels of design and programming expertise within the organization. **Score:** 　Web App: +1 　Hybrid App: +1 　Native App: +1
8. Are you on a quick timeline to develop and implement the mobile solution?	Yes. This solution needs to be completed within the next three months. **Score:** 　Web App: +1 　Hybrid App: +1 　Native App: +0
9. Will users need to access materials offline?	Yes. Users will be in the field when they use the mobile solution. **Score:** 　Web App: +0 　Hybrid App: +0 　Native App: +1
10. Does the app need to be particularly fast?	Yes. **Score:** 　Web App: +0 　Hybrid App: +0 　Native App: +1
11. Does your mLearning solution require advanced graphics?	No. **Score:** 　Web App: +1 　Hybrid App: +1 　Native App: +1
12. Does your mobile solution require push/pull features?	Yes. This will be needed when updates are made to the protocol. **Score:** 　Web App: +0 　Hybrid App: +1 　Native App: +1

Question	Response for Sample Project 2
13. Is the solution for commercial release (for sale)?	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
14. Will the mobile device have constant Internet access while being used for mLearning?	No. **Score:** Web App: +0 Hybrid App: +0 Native App: +1
15. Does your client/organization have policies that govern both Web and App publications?	No. **Score:** Web App: +0 Hybrid App: +0 Native App: +0
Recommendation for Type of App	**Score:** Web App: +7 Hybrid App: +8 Native App: +10 Based on the responses here, a Native App may be most appropriate for this mobile solution.

5.0 Application of Decision Paths to Sample Projects

This section walks through the complete MLDP for each of the two sample projects. The requirements for each of the projects will be presented first. Next, **Figure 14** and **Figure 15,** along with **Table 22** through **Table 43,** will walk you through the choices that the IDs make, relative to each project.

5.1 *Sample Project 1—Information Awareness Training*

INFORMATION AWARENESS REQUIREMENTS:

General Requirements

- Mobile solution based on previously existing course (includes videos and photos).
- **Training delivered through different devices (e.g., different OS, screen sizes, resolutions, capabilities); employees will complete mobile training on their own personal devices (BYOD).**

Project Goals

- Employee compliance with training.
- Take the information conveyed in the eLearning course content, work from scratch to build an appropriate mobile solution—end users must learn the same information.
- To develop technical skills and knowledge about information security and protection of personal and intellectual property.
- To identify possible knowledge gaps.
- To reinforce content from previous training.
- To track completion of the course across employees.

Connectivity Considerations

- Updates to training content will happen rarely, but this means that access to Internet connectivity in the workplace is needed on occasion.

End Users

- A fairly homogenous audience in terms of mobile habits and expectations.
- Employees are not motivated.

Figure 14. Requirements for Information Awareness Training.

Table 22. Sample Project 1: Should you pursue a mobile solution?

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Does your learning address Moment of Need 1: Learning something for the first time?	Mobile may be appropriate here as part of a **blended program**. The focus here is on new material. The user is being introduced and will be expected to do something as a result of the new knowledge. Mobile may play a part in that solution. For instance, perhaps the primary training is done via traditional classroom instruction. A mobile solution can complement this training by explaining why this material matters. Or it might introduce how they will be expected to use what they learn. For example, concepts can be first introduced in short mobile tutorials, and then discussed and applied in the classroom environment. Here, the lecture is on the mobile device, whereas interaction and application of knowledge are done in the live classroom.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. Some new employees will be learning this information for the first time. **Score: 1**
2. Does your learning address Moment of Need 2: Wanting to learn more?	Mobile can be suitable here, especially as a part of a **blended program**. A mobile solution here can augment instruction that already exists by providing users with the option to learn more. For example, a student may learn about a concept in the classroom, but owing to time constraints and curriculum, the instructor may not be able to teach extensively about the applications of that concept in the real world. A mobile tool that includes animations, case studies, and additional resources allows students to drill down into the details of the concept on their own time, when they are interested in learning more about how it applies to real-world environments.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. **Score: 1**
3. Does your learning address Moment of Need 3: Trying to remember?	Mobile is great here in the form of PS and learning aids, where just-in-time access to information and content is a capability (Kadle, 2010); for example, content retention should be reinforced or a job aid needs to be accessed for details that are not in memory. This information will likely be brief and serve as a memory jog. Mobile is being used more frequently as a standalone, just-in-time job aid, where individuals may or may not have previous exposure to the task at hand. Mobile can also be used here as part of a blended program. For instance, for a face-to-face course, the mobile solution can provide opportunities for drill and practice, for review, to check a policy, and to encourage students to be part of community, to link with others tackling similar concerns.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. Some employees who have been with the company for longer than one year may have already received annual training. Consequently, this will be more like refresher training for them. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
4. Does your learning address Moment of Need 4: When things change?	Mobile devices allow people to learn continuously and support tasks that may be constantly changing or evolving. People can carry these devices with them at all times and turn them on instantly, regardless of where they are and when they need the information to help them perform (Kadle, 2010). This is a great way to make sure that contemporary views, ideas, events, and resources are there when needed.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. **Score: 1**
5. Does your learning address Moment of Need 5: When something goes wrong?	Here, just enough information is presented to help end users troubleshoot and move past a barrier to performance, enabling them to do something they otherwise could not. The users may also be experiencing time pressures and stress (Kadle, 2010), so it is critical to give them access to the right information at the right time.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. **Score: 1**
6. Will the end users have to know the information and content by heart?	If end users must know information by heart and apply this information, then a lot of practice will be required to learn and maintain that level of knowledge over time. Here, a mobile PS solution can be extremely helpful because it can aid end users in remembering information while they are performing or applying their knowledge in the field. In this way, mobile enhances performance on tasks and can help users sustain their training over longer periods between practice sessions. Even if end users do not have to remember information by heart, mobile is still a very viable solution as a PS tool. An important consideration for PS tools is the intention of the tool: (1) is the intent to help people remember information, or (2) is the intent to help people perform? If the tool was designed to help people remember information, the assumption is that users will gradually learn to the point which they no longer need the tool for assistance. Conversely, if the intent is to help people perform, those users will always have access to the tool without the need to ever commit anything to memory.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. They should have a good understanding of the material so that they can keep it in mind as they do their jobs. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
7. Does training need to occur anytime/anywhere? Will it require more ready access by users?	A mobile solution is the preferred solution when training needs to occur anytime and anywhere, as the learning should not be constrained to the workplace or classroom environment. For example, during his daily bus commute, a user may watch some podcasts to learn more about a new procedure at work. The user is not constrained by his environment and is able to learn when it is most convenient for him. Mobile access allows more ready learning to occur, in the moment of need (i.e., anytime the user requires it). For example, if an end user is completing a task with an automated system and experiences a system failure, a mobile tool could be utilized right then and there to guide the user through the steps necessary to mitigate the consequences of that failure. However, it is important to note that sometimes connectivity will be required to access certain content that does not reside on the mobile device itself. If training needs to occur at predetermined times and locations, it is likely that eLearning, CBT, face-to-face instruction, or another classroom-based method will be most appropriate. These instructional methods typically require students to learn during set times in specific locations. A mobile solution can certainly complement these approaches, with a blended approach.	**Yes:** While mobile could be used in a more constrained environment, it is very beneficial for situations where it can be used anytime and anywhere. Continue to next question. A score of 4 is attached to this response. **No:** Mobile may still be a viable option although it may not be completely necessary. Continue to next question. A score of 1 is attached to this response.	Yes. Based on the requirements, training should be anytime, anywhere, which means a mobile solution would be appropriate. End users should be able to access it when there is time available to conduct the training. However, the organization requires compliance, which means training should be completed on a yearly basis. **Score: 4**
8. Will users be required or encouraged to contribute to the content of the learning?	Mobile can easily include user-generated content via the features of the mobile device, such as camera and global positioning system (GPS). For example, students enrolled in an art history class with both a lecture and a mobile component may be asked to take photographs in various cultural locations, such as museums, tag them with the geo-location, annotate them, and share them digitally with fellow users. The instructor can then highlight some of the user-generated content in the lecture portion of the course.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
9. Can the information be componentized and delivered as "nuggets" of information linked to tasks, questions, and conditions?	A mobile solution is appropriate when you can create bite-sized chunks of information, which is especially critical when using devices with very small screens (Stayton, 2011). Content from eLearning cannot simply be repurposed for a mobile device. The information and amount of information that will be presented to the end user will need to be condensed to make it more manageable for a mobile device format. For example, including a 10-page biomechanics paper may not be suitable for a mobile device because of its length and the complexity of information covered. However, the essay can be broken down into several key points and animations (if necessary); it still conveys the critical concepts found in the original paper but is more appropriate for an mLearning solution.	**Yes:** Continue to next question. A score of 9 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	Yes. The information that needs to be delivered via training can be chunked into small, short, easily managed bits of information, and linked to key issues, tasks, and questions, which is appropriate for a mobile solution. **Score: 9**
10. Will your mobile solution require only **small** data transfers to move data/content to mobile platforms (via the Internet)?	Additional considerations about the types of devices and whether the mLearning solution will be BYOD will need to be addressed when the mLearning solution requires constant Internet connectivity, especially with large data transfers (e.g., high-volume video streaming, high-resolution graphics and images, and gaming). Many of the tablets purchased today are Wi-Fi only. For these devices, the mLearning solution is only accessible when there is a Wi-Fi connection. Although Wi-Fi is available in many places, such as homes, offices, hotels, airports, and coffee shops, the quality of connection and speed vary. Therefore, the mLearning solution may not function well in some situations. Smartphones and cellular-enabled tablets have lesser limitations on Internet connectivity. But with BYOD, users may incur additional costs for cellular data usage. Additionally, cellular data connection speed is generally slower than Wi-Fi, and that may impact the user experience of the mLearning solution. When Internet connection is not critical or the amount of data transferred is relatively small (i.e., you do not want users to spend hours downloading mobile content), mobile platforms offer a very reasonable option for delivering content. However, other alternatives, such as eLearning, web-based training (WBT), and instructor-led training (ILT) may also be considered.	**Yes:** Only small data transfers are necessary, or the Internet is not needed for this purpose. Continue to next question. A score of 9 is attached to this response. **No:** Large data transfers are necessary. Continue to next question. A score of 0 is attached to this response.	Wireless Internet access is not necessary all the time and the amount of data transferred is relatively small (i.e., just for updates to the content on occasion). A mobile solution can meet that need. **Score: 9**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
11. Will the learning experience benefit from features that are unique to mobile devices?	A mobile solution has advantages over other forms of training because of features unique to the mobile device, such as GPS, camera, QR Codes, accelerometers, and text messaging. An mLearning solution can incorporate touch-, motion-, and visual/sensory-based interactions at the time and location that is best for learning to occur. Not all mobile devices have the same features, sensors, and capabilities. Mobile may still be suitable, even when these features are not critical to learning. It is important for IDs to first analyze requirements and then conduct research to determine what features would be best for the given project. This involves looking at use cases, real-world examples, and current mobile literature (see **Section 8.0** for helpful resources). The level of effort needed to use these features should also be examined. **Examples of appropriate use of mobile device features include:** • **GPS** refers to a global positioning system and tracks the position on earth of the mobile device. This feature is appropriate to use when location and mapping are critical concepts within a given task. For instance, a scavenger hunt may help users learn important locations in a new city. • **Accelerometers** are features that measure acceleration and movement of the mobile device. These are appropriate to use with games or simulations, where users can move their mobile devices in order to perform certain actions within a game. • **Text messaging** or SMS allow users to send short text-based messages to other users. This can be used when you want to engage learners who are not collocated, encourage interactions, and facilitate social learning. • Many mobile devices have built-in **cameras** that allow users to take pictures and record short movies. These can be used when you want to engage learners who are not collocated and when you want include user-generated content (images, videos). • **QR Codes** are tagged artifacts in a learning space that display pertinent information when read and decoded by the user's camera. With this feature, the user is able to quickly access a website (without having to type in a URL) to receive additional details about a product, person, or concept, or even to automatically dial a phone number.	**Yes:** This is a situation where mobile may offer exceptional benefits because of its unique features. Continue to **recommendation**. A score of 2 is attached to this response. **No:** Mobile may still be a viable option, even though unique features are not necessarily needed. Continue to **recommendation**. A score of 1 is attached to this response.	No. This particular learning circumstance does not require specific features, but this does not mean that mobile is inappropriate. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
Recommendation	After all questions are answered, scores are tallied. The overall recommendation of whether to pursue a mobile solution is based on the range that the total score falls into.	**Range of scores**: 9–35 **Acceptable range for mobile**: 27–35 A higher score reflects a greater probability that a mobile solution would work well and be appropriate for the given situation. A low score suggests that you may want to explore other solutions.	**Total Score: 31** **Acceptable range for mobile: 27–35** Based on the answers to these questions, a mobile solution is **suitable** to deliver *Information Awareness* training here. Having made this determination, the ID should now assess what type of mLearning he or she will be creating.

Table 23. Sample Project 1: Is mLearning sufficient? Is performance support sufficient? Do we require a combination?

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Will target users be learning the information for the first time (including changes to previous procedures/things they have learned)?	When designing mLearning content to deliver new knowledge, IDs should consider providing all related materials, including background information, without assuming that users can already perform or are performing the task at a certain level. The goal and outcome are to deliver the knowledge.	**Yes**: This suggests that an mLearning solution would be sufficient. Skip to question 5. **No**: Go to next question.	No. Some will, others will be using this mobile solution as a refresher.
2. Will target users need help recalling or remembering information they have previously learned?	When on the job or performing a task, not all users, even the experienced ones, can recall or remember all the details learned during training. When designing an mLearning solution to help users perform a task better, IDs should consider the best way to effectively and seamlessly provide just-in-time and targeted information without bogging down users with unnecessary information. The goal and outcome are to assist users in performing the task at hand, not to retrain the entire process.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.	No. They should know it by heart and have a good understanding of the content after the training.
3. Will target users need quick access to it to perform everyday tasks or at the time of need?	A tool is an instrument used to perform a certain task or to help a user do a better job. An mLearning PS solution is a tool to help users perform a one-time task or an everyday job better, easier, or faster. A PS tool should be easy to access, available when and where it is needed, and work and be helpful every time.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.	No. The training is primarily for awareness purposes and will not necessarily need to be re-referenced every day.
4. Will the target users require this solution when they encounter an error or a failure during performance?	When users make mistakes or fail a task after they have applied all the knowledge they have learned, they need assistance to identify the causes and to correct them. An mLearning PS solution can provide just-in-time information to refresh users on relevant information, reinforce procedures, provide alternatives, and suggest possible solutions to improve user performance.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Continue to next question.	No. Perhaps, but not likely.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
5. Does content material already exist in another format (e.g., WBT manuals, paper-based training)?	As a part of the analysis process for an mLearning solution, IDs should gather all the existing relevant information and content. If relevant materials exist, IDs should evaluate the materials to ensure they are current, correct, and complete. Designing a mobile solution based on existing materials can save time and resources over designing a solution from scratch, which may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: Continue to next question. **No**: This suggests that you will need to start designing content from scratch to include in the mobile solution.	Yes. There is already desktop training that exists, and this material is what the mobile solution will be based on.
6. Is the existing content material high quality?	The quality of content will definitely impact the quality of a learning solution, including an mLearning solution. When analyzing existing content for its quality, IDs should pay special attention to determine whether it is suitable for use in designing an mLearning solution. The existing content may have to be redesigned (i.e., reducing the amount of information conveyed, as well as formatting) and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to next question. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to improve the quality of the content in the process. Continue to next question.	Yes. It is what the mobile solution content will be based on.
7. Is the existing content material up to date?	The existing content may have been created some time ago and may be outdated. When designing an mLearning solution, IDs should examine the existing content to make sure that it is up to date and accurate. Creating a learning solution with out-of-date information cannot achieve the desired learning outcomes. If the existing content is out of date, IDs will need to update the content, and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to **Recommendation**. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to make sure to update the content in the process. Continue to **Recommendation**.	Yes. There are no significant updates.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
Recommendation	Based on responses to the questions here, an ID can receive guidance on whether PS is appropriate, and considerations to think about when an mLearning solution will require content redesign.	**You should create a PS tool if:** You answered "yes" to questions 2, 3, or 4. **You have taken into account necessary considerations for mobile content redesign if:** You answered "yes" to questions 6 and 7. You already have high-quality content that is ready to be redesigned for your mobile solution. **You should do further analysis if:** You answered "no" to questions 5, 6, or 7. You should do further analysis because it seems that you may need to either create new material or heavily update the quality and information in material before starting the mLearning project.	**You have taken into account necessary considerations for mobile content redesign:** You answered "yes" to questions 6 and 7. You already have high quality content that is ready to be redesigned for your mobile solution. **Note:** Simply shrinking existing eLearning screens to fit mobile devices is not a good idea (e.g., it will make it difficult to read content and/or navigate). The existing content should be split into smaller but meaningful pieces that can also fit within the constraints of the mobile device (e.g., small screen size). This means that the amount of information to be conveyed should be reduced.

Table 24. Sample Project 1: Questions to consider for including video in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

9. Do you plan to use video in the mLearning solution?	Video is a familiar format. Using videos in a mobile solution may require some special considerations. Those include:
	• Size of the videos. The size of the videos impacts an mLearning solution in two ways:
	   o The amount of memory taken by videos on a mobile device
	   o The connection throughput and data usage
	• Mobile device screen size. Mobile devices, especially smartphones, have limited screen size. Videos showing small details may be difficult for learners to see clearly.
	• Videos will also not be appropriate in all learning environments (e.g., environments prone to distractions).
	
	Will video be the best way to show the information? Video may be appropriate when:
	• Users are not motivated
	• The content is nuanced, emerging
	• Details of motion sequences (e.g., machinery in operation) need to be shown, which still images cannot properly convey
	• The material is complex, even controversial
	• The organization needs compliance
	
	Videos are **not** appropriate and a waste of resources when:
	• The video is just a "talking head," which does not add value to the solution (unless it is for inspiration, coming from a highly respected authority figure; P. Berking, personal communication, April 19, 2013).
		Yes: Continue to next question.
		
		No: Stop here. Go to next sequence of questions on audio (**Table 25**).
			Yes.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
10. Will you be designing mLearning or PS?	Some PS may not be ideal for videos because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch a video).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the environment will allow users to view videos effectively. Proceed to next question. A score of 1 is attached to this response.	mLearning—this is annual training that is required, but not necessarily essential to refer back to during daily performance of tasks. **Score: 2**
11. Will the end users be provided with a device to use?	If people will be using their own devices (BYOD), there will be a lot of variety in devices. Although most mobile devices today have video playback capabilities, ensuring the video format used in the mLearning solution works on all mobile devices requires a huge amount of work. Consequently, video formats may not work well for all users.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. This is BYOD. **Score: 1**
12. Will you be using/redesigning existing training content?	If there are existing video clips designed for computer-based eLearning, questions five through eight in this table should be asked when considering using existing videos in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are designing videos from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	Yes. We will be redesigning existing content for mobile purposes. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
13. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing video content, IDs should evaluate the videos to see whether they can be divided into smaller units. More redesign efforts should be given when video reproduction is needed in order to divide existing videos into smaller and shorter clips. Mobile learners expect short, focused answers to problems. If videos are used, five-to-ten-minute clips should be more than sufficient to convey the content and pose fewer bandwidth issues. Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible (Udell, 2012).	**Yes:** Continue to next question. A score of 6 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	Yes. The content can be segmented appropriately. **Score: 6**
14. Are existing videos in proper format already?	Videos for computer-based eLearning content may have been produced with high resolutions and high-quality audio without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, videos should have a resolution and audio quality that is proper for the content and mobile devices. IDs should consider lowering the video and audio quality (within the limits of the design requirements) to reduce the size. Videos should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP4. When including videos in a Web App, another suggestion is to include video in two formats: MP4 (which Android users will be able to view), and Quicktime (which iPhone/iPad can recognize and play) (see Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. The resolution and size of the MP4 videos are appropriate for mobile. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
15. Does the existing content contain Adobe Flash multimedia components?	The current situation is that many mobile devices do not support Adobe Flash content. Adobe announced that it would not no longer develop or support on any mobile platform. If the existing videos are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Videos may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	Yes. It will need to be redesigned for mobile delivery. **Score: 1**
16. Are existing videos included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing videos are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If videos are streamed, a constant data connection is required to deliver these videos to mobile devices. Users are more likely to abort mobile apps if they take more than five seconds to load. For heavy content like video, the mobile device could either allow users an option to download and view the content later, or reduce the resolution of the video for faster download (Training Partners, ND).	**Yes, part of the learning content:** It is easier to package videos into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, streamed in real time:** Videos may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.	Yes. Only short, low-resolution videos that can run even on slow networks will be used. **Score: 2**
Video Recommendation	The aggregated scores will tell the ID how challenging it may be to include video in the mLearning solution, based on the responses to the questions.	**Range of scores**: 6–17 **Acceptable range for including videos in mLearning**: 12–17 Lower scores suggest that it may be challenging (and possibly inappropriate) to incorporate video in your mLearning solution.	**Score**: 15

Table 25. Sample Project 1: Questions to consider for including audio in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Do you plan to use audio in the mLearning solution?	There are several considerations for including audio in the mLearning solution. The contextual learning environment and the end users must be taken into account to determine whether audio is an appropriate feature to use. Audio may be appropriate when: • The user will be multi-tasking (i.e., "travel time" learning, where modules can be taken while riding the metro bus or multi-tasking) • Users are not motivated • The content is nuanced, emerging • The material is complex, even controversial • The organization needs compliance	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on graphics (**Table 26**).	No.
2. Will you be designing mLearning or PS?	Some PS may not be ideal for audio because of the nature of the learning environment (e.g., a Soldier consulting PS tool in the field may not be able to hear audio).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the user environment will allow users to hear audio effectively. If so, then proceed to next question. A score of 1 is attached to this response.	N/A
3. Will users be using mLearning in environments that are free from a lot of distractions or external noise?	Make sure that if users cannot hear the sound (technology issues, or external noise in the environment), it will not severely impact their training of the task.	**Yes:** Continue to next question. A score of 3 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
4. Do you have a small set of sound effects associated with actions in the mLearning solution (e.g., button clicks, buzzers)?	It is important not to have too many competing sound effects (i.e., between the environment and the mLearning). This can be distracting and obnoxious. Select a few of the most important actions that will have sound effects associated with them for good feedback.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
5. Do you intend to use music in your mLearning solution?	Adding music to your mLearning has the potential to be distracting, and can also cause some processing issues depending on the mobile device being used and the necessary connectivity. IDs should carefully consider the effects of music when designing the solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
6. Have you taken precautions to make sure that music will not be played on a loop?	Be cautious about adding continuous or looping background music in your mLearning content. This may be distracting to the learning process. It also increases the processing requirements for the mobile device, especially if the music is streaming. It may be more effective to present intermittent music in conjunction with your other mLearning content.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
7. Do you intend to incorporate verbal feedback in your mLearning?	Verbal feedback may not be appropriate in environments that are very distracting. If you want to use verbal feedback, make sure that it is short and simple.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
8. Will the verbal feedback be short and brief?	Utilizing verbal feedback can be effective, as long as it is chunked appropriately. Extended verbal feedback is not advised.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
9. Will you be using/redesigning existing training content?	If there are existing audio clips designed for computer-based eLearning, questions ten through thirteen in this table should be asked when considering using existing audios in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating audio from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
10. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially in an environment where audio content is not well received. Therefore, it is recommended to design learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing audio content, IDs should evaluate the audio to see whether they can divide it into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when audio reproduction is needed in order to divide existing audio into smaller and shorter clips.	**Yes:** Continue to next question. A score of 10 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
11. Are existing audio files in proper format already?	Audio files for computer-based eLearning content may have produced with high-quality stereo audio without compression. Although they play very well on a computer, they may have large file sizes, need more processing power for playback, and/or be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, audio should have a quality that is proper for the content and mobile devices. IDs should consider (within the limits of the design requirements) lowering the audio quality and removing stereo sound (many smartphones do not have stereo speakers) to reduce the size. Audio should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP3, and it should be tested to make sure the files will actually work on the target mobile device(s) (Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
12. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing audio is contained in a multimedia Flash object, IDs have to redesign it for mobile delivery.	**Yes:** Audio may still be used, but it will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
13. Is the existing audio included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing audios are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The audio is still available to a mobile user even when the device is not online. If audio is streamed, a constant data connection is required to deliver it to mobile devices.	**Yes, part of the learning content:** It is easier to package audio into a mobile solution when it is part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Audio may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
Audio Recommendation	The aggregated scores will tell the ID whether audio is appropriate for the mobile solution, based on the responses to the questions.	**Range of scores**: 10–29 **Acceptable range for including audio in mLearning**: 20–29 Higher scores suggest that audio may be appropriate for the mobile solution. Lower scores suggest that including audio may be challenging and/or inappropriate. Regardless of score, you should also consider the context of use, such as where/when users will be accessing the mobile solution.	N/A

Table 26. Sample Project 1: Questions to consider for including graphics in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Do you intend to use icons/clip-art in your mLearning?	IDs might choose to use icons from existing materials, websites, existing CBT, and other applications (e.g., Microsoft Word®). However, the IDs need to take into account how well these icons will translate to smaller mobile devices.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 3. A score of 1 is attached to this response.	Yes. **Score: 1**
2. Are the icons familiar to the user and simple?	Icons should be familiar and should not be complex. They should be simple enough to translate onto small mobile devices while identifiable. For example, you don't want to use an intricate icon that is only fully visible on a 15-inch laptop monitor. Also, be aware that different mobile devices may display colors differently. However, icons should not save space at the expense of user understanding.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. They will be navigational icons primarily. **Score: 2**
3. Do you intend to use photographs in your mLearning?	IDs need to take into account how well photographs will translate to smaller mobile devices, which may limit how well a user is able to see details, complexities, etc.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 5. A score of 1 is attached to this response.	Yes. **Score: 1**
4. Are the photos lower resolution with no or minimal small details?	If you intend to use high-resolution photographs, keep in mind several things: (1) the screen sizes of the devices that may potentially be accessing the mLearning content; (2) the added processor requirements necessary to store and utilize photos that are large in data size. Details in photos that can be detected on a laptop screen may be hard to see on smaller mobile devices. Make sure no critical content is contained within images that could be hard to see on smaller devices. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution photo: (1) is there value in including high-resolution photos, and (2) what is the target platform for delivery? Only include high-resolution photos when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in photos.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
5. Do you intend to have background images in your mLearning?	IDs need to take into account how well backgrounds will translate to smaller mobile devices. Use of backgrounds may not be preferable if it proves to be a distraction. Make sure that background art is not distracting from the main mLearning content. On smaller mobile devices, it may not be necessary to use background art, as the screen size is a very limiting factor when presenting the critical instructional content of the mLearning.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 7. A score of 1 is attached to this response.	No. **Score: 1**
6. Is your background image lower resolution with few small details?	When working with a small screen, large CSS (Cascading Style Sheet) background images or infographics can be problematic. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution background: (1) is there value in including high-resolution backgrounds, and (2) what is the target platform for delivery? Only include high-resolution backgrounds when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in images.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
7. Will you be using/redesigning existing training content?	If there are existing graphics designed for computer-based eLearning, questions eight and nine in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating graphics from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	Yes. The icons and the photos will be pulled from existing training materials. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing graphics, IDs should evaluate the graphics to see whether they can be divided into smaller units. Simply reducing the size of a graphic may make it hard to read. More redesign efforts should be given when graphics re-creation is needed in order to divide or restructure existing graphics into smaller parts. Cropping and scaling are two methods used to reduce the size of an existing image. To get the right combination of image size and display area, these two methods can be used together to achieve a good result. This technique is called "Relevance-Enhanced Image Reduction" (for more detail, see Nielsen, 1996).	**Yes:** Continue to next question. A score of 5 is attached to this response. **No:** Continue to next question. A score of 0 is attaché to this response	Yes. The larger images can be easily broken down into smaller components. **Score: 5**
9. Are existing graphics in proper format already?	Graphics for computer-based eLearning content may have been produced with high resolution and color depth without compression. Although they display very well on a computer, they may have large file sizes, need more processing power for playback, be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers), or require separate software to open. To be more suitable for mLearning, graphics should have a quality and color depth that is proper for the content and mobile devices. IDs should consider lowering the graphics resolution and color depth (within the limits of the design requirements) to reduce the size. Graphics should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as JPG/JPEG.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	Yes. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
Graphics Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding graphics to mLearning.	**Range of scores**: 7–16 **Acceptable range for including graphics in mLearning**: 12–16 Higher scores suggest that you have adequately addressed aspects of including graphics in your mLearning solution and that they may be appropriate to use. Lower scores suggest that there are still things you should consider and address before trying to incorporate graphics in your mobile solution.	**Score:** 15

Table 27. Sample Project 1: Questions to consider for including animation in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Do you intend to use animations of any kind in your mLearning?	If you are using animations, you need to consider their length, complexity, and frequency when developing your solution. There are many reasons to use animation (P. Berking, personal communication, April 19, 2013): • Show continuity in transitions • Indicate dimensionality in transitions • Illustrate change over time • Show how elements combine or interact dynamically • Multiplex the display • Enrich graphic representations • Visualize three-dimensional structures • Attract attention	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on social learning components (**Table 28**).	No.
2. Will you be designing mLearning, or PS in particular?	Some PS may not be ideal for animations because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch and understand an animation).	**mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS tool:** Carefully consider whether the use environment will allow users to view animations effectively. Continue to next question. A score of 1 is attached to this response.	N/A
3. Have you created short animations that are easily digestible?	It is preferable to utilize shorter animations to show trainee status (e.g., sending email, turning a page), provide useful feedback, enhance the sense of direct manipulation of the app, or to help people visualize the results of their actions (Dannen & White, 2011). Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible, (Udell, 2012).	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
4. Have you simplified the animations that you will be using?	Added complexity in animations can confuse trainees, and it can also place added processing power requirements on the mobile device. Keep animations as simple as possible to convey the necessary information.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
5. Do you plan to use animations conservatively?	Use animations conservatively because they have the tendency to be annoying if used frequently. Also, make animations consistent with other animations incorporated into the app (Dannen & White, 2011).	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
6. Will you be using/redesigning existing training content?	If there are existing animations designed for computer-based eLearning, questions seven through eleven in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating animations from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A
7. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing animations, IDs should evaluate the animations to see whether they can divide the animations into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when animation reproduction is needed in order to divide or restructure existing animations into smaller units.	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
8. Are existing animations in proper format already?	Animations for computer-based eLearning content may have been produced with high resolutions and high frame rates without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, animations should have a resolution and frame rate that is proper for the content and mobile devices. IDs should consider lowering the resolution and frame rate (within the limits of the design requirements) to reduce the size. Animations should be in a format that is widely accepted on most mobile devices.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
9. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing animations are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Animations may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
10. Does the existing content contain programmed interactions that use rich media-like animations?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries from those for computers. Animations developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing animations in an mLearning solution, IDs need to examine existing animations closely, then redesign or reproduce them for mobile devices. In addition to using the right technologies for producing the animations, IDs need to pay attention to UI and User Experience (UX) design because mobile devices use different input methods.	**Yes:** Rich animations can be used in mobile, but they are more challenging to design. Continue to next question. A score of 1 is attached to this response. **No:** Simpler animations are easier to include in mobile solutions. Continue to next question. A score of 2 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
11. Are existing animations included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing animations are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If animations are streamed, a constant data connection is required to deliver these videos to mobile devices.	**Yes, part of the learning content:** It is easier to package animations into a mobile solution when they are part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Animations may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.	N/A
Animation Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding animation to mLearning solutions and the appropriateness of animations for the mobile solution.	**Range of scores**: 7–27 **Acceptable range for including animations in mLearning**: 21–27 Higher scores suggest that you have addressed important considerations and it may be appropriate to include animations in the mobile solution. Lower scores suggest that there are still things you should consider before trying to incorporate animations in your mobile solution.	N/A

Table 28. Sample Project 1: Questions to consider for including social learning components in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Are you aware of the existing social learning components that can be used as part of mLearning solutions?	There are many different ways to incorporate social aspects of learning into an mLearning solution, including: - Email (including group lists) - Whiteboarding and learner-to-learner whiteboard (i.e., not just instructor to learner) - Chat/Instant messenger (IM), text messaging, and multimedia messaging - Blogs, microblogs, and journals - File and desktop sharing - Threaded discussion (aka forums or discussion boards) - Community calendar - Social networking (e.g., Facebook, Twitter, LinkedIn) - Student-created and posting of personal webpages, wikis - Communities of practice (CoPs) or dedicated team spaces. Members/teams can comprise either learner cohorts taking the same course, or functional teams within the organization. - Surveys - Peer rating of content - Webcasting, with the ability for learners to initiate sessions among themselves (i.e., not just one-way, instructor-to-learner webcasting)	**Yes**: Continue to next question. **No**: Stop here and familiarize yourself with the common social learning components listed here. For more information on each, please consult the resources listed in **Section 8.0** of this document. Then continue to next question.	Yes.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
2. Do you plan to use any social learning components in your mLearning (e.g., having students create content, or having them communicate with their peers)?	If planning to use social learning components, there are some considerations that IDs should be aware of. Some of these considerations are highlighted here. In general, social learning is better for higher-order learning outcomes and problem-based, project-based, or team-based learning. Social learning may be appropriate when: • Users are motivated • They know a lot about the topic • They are accustomed to working independently • The content is nuanced, emerging • The material is complex, even controversial • Internet access is not reliable • Supervisors do not know about or necessarily support this material	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on e-books (**Table 29**).	No.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
3. Have you weighed the **pros** and **cons** of including social learning components in your solution?	IDs must understand the benefits and drawbacks of using social learning components as part of their mobile solution. Some examples of pros and cons are outlined here. **Pros (Osborne, 2012):** • Familiar tool with most students and appeals to wide range of learners • Virtually limitless amounts of information available online for students to consult • Can improve students' abilities to do online research • Can improve student/instructor communication • Students learn how to leverage social media in everyday life • Digital citizenship: students learn about appropriate online presence and behavior • Can engage students: especially Generation Y and younger • Encourages user-generated content, and learning materials can be easily shared • Encourages active participation, and shy students may become more involved when they interact virtually • Supports collaborative activities **Cons (Osborne, 2012):** • Can become a waste of time if it doesn't relate directly to a learning objective (incorporating it because it is available, not because it enhances learning) • Students may get distracted more easily • There is a risk of cyber-bullying • Face-to-face interaction is limited • Tracking student contributions and learning with social media can be difficult • Mobile platforms are constantly changing • Potential for sharing of inappropriate content • Need for Internet access for some social media • Potential privacy violations can occur	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
4. Do you intend to use text messaging or instant messaging capabilities in your mLearning?	SMS is a way to deliver content very simply. Texting is cheap and almost universally accessible. It can be designed to not only give information but to collect information (Elias, 2011). SMS applications can work on any mobile devices nearly instantaneously (e.g., for sending timely alerts). However, they're typically limited to 160 characters, provide a limited text-based experience, and can be very expensive (Fling, 2009). Users may also interact with each other using instant messaging programs on devices that are connected to the Internet.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
5. Do you intend to use multimedia messaging capabilities in your mLearning?	Multimedia messaging capabilities (e.g., audio/visual recording capabilities) are required. The mobile device must be able to read and decode the format that the images/video/audio messages are in to be of any use to the end user.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
6. Do you intend to use blogs, micro-blogging, discussion forums, white boards, or wikis in your mLearning?	These social learning components encourage users to be active learners and to participate in collaborative activities. Users contribute to the content of training, or a course, by sharing personal insight, having discussions with peers, and collaborating with others. Using this type of social learning activity encourages users to have open discussions from various perspectives.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
7. Do you intend to use email in your mLearning?	Email requires access to the Internet and requires users to be familiar with email on their mobile devices. Email is easy to use, fast, and practical to use for communication. However, email is also impersonal and can have security issues when content is sensitive.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
8. Do you intend to use social networking features in your mLearning?	Social networking apps require access to the Internet, and they also require users to be familiar with how they work. Some examples include Facebook, Twitter, and LinkedIn. Also, community calendars and CoPs provide networking functions. Users can share information, collaborate on research with similar-minded individuals, and interact with others.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
9. Will users be creating content?	Users are able to generate content to add to the mLearning solution via the features on their mobile devices. For example, users can take pictures, make videos or webcasts, create and post websites, share files, complete surveys, and even rate the content of an mLearning solution. The content from users can create a much richer, more meaningful learning experience because users take more responsibility for their learning and feel as though they are contributing in unique ways. However, it is also possible that some users may attempt to add inappropriate content. Thus, it would be a good idea to have someone monitoring the user-generated content for quality assurance.	**Yes:** Continue to next question. A score of 2 is attached to this response. Mobile platforms are especially useful in this context. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
10. Will you be using/redesigning existing training content?	If there are existing social learning components designed for computer-based eLearning, questions eleven through thirteen in this table should be asked when considering using existing social learning components in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating social components from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A
11. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing social learning components are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Social components may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
12. Does the existing component contain programmed interactions?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Social learning components developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing components in an mLearning solution, IDs need to examine existing social learning functions closely, and to redesign and reproduce them for mobile devices and mLearning behaviors. In addition to using the right technologies for producing the functions, IDs need to pay attention to UI and UX designs because mobile devices use different input methods and users use mobile devices differently than they use computers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
13. Is it reasonable to only use social learning components with online capabilities?	Social learning requires users to be online, but not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When redesigning social learning components for mLearning, IDs need to be aware that not all mobile devices are online everywhere, all the time.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
Social Learning Components Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding social learning components to mLearning solutions and the appropriateness of social learning components for the mobile solution.	**Range of scores**: 11–15 **Acceptable range for including social learning components in mLearning**: 11–15 You may find that you need to do some additional research on social learning components before making a decision to include them in the mLearning solution. However, you may find that you have adequately considered aspects of social learning components and have a good understanding of what is involved. Higher scores suggest that you have addressed important considerations and it may be more appropriate to include social learning components in the mobile solution.	N/A

Table 29. Sample Project 1: Questions to consider for including e-books in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Will you include an e-book in your solution?	Creating an e-book requires specific considerations. These include (Koeller, 2012; JISC Digital Media, 2013): **Design considerations:** • Structure and layout • Navigation through pages (linear format vs. allowing multiple reader "journeys" through the content) • Graphic design requirements **Digital content considerations**: • Format (e.g., basic text, files that use ePub and Adobe PDF standards) • Interactivity, hyperlinking, inclusion of multimedia • Editorial requirements • Quality assurance and focus group testing **Development considerations:** • Level of technical expertise required • Degree of review • Conversion and production **Publishing and distribution considerations:** • E-book delivery: email, downloaded, part of an app, retrieved from a virtual library • Digital content preparation • Submission and content updates	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on mobile games (**Table 30**).	No.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
2. Do you intend to create an e-book from existing materials?	It is relatively easy to translate from existing manuals/books, as long as it is mostly text based. Images may be taxing to the system if the book contains a lot of them. If you are creating a new book (from scratch) for this purpose, it could be a time-consuming process. One of the ways that e-book content differs from paper books is that e-books can include multimedia to enhance the user experience; it is important to note that the type, format, and sizing of the multimedia components depends on which format the e-book will be produce in, as well as what mobile platforms will be accessing it (JISC Digital Media, 2013). Consider that: • Cover images can be added • Illustrations, diagrams, and videos can be included to provide additional context for the user • Audio for "text to speech" can be a feature • Audio versions of the e-book can be created	**Yes:** Continue to next question. No score is attached to this response. **No:** Even if you are creating an e-book from scratch, the same factors should still be considered. Continue to next question. No score is attached to this response.	N/A
3. Do you intend to have the e-book be the primary mLearning component?	If the e-book is the primary component, make sure that it is not too long, which can be boring for users. Present information in well-formed and chunked chapters/sections. If the e-book is a supplement, make sure that it adequately supports the primary content.	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.	N/A
E-book Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of e-books that can impact how you choose to incorporate them into mLearning solutions.	N/A

Table 30. Sample Project 1: Questions to consider for including mobile games in mLearning.

Question	Explanation	Weigh/Decision Point	Sample Project 1 Responses
1. Do you intend to use games in your mLearning?	Games may be appropriate when users are not motivated, or for Generation Y individuals who play a lot of video games.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on augmented reality (**Table 31**).	No.
2. Will you be designing general mLearning or PS?	PS may not be ideal for games because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to play a game). People want quick access to a PS tool (just enough information, just in time, just for "me"). They do not want (or have time to) play a game to get the information that they need.	**General mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS Tool:** Game is not suitable. A score of 0 is attached to this response. Go to next sequence of questions on augmented reality (**Table 31**).	N/A
3. What level of fidelity do you want to include in your mobile game?	May not need a high level of fidelity for students to learn effectively. Only use the necessary level of fidelity, as increased fidelity may cost additional time, resources. Furthermore, a high level of fidelity can take up valuable processing resources. It may force you to design the game to be significantly shorter and less complex in content. Some devices may not be able to fully support high-fidelity games.	**Low:** Continue to next question. A score of 2 is attached to this response. **Mid to High:** Games with higher fidelity are more challenging to incorporate into mobile solutions. Continue to next question. A score of 1 is attached to this response.	N/A
4. How interactive will your mobile game be?	Minimal interaction: This means you will be taking a more cognitive approach in that the student will be passively learning more than actively participating. Very interactive: Constructivist approach where users actively construct their own knowledge.	**Low:** Continue to next question. A score of 1 is attached to this response. **High:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Weigh/Decision Point	Sample Project 1 Responses
5. Do you intend to include quiz games?	Quiz games (periodic knowledge checks). Make sure to keep the quizzes short and to give immediate feedback on the answers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
6. Do you intend to include surveys in your game?	Make sure to keep the surveys short and to give immediate feedback on progress through the survey.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
7. Will you be using/redesigning existing training content?	If there are existing games designed for computer-based eLearning, questions eight through 13 in this table should be asked when considering using existing games in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating a game from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Weigh/Decision Point	Sample Project 1 Responses
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing games, IDs should evaluate the games to see whether they can be divided into smaller units or levels to reduce the amount of information conveyed. More redesign efforts should be given when game redesign and reproduction are needed in order to divide existing games into smaller units or levels. Game play should be modified and simplified to be suitable for mobile platforms. For example, the games designed for PC are traditionally played using a mouse and a keyboard. Mobile devices do not have these physical components, and so different types of interactions are required to play games on mobile platforms.	**Yes:** Continue to next question. A score of 8 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
9. Is the existing game in HTML format already?	Most mobile devices today come with mobile browsers pre-installed or as a part of the mobile OSs. That makes the delivery of HTML-based games possible and easier on mobile devices. Special considerations should still be given to the following when using/redesigning existing games for an mLearning solution: • Do existing games require plug-ins? Many plug-ins made for computer OSs will not work on mobile devices or don't have a mobile equivalent. • Do existing games require a large display? With high processing power and graphics capabilities on today's computers, games display large amounts of detail. When this detail is displayed on a mobile device, it becomes hard to see. • Do existing games require changes in interface and control? Mobile devices largely use touchscreen input. Game interfaces and interactions design for mouse and keyboard on a computer may not function as well on a mobile device.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Weigh/Decision Point	Sample Project 1 Responses
10. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing games are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Games may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
11. Can existing game's code be recompiled for mobile OSs without major recoding?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Games developed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing games in an mLearning solution, IDs need to examine existing games closely, and to redesign and reproduce them for mobile devices. Some game engines are capable of producing games on multiple platforms, including mobile, by simply recompiling the game. In addition to using the right technologies for producing games, IDs need to pay attention to UI, UX, and game content design because mobile devices use different input methods and a much smaller display.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
12. Are existing games stand alone and included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing games are stand alone and included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The games are still available to a mobile user even when the device is not online. If these are online games, a constant data connection is required to deliver them to mobile devices.	**Yes, part of the learning content:** It is easier to package games into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, online:** Games may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Weigh/Decision Point	Sample Project 1 Responses
13. Are IDs ready to change assessment methods?	Owing to the changes in interface, navigation and control, and display size, and details mentioned above, assessments (scoring) designed in the existing games for computers might not be accurate or correct once the games are redesigned and deployed in the mobile form. Assessments (scoring) need to be redesigned while redesigning games or to match the redesigned games.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	N/A
Mobile Games Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding games to mLearning solutions and the appropriateness of games for the mobile solution.	**Range of scores**: 0–25 **Acceptable range for including games in mLearning**: 18–25 Higher scores suggest that there is a greater likelihood that games can be more easily incorporated in your mobile solution Lower scores suggest that it will be more challenging to incorporate games, and there may be considerations that you need to re-assess.	N/A

Table 31. Sample Project 1: Questions to consider for including augmented reality in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. Are you planning on using some form of augmented reality (AR) in your mLearning solution?	**YES:** You must ALWAYS be connected to the Internet; technology is in early stages and does not have full capabilities yet; high cost of development; software design/development is complex and difficult; requires a lot of battery life, computational power, cameras, and tracking sensors (hardware); requires sophisticated AI (artificial intelligence) and 3D modeling applications (software); smartphones provide limited screen space for displaying AR; slow network speeds can be a problem; app developers lack easy authoring tools for creating mobile AR content. Users have to be comfortable and familiar with technology. An AR system must be able to recognize what users are looking at (ARTags, GPS, etc.), and acquire and overlay the appropriate virtual graphics. AR requires a high-end video-capable phone or smartphone/device as well as a fairly high amount of processing power.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on what type of app to use (**Table 32**).	No.
2. Do you intend to include virtual overlays using GPS/location tracker?	While this can help students get real-time help and support, GPS may not work well indoors, which could cause misaligned visual representation of data.	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response. This is a consideration that is dependent on context of use.	N/A

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
3. Do you intend to use AR games?	AR games can be very time consuming and complex to create. Many factors need to be considered, including (Herbst et al., 2008): • Understanding how to keep user attention • Simplifying the interaction scheme • Understanding user safety during use • Understanding the environment of use • Understanding when and how to involve interaction with others • Creating a seamful design that accounts for technology related errors • Understanding how to use both real and virtual objects • Understanding how to maintain constant gameplay	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response.	N/A
4. Do you intend to include virtual overlays with QR Codes?	QR Code is a 2D code and ISO (International Organization for Standardization) standard that can encode information (e.g., text, URLs and other data) (Yoon et al., 2011). Some of advantages of using QR Codes are: • Low computational complexity allows much faster decoding; data are self-contained, and encoded data capacity is high; suitable for mobile environments; robust and scalable; easily created and deployed • QR Codes are useful now for delivering information and wayfinding, but as computer vision improves, QR Codes will essentially become unnecessary (Udell, 2012).	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.	N/A
Augmented Reality Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of augmented reality that can impact how you choose to incorporate it into mLearning solutions. Context of use becomes very important here.	N/A

Table 32. Sample Project 1: Questions to consider for determining what type of app to use.

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
1. What is a Mobile Web App?	**WHAT IS IT?** A website that you access from your device's browser, but that is made to resemble an app rather than a traditional webpage. It can be accessed by any mobile device with a browser. HTML5, CSS3, and JavaScript are being used for this purpose.	Continue to Question 2	N/A
2. What is a Native App?	**WHAT IS IT?** A native mobile app is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices.	Continue to Question 3	N/A
3. What is a Hybrid App?	**WHAT IS IT?** It is built using web technologies, then wrapped in a platform-specific shell that allows it to be installed as a Native App. It is a native, downloadable app that runs all or some of its UI in an embedded browser component. Instead of rewriting app from scratch for each mobile OS, developers write at least some of their app code in HTML, CSS, and JavaScript and reuse it across devices (Jones, 2012).	Continue to Question 4	N/A

4. Do you need a mobile solution that has cross-platform compatibility?	Mobile platform independence is important when a lot of different mobile devices will be accessing the mLearning content. It directly ties to BYOD preferences: if the mobile solution is BYOD, then you will need an app that allows platform independence. Mobile Web Apps are easy to deploy across multiple devices (ADL, 2012).
	
	IDs must also consider the mobile platforms that collaborating or partnering organizations will be using. In particular, this should be considered when:
	• The mobile project is part of a **joint-project initiative**, where multiple agencies collaborate to jointly develop the solution which will then be used across agencies, or
	• The mobile project is developed by one agency with the intent that the mLearning solution will deploy across **multiple agencies**.
		Yes: You must use either Hybrid Apps or mobile Web Apps. Continue to next question.
		
		Scoring:
		    Web App: +1
		    Hybrid App: +1
		    Native App: +0
		
		No: Any app may be appropriate. Continue to next question.
		
		Scoring:
		    Web App: +1
		    Hybrid App: +1
		    Native App: +1
			Yes. This will be a BYOD training solution.
			
			Score:
			    Web App: +1
			    Hybrid App: +1
			    Native App: +0

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
5. Does your solution require the use of internal features of the mobile device (e.g., camera, GPS)?	Only certain apps (hybrids and Native Apps) allow users to access internal features of the mobile device. However, a Hybrid App's performance is dependent on the device's browser capabilities. Web Apps do not have the same access to the device's hardware and OS features, and don't have full access to all the methods exposed by the device's OS compared to a Native App, meaning you are limited to the APIs made available by the browser (Jones, 2012).	**Yes:** You must use either Hybrid Apps or Native Apps. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +1 Native App: +1 **No:** Any app may be appropriate. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
6. What is your relative budget for developing and implementing the mobile solution?	Certain apps require more resources to develop. Your estimated budget will constrain what you can do. A native mobile application is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices. Deloitte estimates the cost of developing for two OSs is 160 percent of the cost of developing for one (ADL, 2012). Costly to develop. Industry analysts provide cost estimates that range from $20,000 to build a simple mobile app, to $150,000 or more for a complex app. These costs are largely replicated for each mobile OS the app must support (Sybase, Inc., 2012). Mobile Web Apps are low-cost solutions in comparison, especially when designing for more than one mobile device. Hybrid Applications can be built by web developers familiar with HTML, CSS, and JavaScript. Many companies already have web developers in house. It becomes a low-cost solution to create a team of in-house Hybrid App builders (Sybase, Inc., 2012). **Note:** Those IDs developing mobile for internal training may see different costs than those IDs developing mLearning for wide use.	***Low budget:** <$20k (mobile Web App is likely to fall into this budget). Continue to next question. **Scoring:** Web App: +1 Hybrid App: +0 Native App: +0 ***Medium budget:** $20k-$150k (mobile Web App, Hybrid App, and possibly Native App). Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +0 ***High budget:** >$150k (you can likely build any type of app with this budget). Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1 *These estimates are based on information obtained from Sybase (2012). These are recommendations. Actual budget required to develop is based on nature of project and learning outcome to be achieved.	Relatively low budget at $15k. The ID estimates that this will be the budget to develop this particular sample project. **Score:** Web App: +1 Hybrid App: +0 Native App: +0

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
7. What level of design and programming expertise can your organization support?	Some apps require more complex programming. If these skills are not available in house, you will need to consider using external software engineers to program certain types of apps. **Mobile Web Apps** use basic HTML, CSS, and JavaScript, which are arguably easier to learn than native languages such as Objective-C or Java. "Using basic HTML via Adobe Dreamweaver to develop a mobile website is easier for the average user, as they do not need to understand advanced programming and can focus on design rather than programming" (Martin et al., 2012). Mobile Web Apps can be challenging (but not impossible) to support across multiple browsers (ADL, 2012). **Hybrid Apps can also be somewhat complex to build:** Mobile developers need to know HTML, and web developers need to know mobile phone APIs. People who build hybrids need to know both (Jones, 2012). **Native Apps: More difficult programming.** In general, developing a Native App from the ground up using native code for a mobile OS requires in-depth knowledge of that particular mobile platform, higher programming experience and skills, and longer development time. Building Native Apps requires specific development skills associated with the targeted mobile platforms. Developing a mobile solution that can be deployed to multiple mobile platforms not only requires in-depth knowledge of all targeted platforms, but also design considerations that will minimize the differences between mobile platforms so the solution will function similarly to achieve the same learning outcomes. Many companies cannot justify the cost of building large teams of these specialists in house, so they outsource this work to high-cost contractor resources (Sybase, Inc., 2012).	**Simple programming:** A Web App can be created. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +0 Native App: +0 **Mid-level programming:** A Web App, and maybe a Hybrid App in some cases. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +0 **High level, complex programming:** Can support Web App, Hybrid App, and Native App. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1	Low levels of design and programming expertise within the organization. **Score:** Web App: +1 Hybrid App: +0 Native App: +0

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

8. Are you on a quick timeline to develop and implement the mobile solution?	Native Apps take a longer time to develop and implement than Mobile Web Apps and Hybrid Apps, which is important to consider if you have strict time constraints for the project.
	
	A typical Native App takes three to six months to build (Gill, 2012). Because the codebase needs to be reworked for each OS, the time to build an app for multiple devices can also be extensive (Jones, 2012).
		Yes: Use Web App or Hybrid App. Continue to next question.
		
		Scoring:
		   Web App: +1
		   Hybrid App: +1
		   Native App: +0
		
		No: Native App can be an option, but it takes longer to build. Hybrid Apps and Web Apps are options too. Continue to next question.
		
		Scoring:
		   Web App: +1
		   Hybrid App: +1
		   Native App: +1
			Yes. This solution needs to be completed within the next six months.
			
			Score:
			   Web App: +1
			   Hybrid App: +1
			   Native App: +0

9. Will users need to access materials offline?	Connectivity: Mobile Web Apps have to be online in order to access information. IDs need to take the online requirement of a Web App into consideration when it is going to be deployed in a BYOD setting, since users may incur additional costs for using additional mobile data.
	
	If there is a chance that people need to access material offline, a Native App is probably "safer" to use, since all material can be accessed without an Internet connection. If people will definitely need access to content offline, you should probably use a Native App. However, a Hybrid App is also able to access some content offline.
		Yes: Native App is best option. Continue to next question.
		
		Scoring:
		   Web App: +0
		   Hybrid App: +0
		   Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		   Web App: +1
		   Hybrid App: +1
		   Native App: +1
			No. It would be nice if they could, but not required to perform their job.
			
			Score:
			   Web App: +1
			   Hybrid App: +1
			   Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

10. Does the app need to be particularly fast?	The speed of different types of apps varies. For a given set of features and functions, if you require a fast app, then a Native App may be ideal. If the speed of the app is not the primary concern (as long as it is an acceptable speed), then a Mobile Web App or a Hybrid App may be sufficient.
	
	Native Apps have better performance (at least for now), snappier animations and transitions, and faster load times. The performance difference between Native and Web Apps is far more pronounced on slower devices (e.g., iPhone 3G running iOS4) (Jones, 2012).
	
	This is due to different techniques and technologies used in developing the apps. A Web App uses web programming technologies, meaning that it uses interpreted code as opposed to compiled code used in Native Apps. Technically, interpreted code used for Web Apps will always be slower than compiled code used in Native Apps on the same mobile device (Jones, 2012).
	
	Additionally, a Native App's performance is dependent on the mobile device's local resources, such as processing power. For a given device, local resources remain constant. Therefore, the performance of a Native App remains relatively constant. As for a Web App or a Hybrid App, its performance is affected by the Internet connection speed. A slow Internet connection will reduce the performance for a Web App or a Hybrid App.
		Yes: Native App offers faster performance. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			No.
			
			Score:
			
			    Web App: +1
			
			    Hybrid App: +1
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

11. Does your mLearning solution require advanced graphics?	Native and Hybrid Apps deliver more advanced graphics than a Mobile Web App.
	
	For this reason, a Mobile Web App is not recommended for game development.
	
	If your goal is to create a mobile game, then you need to create a Native App. It can be ported to other devices fairly quickly (Fling, 2009).
		Yes: Native and Hybrid Apps are preferable. Continue to next question.
		
		Scoring:
		
		  Web App: +0
		
		  Hybrid App: +1
		
		  Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		  Web App: +1
		
		  Hybrid App: +1
		
		  Native App: +1
			No, but it should be able to play short videos and display lower resolution images.
			
			Score:
			
			  Web App: +1
			
			  Hybrid App: +1
			
			  Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

12. Does your mobile solution require push/pull features?	**Push**: New events, messages, or data are sent to the mobile device as they occur without the user of the device first requesting them.
	
	Pull: The user of the mobile device makes a request for data or events.
	
	The Push/Pull design should also take into account whether users are allowed to provide input, such as file upload.
	
	A Native App allows both push and pull.
	
	Pull benefits: Client and server are both simpler to engineer. It allows user to determine when the action occurs and when bandwidth is used (AT&T, 2007).
	
	Push benefits: The user is notified in near real time when an event occurs; can reduce bandwidth consumption if events are infrequent; significantly more complex to engineer (AT&T, 2007). Resist the temptation to put everything into push-mode because this can discourage people from learning how to search the content to find the answers they need and from being self-reliant (Griffin, 2011).
	
	In addition to the technical differences described above, IDs need to consider how the push and pull features will help serve and achieve desired learning outcomes. The pull feature is better for users to search and retrieve information when they are ready and need the information. Users have control of what to receive and when. The push feature may be better used for prompting users with feedback, such as texts, at spaced intervals, which may help reinforce learning over time, prevent skill decay, and lead to better transfer of knowledge.
		Yes: Native App or Hybrid App has this capability. Continue to next question.
		
		Scoring:
		
		  Web App: +0
		
		  Hybrid App: +1
		
		  Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		  Web App: +1
		
		  Hybrid App: +1
		
		  Native App: +1
			No.
			
			Score:
			
			  Web App: +1
			
			  Hybrid App: +1
			
			  Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

13. Is the solution for commercial release (for sale)?	A Native App and a mobile website solution use totally different distribution methods. This impacts how the solution is delivered and how much control the organization has on the distribution. A Native App type of solution is much easier for public, commercial distribution and accounting than a mobile website type of solution.
	
	A Native App and a Hybrid App are normally distributed from a third-party distribution service, such as Apple App Store or Google Play Store, so the organization does not need to manage and track the distribution. This is easier for commercial release.
	
	A Web App is like a website. Users use a URL to launch the app, making it harder to manage and track the distribution.
		Yes: A Native App is applicable here. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +1
		
		No: Any type of app would work. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			No.
			
			Score:
			
			    Web App: +1
			
			    Hybrid App: +1
			
			    Native App: +1

14. Will the mobile device have constant Internet access while being used for mLearning?	A mLearning solution with the need of having constant data connectivity defines the target mobile devices, especially when allowing BYOD, and the availability of the solution. Today, a large portion of tablets purchased is Wi-Fi only. Those devices will only be able to use the solution when they are connected to a Wi-Fi network. Even with the Wi-Fi networks getting more and more accessible, they are still far less than "anywhere, anytime."	**Yes**: Any type of app would work. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
		
		No: Native Apps do not require constant Internet connectivity. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +1
			No.
			
			Score:
			
			    Web App: +0
			
			    Hybrid App: +0
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 1 Responses

15. Does your client/organization have policies that govern both Web and App publications?	A Native App and a mobile website solution use totally different distribution methods. With the long history and good understanding of publishing content on websites, most organizations have policies, process/procedures, and dedicated resources managing website content. App publications and releases are still relatively new. Many organizations do not have policies and process/procedures in place to manage that. This may raise certain issues, such as security.	**Yes:** You should research the existing policies that your organization has so that you can create a mobile solution that aligns with these policies. Continue to next question.
		
		Scoring:
		
		    Web App: +1 (if policy exists)
		
		    Hybrid App: +1 (if policy exists)
		
		    Native App: +1 (if policy exists)
		
		No: You should approach the leadership of your organization about creating policies to guide future mobile projects. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +0
			No.
			
			Score:
			
			    Web App: +0
			
			    Hybrid App: +0
			
			    Native App: +0

Question	Explanation	Responses & Scoring	Sample Project 1 Responses
Recommendation for Type of App	The ID should have a better understanding of the factors involved in making decisions about what type of app would be most appropriate for his or her mobile solution. **Table 18** below can provide more guidance. A frequency count will be given for the number of times a Native App, Hybrid App, and Web App applied to a user's response to questions 4, 5, 7, 8, 9, 10, 11, 12, 13, and 14. For example, the user answers "no" and discovers that in that particular instance, a Hybrid App would be the best option. The frequency counts will be listed here so that users can see what type of app has the highest/lowest frequencies, which may suggest what type of app(s) the user may want to explore further for his or her mobile solution, and which type of app(s) the user may want to avoid (i.e., the one with the lowest frequency).	**Frequency count for response:** Mobile Web App: # Hybrid App: # Native App: # The type (or types) with the highest frequency count(s) may be best suited for your needs.	**Score:** 　Web App: +10 　Hybrid App: +8 　Native App: +7 Based on the responses here, a mobile Web App may be most appropriate for this mobile solution.

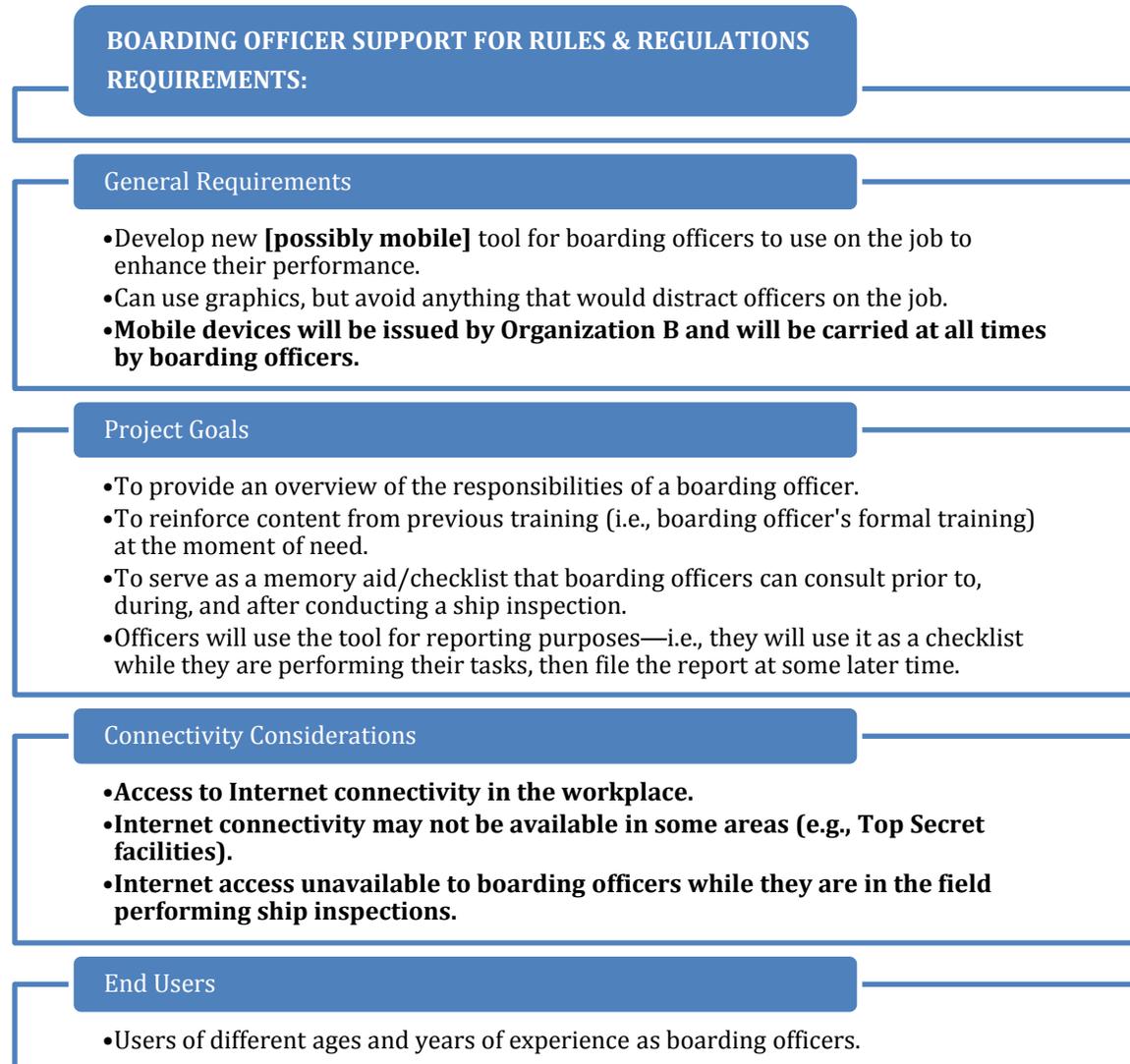## 5.2   *Sample Project 2—Boarding Officer Support for Rules & Regulations*

BOARDING OFFICER SUPPORT FOR RULES & REGULATIONS REQUIREMENTS:

General Requirements

- Develop new **[possibly mobile]** tool for boarding officers to use on the job to enhance their performance.
- Can use graphics, but avoid anything that would distract officers on the job.
- **Mobile devices will be issued by Organization B and will be carried at all times by boarding officers.**

Project Goals

- To provide an overview of the responsibilities of a boarding officer.
- To reinforce content from previous training (i.e., boarding officer's formal training) at the moment of need.
- To serve as a memory aid/checklist that boarding officers can consult prior to, during, and after conducting a ship inspection.
- Officers will use the tool for reporting purposes—i.e., they will use it as a checklist while they are performing their tasks, then file the report at some later time.

Connectivity Considerations

- **Access to Internet connectivity in the workplace.**
- **Internet connectivity may not be available in some areas (e.g., Top Secret facilities).**
- **Internet access unavailable to boarding officers while they are in the field performing ship inspections.**

End Users

- Users of different ages and years of experience as boarding officers.

Figure 15. Requirements for Boarding Officer Support.

Table 33. Sample Project 2: Should you pursue a mobile solution?

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Does your learning address Moment of Need 1: Learning something for the first time?	Mobile may be appropriate here as part of a **blended program**. The focus here is on new material. The user is being introduced and will be expected to do something as a result of the new knowledge. Mobile may play a part in that solution. For instance, perhaps the primary training is done via traditional classroom instruction. A mobile solution can complement this training by explaining why this material matters. Or it might introduce how they will be expected to use what they learn. For example, concepts can be first introduced in short mobile tutorials, and then discussed and applied in the classroom environment. Here, the lecture is on the mobile device, whereas interaction and application of knowledge are done in the live classroom.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. Boarding officers should already have learned the procedures. This training will be support for them as they complete their complex tasking in the field. **Score: 1**
2. Does your learning address Moment of Need 2: Wanting to learn more?	Mobile can be suitable here, especially as a part of a **blended program**. A mobile solution here can augment instruction that already exists by providing users with the option to learn more. For example, a student may learn about a concept in the classroom, but owing to time constraints and curriculum, the instructor may not be able to teach extensively about the applications of that concept in the real world. A mobile tool that includes animations, case studies, and additional resources allows students to drill down into the details of the concept on their own time, when they are interested in learning more about how it applies to real-world environments.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. **Score: 1**
3. Does your learning address Moment of Need 3: Trying to remember?	Mobile is great here in the form of PS and learning aids, where just-in-time access to information and content is a capability (Kadle, 2010); for example, content retention should be reinforced or a job aid needs to be accessed for details that are not in memory. This information will likely be brief and serve as a memory jog. Mobile is being used more frequently as a standalone, just-in-time job aid, where individuals may or may not have previous exposure to the task at hand. Mobile can also be used here as part of a blended program. For instance, for a face-to-face course, the mobile solution can provide opportunities for drill and practice, for review, to check a policy, and to encourage students to be part of community, to link with others tackling similar concerns.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. The job of boarding officers is complex and requires an external support mechanism to help them complete their tasks. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
4. Does your learning address Moment of Need 4: When things change?	Mobile devices allow people to learn continuously and support tasks that may be constantly changing or evolving. People can carry these devices with them at all times and turn them on instantly, regardless of where they are and when they need the information to help them perform (Kadle, 2010). This is a great way to make sure that contemporary views, ideas, events, and resources are there when needed.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes, to an extent. If protocol changes, then this solution can help support the boarding officers as they learn the changed procedures. **Score: 2**
5. Does your learning address Moment of Need 5: When something goes wrong?	Here, just enough information is presented to help end users troubleshoot and move past a barrier to performance, enabling them to do something they otherwise could not. The users may also be experiencing time pressures and stress (Kadle, 2010), so it is critical to give them access to the right information at the right time.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. This solution can be consulted when boarding officers find themselves in difficult situations, or when things go wrong. It can help them troubleshoot by offering support on how to do the tasks. **Score: 2**
6. Will the end users have to know the information and content by heart?	If end users must know information by heart and apply this information, then a lot of practice will be required to learn and maintain that level of knowledge over time. Here, a mobile PS solution can be extremely helpful because it can aid end users in remembering information while they are performing or applying their knowledge in the field. In this way, mobile enhances performance on tasks and can help users sustain their training over longer periods between practice sessions. Even if end users do not have to remember information by heart, mobile is still a very viable solution as a PS tool. An important consideration for PS tools is the intention of the tool: (1) is the intent to help people remember information, or (2) is the intent to help people perform? If the tool was designed to help people remember information, the assumption is that users will gradually learn to the point which they no longer need the tool for assistance. Conversely, if the intent is to help people perform, those users will always have access to the tool without the need to ever commit anything to memory.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	No. The support tool will help them to perform their job. The intention here is for the officers to always have access to the tool. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
7. Does training need to occur anytime/anywhere? Will it require more ready access by users?	A mobile solution is the preferred solution when training needs to occur anytime and anywhere, as the learning should not be constrained to the workplace or classroom environment. For example, during his daily bus commute, a user may watch some podcasts to learn more about a new procedure at work . The user is not constrained by his environment and is able to learn when it is most convenient for him. Mobile access allows more ready learning to occur, in the moment of need (i.e., anytime the user requires it). For example, if an end user is completing a task with an automated system and experiences a system failure, a mobile tool could be utilized right then and there to guide the user through the steps necessary to mitigate the consequences of that failure. However, it is important to note that sometimes connectivity will be required to access certain content that does not reside on the mobile device itself. If training needs to occur at predetermined times and locations, it is likely that eLearning, CBT, face-to-face instruction, or another classroom-based method will be most appropriate. These instructional methods typically require students to learn during set times in specific locations. A mobile solution can certainly complement these approaches, with a blended approach.	**Yes:** While mobile could be used in a more constrained environment, it is very beneficial for situations where it can be used anytime and anywhere. Continue to next question. A score of 4 is attached to this response. **No:** Mobile may still be a viable option although it may not be completely necessary. Continue to next question. A score of 1 is attached to this response.	Yes. Based on the requirements, PS should assist a boarding officer by providing anytime, anywhere information (in the field or in the office). Here, a mobile solution would be appropriate. The boarding officer should be able to pull up the tool whenever he or she needs help. **Score: 4**
8. Will users be required or encouraged to contribute to the content of the learning?	Mobile can easily include user-generated content via the features of the mobile device, such as camera and global positioning system (GPS). For example, students enrolled in an art history class with both a lecture and a mobile component may be asked to take photographs in various cultural locations, such as museums, tag them with the geo-location, annotate them, and share them digitally with fellow users. The instructor can then highlight some of the user-generated content in the lecture portion of the course.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	At the current moment, no. However, stakeholders are thinking about the value of incorporating user-generated content in the future, in the form of Lessons Learned, Tactics, and Tips that users can contribute to. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
9. Can the information be componentized and delivered as "nuggets" of information linked to tasks, questions, and conditions?	A mobile solution is appropriate when you can create bite-sized chunks of information, which is especially critical when using devices with very small screens (Stayton, 2011). Content from eLearning cannot simply be repurposed for a mobile device. The information and amount of information that will be presented to the end user will need to be condensed to make it more manageable for a mobile device format. For example, including a 10-page biomechanics paper may not be suitable for a mobile device because of its length and the complexity of information covered. However, the essay can be broken down into several key points and animations (if necessary); it still conveys the critical concepts found in the original paper but is more appropriate for an mLearning solution.	**Yes:** Continue to next question. A score of 9 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	Yes. The support information that needs to be delivered can be chunked into small, short, easily managed bits of information. **Score: 9**
10. Will your mobile solution require only **small** data transfers to move data/content to mobile platforms (via the Internet)?	Additional considerations about the types of devices and whether the mLearning solution will be BYOD will need to be addressed when the mLearning solution requires constant Internet connectivity, especially with large data transfers (e.g., high-volume video streaming, high-resolution graphics and images, and gaming). Many of the tablets purchased today are Wi-Fi only. For these devices, the mLearning solution is only accessible when there is a Wi-Fi connection. Although Wi-Fi is available in many places, such as homes, offices, hotels, airports, and coffee shops, the quality of connection and speed vary. Therefore, the mLearning solution may not function well in some situations. Smartphones and cellular-enabled tablets have lesser limitations on Internet connectivity. But with BYOD, users may incur additional costs for cellular data usage. Additionally, cellular data connection speed is generally slower than Wi-Fi, and that may impact the user experience of the mLearning solution. When Internet connection is not critical or the amount of data transferred is relatively small (i.e., you do not want users to spend hours downloading mobile content), mobile platforms offer a very reasonable option for delivering content. However, other alternatives, such as eLearning, web-based training (WBT), and instructor-led training (ILT) may also be considered.	**Yes:** Only small data transfers are necessary, or the Internet is not needed for this purpose. Continue to next question. A score of 9 is attached to this response. **No:** Large data transfers are necessary. Continue to next question. A score of 0 is attached to this response.	Wireless Internet access is not necessary all the time (i.e., just for reporting purposes), and the amount of data transferred is small when connected. **Score: 9**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
11. Will the learning experience benefit from features that are unique to mobile devices?	A mobile solution has advantages over other forms of training because of features unique to the mobile device, such as GPS, camera, QR Codes, accelerometers, and text messaging. An mLearning solution can incorporate touch-, motion-, and visual/sensory-based interactions at the time and location that is best for learning to occur. Not all mobile devices have the same features, sensors, and capabilities. Mobile may still be suitable, even when these features are not critical to learning. It is important for IDs to first analyze requirements and then conduct research to determine what features would be best for the given project. This involves looking at use cases, real-world examples, and current mobile literature (see **Section 8.0** for helpful resources). The level of effort needed to use these features should also be examined. **Examples of appropriate use of mobile device features include:** • **GPS** refers to a global positioning system and tracks the position on earth of the mobile device. This feature is appropriate to use when location and mapping are critical concepts within a given task. For instance, a scavenger hunt may help users learn important locations in a new city. • **Accelerometers** are features that measure acceleration and movement of the mobile device. These are appropriate to use with games or simulations, where users can move their mobile devices in order to perform certain actions within a game. • **Text messaging** or SMS allow users to send short text-based messages to other users. This can be used when you want to engage learners who are not collocated, encourage interactions, and facilitate social learning. • Many mobile devices have built-in **cameras** that allow users to take pictures and record short movies. These can be used when you want to engage learners who are not collocated and when you want include user-generated content (images, videos). • **QR Codes** are tagged artifacts in a learning space that display pertinent information when read and decoded by the user's camera. With this feature, the user is able to quickly access a website (without having to type in a URL) to receive additional details about a product, person, or concept, or even to automatically dial a phone number.	**Yes:** This is a situation where mobile may offer exceptional benefits because of its unique features. Continue to **recommendation**. A score of 2 is attached to this response. **No:** Mobile may still be a viable option, even though unique features are not necessarily needed. Continue to **recommendation**. A score of 1 is attached to this response.	No. This particular learning circumstance would not necessarily benefit from features specific to mobile. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
Recommendation	After all questions are answered, scores are tallied. The overall recommendation of whether to pursue a mobile solution is based on the range that the total score falls into.	**Range of scores**: 9–35 **Acceptable range for mobile**: 27–35 A higher score reflects a greater probability that a mobile solution would work well and be appropriate for the given situation. A low score suggests that you may want to explore other solutions.	**Total Score: 32** **Acceptable range for mobile: 27–35** Based on the answers to these questions, a mobile solution is **suitable** to deliver *Officer Boarding Support* here. Having made this determination, the ID should now assess what type of mLearning he or she will be creating.

Table 34. Sample Project 2: Is mLearning sufficient? Is performance support sufficient? Do we require a combination?

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Will target users be learning the information for the first time (including changes to previous procedures/things they have learned)?	When designing mLearning content to deliver new knowledge, IDs should consider providing all related materials, including background information, without assuming that users can already perform or are performing the task at a certain level. The goal and outcome are to deliver the knowledge.	**Yes**: This suggests that an mLearning solution would be sufficient. Skip to question 5. **No**: Go to next question.	No, they need support for things they have already learned but not necessarily memorized.
2. Will target users need help recalling or remembering information they have previously learned?	When on the job or performing a task, not all users, even the experienced ones, can recall or remember all the details learned during training. When designing an mLearning solution to help users perform a task better, IDs should consider the best way to effectively and seamlessly provide just-in-time and targeted information without bogging down users with unnecessary information. The goal and outcome are to assist users in performing the task at hand, not to retrain the entire process.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.	Yes, they will use the mobile solution to support their performance of tasks in the field, so there is not a need to memorize every little detail of the content.
3. Will target users need quick access to it to perform everyday tasks or at the time of need?	A tool is an instrument used to perform a certain task or to help a user do a better job. An mLearning PS solution is a tool to help users perform a one-time task or an everyday job better, easier, or faster. A PS tool should be easy to access, available when and where it is needed, and work and be helpful every time.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.	N/A
4. Will the target users require this solution when they encounter an error or a failure during performance?	When users make mistakes or fail a task after they have applied all the knowledge they have learned, they need assistance to identify the causes and to correct them. An mLearning PS solution can provide just-in-time information to refresh users on relevant information, reinforce procedures, provide alternatives, and suggest possible solutions to improve user performance.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Continue to next question.	N/A

	Question	Explanation	Responses & Scoring	Sample Project 2 Responses
5.	Does content material already exist in another format (e.g., WBT manuals, paper-based training)?	As a part of the analysis process for an mLearning solution, IDs should gather all the existing relevant information and content. If relevant materials exist, IDs should evaluate the materials to ensure they are current, correct, and complete. Designing a mobile solution based on existing materials can save time and resources over designing a solution from scratch, which may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: Continue to next question. **No**: This suggests that you will need to start designing content from scratch to include in the mobile solution.	N/A
6.	Is the existing content material high quality?	The quality of content will definitely impact the quality of a learning solution, including an mLearning solution. When analyzing existing content for its quality, IDs should pay special attention to determine whether it is suitable for use in designing an mLearning solution. The existing content may have to be redesigned (i.e., reducing the amount of information conveyed, as well as formatting) and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to next question. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to improve the quality of the content in the process. Continue to next question.	N/A
7.	Is the existing content material up to date?	The existing content may have been created some time ago and may be outdated. When designing an mLearning solution, IDs should examine the existing content to make sure that it is up to date and accurate. Creating a learning solution with out-of-date information cannot achieve the desired learning outcomes. If the existing content is out of date, IDs will need to update the content, and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to **Recommendation**. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to make sure to update the content in the process. Continue to **Recommendation**.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
Recommendation	Based on responses to the questions here, an ID can receive guidance on whether PS is appropriate, and considerations to think about when an mLearning solution will require content redesign.	**You should create a PS tool if:** You answered "yes" to questions 2, 3, or 4. **You have taken into account necessary considerations for mobile content redesign if:** You answered "yes" to questions 6 and 7. You already have high-quality content that is ready to be redesigned for your mobile solution. **You should do further analysis if:** You answered "no" to questions 5, 6, or 7. You should do further analysis because it seems that you may need to either create new material or heavily update the quality and information in material before starting the mLearning project.	**You should create a PS tool:** You answered "yes" to questions 2, 3, or 4. You should explore building a PS tool.

Table 35. Sample Project 2: Questions to consider for including video in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Do you plan to use video in the mLearning solution?	Video is a familiar format. Using videos in a mobile solution may require some special considerations. Those include: • Size of the videos. The size of the videos impacts an mLearning solution in two ways: ○ The amount of memory taken by videos on a mobile device ○ The connection throughput and data usage • Mobile device screen size. Mobile devices, especially smartphones, have limited screen size. Videos showing small details may be difficult for learners to see clearly. • Videos will also not be appropriate in all learning environments (e.g., environments prone to distractions). Will video be the best way to show the information? Video may be appropriate when: • Users are not motivated • The content is nuanced, emerging • Details of motion sequences (e.g., machinery in operation) need to be shown, which still images cannot properly convey • The material is complex, even controversial • The organization needs compliance Videos are **not** appropriate and a waste of resources when: • The video is just a "talking head," which does not add value to the solution (unless it is for inspiration, coming from a highly respected authority figure; P. Berking, personal communication, April 19, 2013).	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on audio (**Table 36**).	No.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
2. Will you be designing mLearning or PS?	Some PS may not be ideal for videos because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch a video).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the environment will allow users to view videos effectively. Proceed to next question. A score of 1 is attached to this response.	N/A
3. Will the end users be provided with a device to use?	If people will be using their own devices (BYOD), there will be a lot of variety in devices. Although most mobile devices today have video playback capabilities, ensuring the video format used in the mLearning solution works on all mobile devices requires a huge amount of work. Consequently, video formats may not work well for all users.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
4. Will you be using/redesigning existing training content?	If there are existing video clips designed for computer-based eLearning, questions five through eight in this table should be asked when considering using existing videos in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are designing videos from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
5. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing video content, IDs should evaluate the videos to see whether they can be divided into smaller units. More redesign efforts should be given when video reproduction is needed in order to divide existing videos into smaller and shorter clips. Mobile learners expect short, focused answers to problems. If videos are used, five-to-ten-minute clips should be more than sufficient to convey the content and pose fewer bandwidth issues. Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible (Udell, 2012).	**Yes:** Continue to next question. A score of 6 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
6. Are existing videos in proper format already?	Videos for computer-based eLearning content may have been produced with high resolutions and high-quality audio without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, videos should have a resolution and audio quality that is proper for the content and mobile devices. IDs should consider lowering the video and audio quality (within the limits of the design requirements) to reduce the size. Videos should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP4. When including videos in a Web App, another suggestion is to include video in two formats: MP4 (which Android users will be able to view), and Quicktime (which iPhone/iPad can recognize and play) (see Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
7. Does the existing content contain Adobe Flash multimedia components?	The current situation is that many mobile devices do not support Adobe Flash content. Adobe announced that it would not no longer develop or support on any mobile platform. If the existing videos are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Videos may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
8. Are existing videos included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing videos are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If videos are streamed, a constant data connection is required to deliver these videos to mobile devices. Users are more likely to abort mobile apps if they take more than five seconds to load. For heavy content like video, the mobile device could either allow users an option to download and view the content later, or reduce the resolution of the video for faster download (Training Partners, ND).	**Yes, part of the learning content:** It is easier to package videos into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, streamed in real time:** Videos may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.	N/A
Video Recommendation	The aggregated scores will tell the ID how challenging it may be to include video in the mLearning solution, based on the responses to the questions.	**Range of scores**: 6–17 **Acceptable range for including videos in mLearning**: 12–17 Lower scores suggest that it may be challenging (and possibly inappropriate) to incorporate video in your mLearning solution.	N/A

Table 36. Sample Project 2: Questions to consider for including audio in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Do you plan to use audio in the mLearning solution?	There are several considerations for including audio in the mLearning solution. The contextual learning environment and the end users must be taken into account to determine whether audio is an appropriate feature to use. Audio may be appropriate when: • The user will be multi-tasking (i.e., "travel time" learning, where modules can be taken while riding the metro bus or multi-tasking) • Users are not motivated • The content is nuanced, emerging • The material is complex, even controversial • The organization needs compliance	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on graphics (**Table 37**).	No.
2. Will you be designing mLearning or PS?	Some PS may not be ideal for audio because of the nature of the learning environment (e.g., a Soldier consulting PS tool in the field may not be able to hear audio).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the user environment will allow users to hear audio effectively. If so, then proceed to next question. A score of 1 is attached to this response.	N/A
3. Will users be using mLearning in environments that are free from a lot of distractions or external noise?	Make sure that if users cannot hear the sound (technology issues, or external noise in the environment), it will not severely impact their training of the task.	**Yes:** Continue to next question. A score of 3 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
4. Do you have a small set of sound effects associated with actions in the mLearning solution (e.g., button clicks, buzzers)?	It is important not to have too many competing sound effects (i.e., between the environment and the mLearning). This can be distracting and obnoxious. Select a few of the most important actions that will have sound effects associated with them for good feedback.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
5. Do you intend to use music in your mLearning solution?	Adding music to your mLearning has the potential to be distracting, and can also cause some processing issues depending on the mobile device being used and the necessary connectivity. IDs should carefully consider the effects of music when designing the solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
6. Have you taken precautions to make sure that music will not be played on a loop?	Be cautious about adding continuous or looping background music in your mLearning content. This may be distracting to the learning process. It also increases the processing requirements for the mobile device, especially if the music is streaming. It may be more effective to present intermittent music in conjunction with your other mLearning content.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
7. Do you intend to incorporate verbal feedback in your mLearning?	Verbal feedback may not be appropriate in environments that are very distracting. If you want to use verbal feedback, make sure that it is short and simple.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
8. Will the verbal feedback be short and brief?	Utilizing verbal feedback can be effective, as long as it is chunked appropriately. Extended verbal feedback is not advised.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
9. Will you be using/redesigning existing training content?	If there are existing audio clips designed for computer-based eLearning, questions ten through thirteen in this table should be asked when considering using existing audios in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating audio from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
10. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially in an environment where audio content is not well received. Therefore, it is recommended to design learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing audio content, IDs should evaluate the audio to see whether they can divide it into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when audio reproduction is needed in order to divide existing audio into smaller and shorter clips.	**Yes:** Continue to next question. A score of 10 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
11. Are existing audio files in proper format already?	Audio files for computer-based eLearning content may have produced with high-quality stereo audio without compression. Although they play very well on a computer, they may have large file sizes, need more processing power for playback, and/or be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, audio should have a quality that is proper for the content and mobile devices. IDs should consider (within the limits of the design requirements) lowering the audio quality and removing stereo sound (many smartphones do not have stereo speakers) to reduce the size. Audio should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP3, and it should be tested to make sure the files will actually work on the target mobile device(s) (Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
12. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing audio is contained in a multimedia Flash object, IDs have to redesign it for mobile delivery.	**Yes:** Audio may still be used, but it will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
13. Is the existing audio included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing audios are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The audio is still available to a mobile user even when the device is not online. If audio is streamed, a constant data connection is required to deliver it to mobile devices.	**Yes, part of the learning content:** It is easier to package audio into a mobile solution when it is part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Audio may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
Audio Recommendation	The aggregated scores will tell the ID whether audio is appropriate for the mobile solution, based on the responses to the questions.	**Range of scores**: 10–29 **Acceptable range for including audio in mLearning**: 20–29 Higher scores suggest that audio may be appropriate for the mobile solution. Lower scores suggest that including audio may be challenging and/or inappropriate. Regardless of score, you should also consider the context of use, such as where/when users will be accessing the mobile solution.	N/A

Table 37. Sample Project 2: Questions to consider for including graphics in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Do you intend to use icons/clip-art in your mLearning?	IDs might choose to use icons from existing materials, websites, existing CBT, and other applications (e.g., Microsoft Word®). However, the IDs need to take into account how well these icons will translate to smaller mobile devices.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 3. A score of 1 is attached to this response.	Yes. **Score: 1**
2. Are the icons familiar to the user and simple?	Icons should be familiar and should not be complex. They should be simple enough to translate onto small mobile devices while identifiable. For example, you don't want to use an intricate icon that is only fully visible on a 15-inch laptop monitor. Also, be aware that different mobile devices may display colors differently. However, icons should not save space at the expense of user understanding.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. They will be navigational icons primarily. **Score: 2**
3. Do you intend to use photographs in your mLearning?	IDs need to take into account how well photographs will translate to smaller mobile devices, which may limit how well a user is able to see details, complexities, etc.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 5. A score of 1 is attached to this response.	Yes. **Score: 1**
4. Are the photos lower resolution with no or minimal small details?	If you intend to use high-resolution photographs, keep in mind several things: (1) the screen sizes of the devices that may potentially be accessing the mLearning content; (2) the added processor requirements necessary to store and utilize photos that are large in data size. Details in photos that can be detected on a laptop screen may be hard to see on smaller mobile devices. Make sure no critical content is contained within images that could be hard to see on smaller devices. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution photo: (1) is there value in including high-resolution photos, and (2) what is the target platform for delivery? Only include high-resolution photos when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in photos.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	Yes. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
5. Do you intend to have background images in your mLearning?	IDs need to take into account how well backgrounds will translate to smaller mobile devices. Use of backgrounds may not be preferable if it proves to be a distraction. Make sure that background art is not distracting from the main mLearning content. On smaller mobile devices, it may not be necessary to use background art, as the screen size is a very limiting factor when presenting the critical instructional content of the mLearning.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 7. A score of 1 is attached to this response.	No. **Score: 1**
6. Is your background image lower resolution with few small details?	When working with a small screen, large CSS (Cascading Style Sheet) background images or infographics can be problematic. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution background: (1) is there value in including high-resolution backgrounds, and (2) what is the target platform for delivery? Only include high-resolution backgrounds when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in images.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
7. Will you be using/redesigning existing training content?	If there are existing graphics designed for computer-based eLearning, questions eight and nine in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating graphics from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	Yes. The icons and the photos will be pulled from existing training materials. **Score: 1**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing graphics, IDs should evaluate the graphics to see whether they can be divided into smaller units. Simply reducing the size of a graphic may make it hard to read. More redesign efforts should be given when graphics re-creation is needed in order to divide or restructure existing graphics into smaller parts. Cropping and scaling are two methods used to reduce the size of an existing image. To get the right combination of image size and display area, these two methods can be used together to achieve a good result. This technique is called "Relevance-Enhanced Image Reduction" (for more detail, see Nielsen, 1996).	**Yes:** Continue to next question. A score of 5 is attached to this response. **No:** Continue to next question. A score of 0 is attaché to this response	Yes. The larger images can be easily broken down into smaller components. **Score: 5**
9. Are existing graphics in proper format already?	Graphics for computer-based eLearning content may have been produced with high resolution and color depth without compression. Although they display very well on a computer, they may have large file sizes, need more processing power for playback, be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers), or require separate software to open. To be more suitable for mLearning, graphics should have a quality and color depth that is proper for the content and mobile devices. IDs should consider lowering the graphics resolution and color depth (within the limits of the design requirements) to reduce the size. Graphics should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as JPG/JPEG.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	Yes. **Score: 2**

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
Graphics Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding graphics to mLearning.	**Range of scores**: 7–16 **Acceptable range for including graphics in mLearning**: 12–16 Higher scores suggest that you have adequately addressed aspects of including graphics in your mLearning solution and that they may be appropriate to use. Lower scores suggest that there are still things you should consider and address before trying to incorporate graphics in your mobile solution.	**Score:** 15

Table 38. Sample Project 2: Questions to consider for including animation in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Do you intend to use animations of any kind in your mLearning?	If you are using animations, you need to consider their length, complexity, and frequency when developing your solution. There are many reasons to use animation (P. Berking, personal communication, April 19, 2013): • Show continuity in transitions • Indicate dimensionality in transitions • Illustrate change over time • Show how elements combine or interact dynamically • Multiplex the display • Enrich graphic representations • Visualize three-dimensional structures • Attract attention	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on social learning components (**Table 39**).	No.
2. Will you be designing mLearning, or PS in particular?	Some PS may not be ideal for animations because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch and understand an animation).	**mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS tool:** Carefully consider whether the use environment will allow users to view animations effectively. Continue to next question. A score of 1 is attached to this response.	N/A
3. Have you created short animations that are easily digestible?	It is preferable to utilize shorter animations to show trainee status (e.g., sending email, turning a page), provide useful feedback, enhance the sense of direct manipulation of the app, or to help people visualize the results of their actions (Dannen & White, 2011). Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible, (Udell, 2012).	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
4. Have you simplified the animations that you will be using?	Added complexity in animations can confuse trainees, and it can also place added processing power requirements on the mobile device. Keep animations as simple as possible to convey the necessary information.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
5. Do you plan to use animations conservatively?	Use animations conservatively because they have the tendency to be annoying if used frequently. Also, make animations consistent with other animations incorporated into the app (Dannen & White, 2011).	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
6. Will you be using/redesigning existing training content?	If there are existing animations designed for computer-based eLearning, questions seven through eleven in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating animations from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A
7. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing animations, IDs should evaluate the animations to see whether they can divide the animations into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when animation reproduction is needed in order to divide or restructure existing animations into smaller units.	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
8. Are existing animations in proper format already?	Animations for computer-based eLearning content may have been produced with high resolutions and high frame rates without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, animations should have a resolution and frame rate that is proper for the content and mobile devices. IDs should consider lowering the resolution and frame rate (within the limits of the design requirements) to reduce the size. Animations should be in a format that is widely accepted on most mobile devices.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
9. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing animations are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Animations may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
10. Does the existing content contain programmed interactions that use rich media-like animations?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries from those for computers. Animations developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing animations in an mLearning solution, IDs need to examine existing animations closely, then redesign or reproduce them for mobile devices. In addition to using the right technologies for producing the animations, IDs need to pay attention to UI and User Experience (UX) design because mobile devices use different input methods.	**Yes:** Rich animations can be used in mobile, but they are more challenging to design. Continue to next question. A score of 1 is attached to this response. **No:** Simpler animations are easier to include in mobile solutions. Continue to next question. A score of 2 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
11. Are existing animations included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing animations are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If animations are streamed, a constant data connection is required to deliver these videos to mobile devices.	**Yes, part of the learning content:** It is easier to package animations into a mobile solution when they are part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Animations may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.	N/A
Animation Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding animation to mLearning solutions and the appropriateness of animations for the mobile solution.	**Range of scores**: 7–27 **Acceptable range for including animations in mLearning**: 21–27 Higher scores suggest that you have addressed important considerations and it may be appropriate to include animations in the mobile solution. Lower scores suggest that there are still things you should consider before trying to incorporate animations in your mobile solution.	N/A

Table 39. Sample Project 2: Questions to consider for including social learning components in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Are you aware of the existing social learning components that can be used as part of mLearning solutions?	There are many different ways to incorporate social aspects of learning into an mLearning solution, including: • Email (including group lists) • Whiteboarding and learner-to-learner whiteboard (i.e., not just instructor to learner) • Chat/Instant messenger (IM), text messaging, and multimedia messaging • Blogs, microblogs, and journals • File and desktop sharing • Threaded discussion (aka forums or discussion boards) • Community calendar • Social networking (e.g., Facebook, Twitter, LinkedIn) • Student-created and posting of personal webpages, wikis • Communities of practice (CoPs) or dedicated team spaces. Members/teams can comprise either learner cohorts taking the same course, or functional teams within the organization. • Surveys • Peer rating of content • Webcasting, with the ability for learners to initiate sessions among themselves (i.e., not just one-way, instructor-to-learner webcasting)	**Yes**: Continue to next question. **No**: Stop here and familiarize yourself with the common social learning components listed here. For more information on each, please consult the resources listed in **Section 8.0** of this document. Then continue to next question.	Yes.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
2. Do you plan to use any social learning components in your mLearning (e.g., having students create content, or having them communicate with their peers)?	If planning to use social learning components, there are some considerations that IDs should be aware of. Some of these considerations are highlighted here. In general, social learning is better for higher-order learning outcomes and problem-based, project-based, or team-based learning. Social learning may be appropriate when: • Users are motivated • They know a lot about the topic • They are accustomed to working independently • The content is nuanced, emerging • The material is complex, even controversial • Internet access is not reliable • Supervisors do not know about or necessarily support this material	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on e-books (**Table 40**).	No.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
3. Have you weighed the **pros** and **cons** of including social learning components in your solution?	IDs must understand the benefits and drawbacks of using social learning components as part of their mobile solution. Some examples of pros and cons are outlined here. **Pros (Osborne, 2012):** • Familiar tool with most students and appeals to wide range of learners • Virtually limitless amounts of information available online for students to consult • Can improve students' abilities to do online research • Can improve student/instructor communication • Students learn how to leverage social media in everyday life • Digital citizenship: students learn about appropriate online presence and behavior • Can engage students: especially Generation Y and younger • Encourages user-generated content, and learning materials can be easily shared • Encourages active participation, and shy students may become more involved when they interact virtually • Supports collaborative activities **Cons (Osborne, 2012):** • Can become a waste of time if it doesn't relate directly to a learning objective (incorporating it because it is available, not because it enhances learning) • Students may get distracted more easily • There is a risk of cyber-bullying • Face-to-face interaction is limited • Tracking student contributions and learning with social media can be difficult • Mobile platforms are constantly changing • Potential for sharing of inappropriate content • Need for Internet access for some social media • Potential privacy violations can occur	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
4. Do you intend to use text messaging or instant messaging capabilities in your mLearning?	SMS is a way to deliver content very simply. Texting is cheap and almost universally accessible. It can be designed to not only give information but to collect information (Elias, 2011). SMS applications can work on any mobile devices nearly instantaneously (e.g., for sending timely alerts). However, they're typically limited to 160 characters, provide a limited text-based experience, and can be very expensive (Fling, 2009). Users may also interact with each other using instant messaging programs on devices that are connected to the Internet.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
5. Do you intend to use multimedia messaging capabilities in your mLearning?	Multimedia messaging capabilities (e.g., audio/visual recording capabilities) are required. The mobile device must be able to read and decode the format that the images/video/audio messages are in to be of any use to the end user.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
6. Do you intend to use blogs, micro-blogging, discussion forums, white boards, or wikis in your mLearning?	These social learning components encourage users to be active learners and to participate in collaborative activities. Users contribute to the content of training, or a course, by sharing personal insight, having discussions with peers, and collaborating with others. Using this type of social learning activity encourages users to have open discussions from various perspectives.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
7. Do you intend to use email in your mLearning?	Email requires access to the Internet and requires users to be familiar with email on their mobile devices. Email is easy to use, fast, and practical to use for communication. However, email is also impersonal and can have security issues when content is sensitive.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
8. Do you intend to use social networking features in your mLearning?	Social networking apps require access to the Internet, and they also require users to be familiar with how they work. Some examples include Facebook, Twitter, and LinkedIn. Also, community calendars and CoPs provide networking functions. Users can share information, collaborate on research with similar-minded individuals, and interact with others.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
9. Will users be creating content?	Users are able to generate content to add to the mLearning solution via the features on their mobile devices. For example, users can take pictures, make videos or webcasts, create and post websites, share files, complete surveys, and even rate the content of an mLearning solution. The content from users can create a much richer, more meaningful learning experience because users take more responsibility for their learning and feel as though they are contributing in unique ways. However, it is also possible that some users may attempt to add inappropriate content. Thus, it would be a good idea to have someone monitoring the user-generated content for quality assurance.	**Yes:** Continue to next question. A score of 2 is attached to this response. Mobile platforms are especially useful in this context. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
10. Will you be using/redesigning existing training content?	If there are existing social learning components designed for computer-based eLearning, questions eleven through thirteen in this table should be asked when considering using existing social learning components in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating social components from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A
11. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing social learning components are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Social components may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
12. Does the existing component contain programmed interactions?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Social learning components developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing components in an mLearning solution, IDs need to examine existing social learning functions closely, and to redesign and reproduce them for mobile devices and mLearning behaviors. In addition to using the right technologies for producing the functions, IDs need to pay attention to UI and UX designs because mobile devices use different input methods and users use mobile devices differently than they use computers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
13. Is it reasonable to only use social learning components with online capabilities?	Social learning requires users to be online, but not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When redesigning social learning components for mLearning, IDs need to be aware that not all mobile devices are online everywhere, all the time.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
Social Learning Components Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding social learning components to mLearning solutions and the appropriateness of social learning components for the mobile solution.	**Range of scores**: 11–15 **Acceptable range for including social learning components in mLearning**: 11–15 You may find that you need to do some additional research on social learning components before making a decision to include them in the mLearning solution. However, you may find that you have adequately considered aspects of social learning components and have a good understanding of what is involved. Higher scores suggest that you have addressed important considerations and it may be more appropriate to include social learning components in the mobile solution.	N/A

Table 40. Sample Project 2: Questions to consider for including e-books in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Will you include an e-book in your solution?	Creating an e-book requires specific considerations. These include (Koeller, 2012; JISC Digital Media, 2013): **Design considerations:** • Structure and layout • Navigation through pages (linear format vs. allowing multiple reader "journeys" through the content) • Graphic design requirements **Digital content considerations**: • Format (e.g., basic text, files that use ePub and Adobe PDF standards) • Interactivity, hyperlinking, inclusion of multimedia • Editorial requirements • Quality assurance and focus group testing **Development considerations:** • Level of technical expertise required • Degree of review • Conversion and production **Publishing and distribution considerations:** • E-book delivery: email, downloaded, part of an app, retrieved from a virtual library • Digital content preparation • Submission and content updates	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on mobile games (**Table 41**Table 15).	No.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
2. Do you intend to create an e-book from existing materials?	It is relatively easy to translate from existing manuals/books, as long as it is mostly text based. Images may be taxing to the system if the book contains a lot of them. If you are creating a new book (from scratch) for this purpose, it could be a time-consuming process. One of the ways that e-book content differs from paper books is that e-books can include multimedia to enhance the user experience; it is important to note that the type, format, and sizing of the multimedia components depends on which format the e-book will be produce in, as well as what mobile platforms will be accessing it (JISC Digital Media, 2013). Consider that: • Cover images can be added • Illustrations, diagrams, and videos can be included to provide additional context for the user • Audio for "text to speech" can be a feature • Audio versions of the e-book can be created	**Yes:** Continue to next question. No score is attached to this response. **No:** Even if you are creating an e-book from scratch, the same factors should still be considered. Continue to next question. No score is attached to this response.	N/A
3. Do you intend to have the e-book be the primary mLearning component?	If the e-book is the primary component, make sure that it is not too long, which can be boring for users. Present information in well-formed and chunked chapters/sections. If the e-book is a supplement, make sure that it adequately supports the primary content.	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.	N/A
E-book Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of e-books that can impact how you choose to incorporate them into mLearning solutions.	N/A

Table 41. Sample Project 2: Questions to consider for including mobile games in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Do you intend to use games in your mLearning?	Games may be appropriate when users are not motivated, or for Generation Y individuals who play a lot of video games.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on augmented reality (**Table 42**).	No.
2. Will you be designing general mLearning or PS?	PS may not be ideal for games because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to play a game). People want quick access to a PS tool (just enough information, just in time, just for "me"). They do not want (or have time to) play a game to get the information that they need.	**General mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS Tool:** Game is not suitable. A score of 0 is attached to this response. Go to next sequence of questions on augmented reality (**Table 42**).	N/A
3. What level of fidelity do you want to include in your mobile game?	May not need a high level of fidelity for students to learn effectively. Only use the necessary level of fidelity, as increased fidelity may cost additional time, resources. Furthermore, a high level of fidelity can take up valuable processing resources. It may force you to design the game to be significantly shorter and less complex in content. Some devices may not be able to fully support high-fidelity games.	**Low:** Continue to next question. A score of 2 is attached to this response. **Mid to High:** Games with higher fidelity are more challenging to incorporate into mobile solutions. Continue to next question. A score of 1 is attached to this response.	N/A
4. How interactive will your mobile game be?	Minimal interaction: This means you will be taking a more cognitive approach in that the student will be passively learning more than actively participating. Very interactive: Constructivist approach where users actively construct their own knowledge.	**Low:** Continue to next question. A score of 1 is attached to this response. **High:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
5. Do you intend to include quiz games?	Quiz games (periodic knowledge checks). Make sure to keep the quizzes short and to give immediate feedback on the answers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
6. Do you intend to include surveys in your game?	Make sure to keep the surveys short and to give immediate feedback on progress through the survey.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
7. Will you be using/redesigning existing training content?	If there are existing games designed for computer-based eLearning, questions eight through 13 in this table should be asked when considering using existing games in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating a game from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing games, IDs should evaluate the games to see whether they can be divided into smaller units or levels to reduce the amount of information conveyed. More redesign efforts should be given when game redesign and reproduction are needed in order to divide existing games into smaller units or levels. Game play should be modified and simplified to be suitable for mobile platforms. For example, the games designed for PC are traditionally played using a mouse and a keyboard. Mobile devices do not have these physical components, and so different types of interactions are required to play games on mobile platforms.	**Yes:** Continue to next question. A score of 8 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	N/A
9. Is the existing game in HTML format already?	Most mobile devices today come with mobile browsers pre-installed or as a part of the mobile OSs. That makes the delivery of HTML-based games possible and easier on mobile devices. Special considerations should still be given to the following when using/redesigning existing games for an mLearning solution: • Do existing games require plug-ins? Many plug-ins made for computer OSs will not work on mobile devices or don't have a mobile equivalent. • Do existing games require a large display? With high processing power and graphics capabilities on today's computers, games display large amounts of detail. When this detail is displayed on a mobile device, it becomes hard to see. • Do existing games require changes in interface and control? Mobile devices largely use touchscreen input. Game interfaces and interactions design for mouse and keyboard on a computer may not function as well on a mobile device.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
10. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing games are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Games may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	N/A
11. Can existing game's code be recompiled for mobile OSs without major recoding?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Games developed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing games in an mLearning solution, IDs need to examine existing games closely, and to redesign and reproduce them for mobile devices. Some game engines are capable of producing games on multiple platforms, including mobile, by simply recompiling the game. In addition to using the right technologies for producing games, IDs need to pay attention to UI, UX, and game content design because mobile devices use different input methods and a much smaller display.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	N/A
12. Are existing games stand alone and included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing games are stand alone and included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The games are still available to a mobile user even when the device is not online. If these are online games, a constant data connection is required to deliver them to mobile devices.	**Yes, part of the learning content:** It is easier to package games into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, online:** Games may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
13. Are IDs ready to change assessment methods?	Owing to the changes in interface, navigation and control, and display size, and details mentioned above, assessments (scoring) designed in the existing games for computers might not be accurate or correct once the games are redesigned and deployed in the mobile form. Assessments (scoring) need to be redesigned while redesigning games or to match the redesigned games.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	N/A
Mobile Games Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding games to mLearning solutions and the appropriateness of games for the mobile solution.	**Range of scores**: 0–25 **Acceptable range for including games in mLearning**: 18–25 Higher scores suggest that there is a greater likelihood that games can be more easily incorporated in your mobile solution Lower scores suggest that it will be more challenging to incorporate games, and there may be considerations that you need to re-assess.	N/A

Table 42. Sample Project 2: Questions to consider for including augmented reality in mLearning.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. Are you planning on using some form of augmented reality (AR) in your mLearning solution?	**YES:** You must ALWAYS be connected to the Internet; technology is in early stages and does not have full capabilities yet; high cost of development; software design/development is complex and difficult; requires a lot of battery life, computational power, cameras, and tracking sensors (hardware); requires sophisticated AI (artificial intelligence) and 3D modeling applications (software); smartphones provide limited screen space for displaying AR; slow network speeds can be a problem; app developers lack easy authoring tools for creating mobile AR content. Users have to be comfortable and familiar with technology. An AR system must be able to recognize what users are looking at (ARTags, GPS, etc.), and acquire and overlay the appropriate virtual graphics. AR requires a high-end video-capable phone or smartphone/device as well as a fairly high amount of processing power.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on what type of app to use (**Table 43**).	No.
2. Do you intend to include virtual overlays using GPS/location tracker?	While this can help students get real-time help and support, GPS may not work well indoors, which could cause misaligned visual representation of data.	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response. This is a consideration that is dependent on context of use.	N/A

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
3. Do you intend to use AR games?	AR games can be very time consuming and complex to create. Many factors need to be considered, including (Herbst et al., 2008): • Understanding how to keep user attention • Simplifying the interaction scheme • Understanding user safety during use • Understanding the environment of use • Understanding when and how to involve interaction with others • Creating a seamful design that accounts for technology related errors • Understanding how to use both real and virtual objects • Understanding how to maintain constant gameplay	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response.	N/A
4. Do you intend to include virtual overlays with QR Codes?	QR Code is a 2D code and ISO (International Organization for Standardization) standard that can encode information (e.g., text, URLs and other data) (Yoon et al., 2011). Some of advantages of using QR Codes are: • Low computational complexity allows much faster decoding; data are self-contained, and encoded data capacity is high; suitable for mobile environments; robust and scalable; easily created and deployed • QR Codes are useful now for delivering information and wayfinding, but as computer vision improves, QR Codes will essentially become unnecessary (Udell, 2012).	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.	N/A
Augmented Reality Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of augmented reality that can impact how you choose to incorporate it into mLearning solutions. Context of use becomes very important here.	N/A

Table 43. Sample Project 2: Questions to consider for determining what type of app to use.

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
1. What is a Mobile Web App?	**WHAT IS IT?** A website that you access from your device's browser, but that is made to resemble an app rather than a traditional webpage. It can be accessed by any mobile device with a browser. HTML5, CSS3, and JavaScript are being used for this purpose.	Continue to Question 2	N/A
2. What is a Native App?	**WHAT IS IT?** A native mobile app is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices.	Continue to Question 3	N/A
3. What is a Hybrid App?	**WHAT IS IT?** It is built using web technologies, then wrapped in a platform-specific shell that allows it to be installed as a Native App. It is a native, downloadable app that runs all or some of its UI in an embedded browser component. Instead of rewriting app from scratch for each mobile OS, developers write at least some of their app code in HTML, CSS, and JavaScript and reuse it across devices (Jones, 2012).	Continue to Question 4	N/A

4. Do you need a mobile solution that has cross-platform compatibility?	Mobile platform independence is important when a lot of different mobile devices will be accessing the mLearning content. It directly ties to BYOD preferences: if the mobile solution is BYOD, then you will need an app that allows platform independence. Mobile Web Apps are easy to deploy across multiple devices (ADL, 2012).
	
	IDs must also consider the mobile platforms that collaborating or partnering organizations will be using. In particular, this should be considered when:
	• The mobile project is part of a **joint-project initiative**, where multiple agencies collaborate to jointly develop the solution which will then be used across agencies, or
	• The mobile project is developed by one agency with the intent that the mLearning solution will deploy across **multiple agencies**.
		Yes: You must use either Hybrid Apps or mobile Web Apps. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +0
		No: Any app may be appropriate. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +1
			No. End users will be supplied with the same type of device. The information designed into this tool is so specific to boarding officers that it will only remain available to that group of users.
			
			Score:
			  Web App: +1
			  Hybrid App: +1
			  Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses

5. Does your solution require the use of internal features of the mobile device (e.g., camera, GPS)?	Only certain apps (hybrids and Native Apps) allow users to access internal features of the mobile device. However, a Hybrid App's performance is dependent on the device's browser capabilities.
	
	Web Apps do not have the same access to the device's hardware and OS features, and don't have full access to all the methods exposed by the device's OS compared to a Native App, meaning you are limited to the APIs made available by the browser (Jones, 2012).
		Yes: You must use either Hybrid Apps or Native Apps. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +1
		
		    Native App: +1
		
		No: Any app may be appropriate. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			No.
			
			Score:
			
			    Web App: +1
			
			    Hybrid App: +1
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
6.　What is your relative budget for developing and implementing the mobile solution?	Certain apps require more resources to develop. Your estimated budget will constrain what you can do. A native mobile application is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices. Deloitte estimates the cost of developing for two OSs is 160 percent of the cost of developing for one (ADL, 2012). Costly to develop. Industry analysts provide cost estimates that range from $20,000 to build a simple mobile app, to $150,000 or more for a complex app. These costs are largely replicated for each mobile OS the app must support (Sybase, Inc., 2012). Mobile Web Apps are low-cost solutions in comparison, especially when designing for more than one mobile device. Hybrid Applications can be built by web developers familiar with HTML, CSS, and JavaScript. Many companies already have web developers in house. It becomes a low-cost solution to create a team of in-house Hybrid App builders (Sybase, Inc., 2012). **Note:** Those IDs developing mobile for internal training may see different costs than those IDs developing mLearning for wide use.	***Low budget:** <$20k (mobile Web App is likely to fall into this budget). Continue to next question. **Scoring:** 　Web App: +1 　Hybrid App: +0 　Native App: +0 ***Medium budget:** $20k-$150k (mobile Web App, Hybrid App, and possibly Native App). Continue to next question. **Scoring:** 　Web App: +1 　Hybrid App: +1 　Native App: +0 ***High budget:** >$150k (you can likely build any type of app with this budget). Continue to next question. **Scoring:** 　Web App: +1 　Hybrid App: +1 　Native App: +1 *These estimates are based on information obtained from Sybase (2012). These are recommendations. Actual budget required to develop is based on nature of project and learning outcome to be achieved.	Relatively large budget at $150k. The ID estimates that this will be the budget to develop this particular sample project. **Score:** 　Web App: +1 　Hybrid App: +1 　Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses

7. What level of design and programming expertise can your organization support?	Some apps require more complex programming. If these skills are not available in house, you will need to consider using external software engineers to program certain types of apps.
	
	Mobile Web Apps use basic HTML, CSS, and JavaScript, which are arguably easier to learn than native languages such as Objective-C or Java. "Using basic HTML via Adobe Dreamweaver to develop a mobile website is easier for the average user, as they do not need to understand advanced programming and can focus on design rather than programming" (Martin et al., 2012). Mobile Web Apps can be challenging (but not impossible) to support across multiple browsers (ADL, 2012).
	
	Hybrid Apps can also be somewhat complex to build: Mobile developers need to know HTML, and web developers need to know mobile phone APIs. People who build hybrids need to know both (Jones, 2012).
	
	Native Apps: More difficult programming. In general, developing a Native App from the ground up using native code for a mobile OS requires in-depth knowledge of that particular mobile platform, higher programming experience and skills, and longer development time.
	
	Building Native Apps requires specific development skills associated with the targeted mobile platforms. Developing a mobile solution that can be deployed to multiple mobile platforms not only requires in-depth knowledge of all targeted platforms, but also design considerations that will minimize the differences between mobile platforms so the solution will function similarly to achieve the same learning outcomes.
	
	Many companies cannot justify the cost of building large teams of these specialists in house, so they outsource this work to high-cost contractor resources (Sybase, Inc., 2012).
		Simple programming: A Web App can be created. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +0
		
		    Native App: +0
		
		Mid-level programming: A Web App, and maybe a Hybrid App in some cases. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +0
		
		High level, complex programming: Can support Web App, Hybrid App, and Native App. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			High levels of design and programming expertise within the organization.
			
			Score:
			
			    Web App: +1
			
			    Hybrid App: +1
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses

8. Are you on a quick timeline to develop and implement the mobile solution?	Native Apps take a longer time to develop and implement than Mobile Web Apps and Hybrid Apps, which is important to consider if you have strict time constraints for the project.
	
	A typical Native App takes three to six months to build (Gill, 2012). Because the codebase needs to be reworked for each OS, the time to build an app for multiple devices can also be extensive (Jones, 2012).
		Yes: Use Web App or Hybrid App. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +0
		
		No: Native App can be an option, but it takes longer to build. Hybrid Apps and Web Apps are options too. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +1
			Yes. This solution needs to be completed within the next three months.
			
			Score:
			  Web App: +1
			  Hybrid App: +1
			  Native App: +0

9. Will users need to access materials offline?	Connectivity: Mobile Web Apps have to be online in order to access information. IDs need to take the online requirement of a Web App into consideration when it is going to be deployed in a BYOD setting, since users may incur additional costs for using additional mobile data.
	
	If there is a chance that people need to access material offline, a Native App is probably "safer" to use, since all material can be accessed without an Internet connection. If people will definitely need access to content offline, you should probably use a Native App. However, a Hybrid App is also able to access some content offline.
		Yes: Native App is best option. Continue to next question.
		
		Scoring:
		  Web App: +0
		  Hybrid App: +0
		  Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +1
			Yes. Users will be in the field when they use the mobile solution.
			
			Score:
			  Web App: +0
			  Hybrid App: +0
			  Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses

10. Does the app need to be particularly fast?	The speed of different types of apps varies. For a given set of features and functions, if you require a fast app, then a Native App may be ideal. If the speed of the app is not the primary concern (as long as it is an acceptable speed), then a Mobile Web App or a Hybrid App may be sufficient.
	
	Native Apps have better performance (at least for now), snappier animations and transitions, and faster load times. The performance difference between Native and Web Apps is far more pronounced on slower devices (e.g., iPhone 3G running iOS4) (Jones, 2012).
	
	This is due to different techniques and technologies used in developing the apps. A Web App uses web programming technologies, meaning that it uses interpreted code as opposed to compiled code used in Native Apps. Technically, interpreted code used for Web Apps will always be slower than compiled code used in Native Apps on the same mobile device (Jones, 2012).
	
	Additionally, a Native App's performance is dependent on the mobile device's local resources, such as processing power. For a given device, local resources remain constant. Therefore, the performance of a Native App remains relatively constant. As for a Web App or a Hybrid App, its performance is affected by the Internet connection speed. A slow Internet connection will reduce the performance for a Web App or a Hybrid App.
		Yes: Native App offers faster performance. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +0
		
		    Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			Yes.
			
			Score:
			
			    Web App: +0
			
			    Hybrid App: +0
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses

11. Does your mLearning solution require advanced graphics?	Native and Hybrid Apps deliver more advanced graphics than a Mobile Web App.
	
	For this reason, a Mobile Web App is not recommended for game development.
	
	If your goal is to create a mobile game, then you need to create a Native App. It can be ported to other devices fairly quickly (Fling, 2009).
		Yes: Native and Hybrid Apps are preferable. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +1
		
		    Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			No.
			
			Score:
			
			    Web App: +1
			
			    Hybrid App: +1
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses

12. Does your mobile solution require push/pull features?	**Push**: New events, messages, or data are sent to the mobile device as they occur without the user of the device first requesting them.
	
	Pull: The user of the mobile device makes a request for data or events.
	
	The Push/Pull design should also take into account whether users are allowed to provide input, such as file upload.
	
	A Native App allows both push and pull.
	
	Pull benefits: Client and server are both simpler to engineer. It allows user to determine when the action occurs and when bandwidth is used (AT&T, 2007).
	
	Push benefits: The user is notified in near real time when an event occurs; can reduce bandwidth consumption if events are infrequent; significantly more complex to engineer (AT&T, 2007). Resist the temptation to put everything into push-mode because this can discourage people from learning how to search the content to find the answers they need and from being self-reliant (Griffin, 2011).
	
	In addition to the technical differences described above, IDs need to consider how the push and pull features will help serve and achieve desired learning outcomes. The pull feature is better for users to search and retrieve information when they are ready and need the information. Users have control of what to receive and when. The push feature may be better used for prompting users with feedback, such as texts, at spaced intervals, which may help reinforce learning over time, prevent skill decay, and lead to better transfer of knowledge.
		Yes: Native App or Hybrid App has this capability. Continue to next question.
		
		Scoring:
		
		    Web App: +0
		
		    Hybrid App: +1
		
		    Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		    Web App: +1
		
		    Hybrid App: +1
		
		    Native App: +1
			Yes. This will be needed when updates are made to the protocol.
			
			Score:
			
			    Web App: +0
			
			    Hybrid App: +1
			
			    Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
13. Is the solution for commercial release (for sale)?	A Native App and a mobile website solution use totally different distribution methods. This impacts how the solution is delivered and how much control the organization has on the distribution. A Native App type of solution is much easier for public, commercial distribution and accounting than a mobile website type of solution. A Native App and a Hybrid App are normally distributed from a third-party distribution service, such as Apple App Store or Google Play Store, so the organization does not need to manage and track the distribution. This is easier for commercial release. A Web App is like a website. Users use a URL to launch the app, making it harder to manage and track the distribution.	**Yes:** A Native App is applicable here. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +0 Native App: +1 **No:** Any type of app would work. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1	No. **Score:** Web App: +1 Hybrid App: +1 Native App: +1
14. Will the mobile device have constant Internet access while being used for mLearning?	A mLearning solution with the need of having constant data connectivity defines the target mobile devices, especially when allowing BYOD, and the availability of the solution. Today, a large portion of tablets purchased is Wi-Fi only. Those devices will only be able to use the solution when they are connected to a Wi-Fi network. Even with the Wi-Fi networks getting more and more accessible, they are still far less than "anywhere, anytime."	**Yes**: Any type of app would work. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1 **No**: Native Apps do not require constant Internet connectivity. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +0 Native App: +1	No. **Score:** Web App: +0 Hybrid App: +0 Native App: +1

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
15. Does your client/organization have policies that govern both Web and App publications?	A Native App and a mobile website solution use totally different distribution methods. With the long history and good understanding of publishing content on websites, most organizations have policies, process/procedures, and dedicated resources managing website content. App publications and releases are still relatively new. Many organizations do not have policies and process/procedures in place to manage that. This may raise certain issues, such as security.	**Yes:** You should research the existing policies that your organization has so that you can create a mobile solution that aligns with these policies. Continue to next question. **Scoring:** Web App: +1 (if policy exists) Hybrid App: +1 (if policy exists) Native App: +1 (if policy exists) **No:** You should approach the leadership of your organization about creating policies to guide future mobile projects. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +0 Native App: +0	No. **Score:** Web App: +0 Hybrid App: +0 Native App: +0

Question	Explanation	Responses & Scoring	Sample Project 2 Responses
Recommendation for Type of App	The ID should have a better understanding of the factors involved in making decisions about what type of app would be most appropriate for his or her mobile solution. **Table 18** below can provide more guidance. A frequency count will be given for the number of times a Native App, Hybrid App, and Web App applied to a user's response to questions 4, 5, 7, 8, 9, 10, 11, 12, 13, and 14. For example, the user answers "no" and discovers that in that particular instance, a Hybrid App would be the best option. The frequency counts will be listed here so that users can see what type of app has the highest/lowest frequencies, which may suggest what type of app(s) the user may want to explore further for his or her mobile solution, and which type of app(s) the user may want to avoid (i.e., the one with the lowest frequency).	**Frequency count for response:** Mobile Web App: # Hybrid App: # Native App: # The type (or types) with the highest frequency count(s) may be best suited for your needs.	**Score:** Web App: +7 Hybrid App: +8 Native App: +10 Based on the responses here, a Native App may be most appropriate for this mobile solution.

6.0   Future Considerations & Recommendations

mLearning covers a wide range of learning content, learning activities, delivery modalities, design techniques and processes, and development technologies that use mobile devices as a final delivery platform. The MLDP can be used to assist IDs who are (or will be) creating an mLearning solution. It is important to keep in mind that the MLDP can be applied to any mLearning project. While this document illustrates application of the MLDP in two specific examples (e.g., content redesign based on existing non-mLearning content, and PS) it is not limited to only these two situations. Future efforts should extend beyond these to cover a broader range of mLearning situations that IDs may experience. Other recommendations for future efforts include:

- Continue the development efforts of this MLDP guide to assist IDs beyond the Analysis and Design phases of the mLearning solution development lifecycle.
- Consistently maintain and update this MLDP, because of the ever-changing nature of the mLearning space.
- Include some representative technologies, specifications, tools, and software libraries with wide acceptance and approval for those working for or supporting the government in future related efforts. This is especially relevant for any recommendations related to the Development phase and beyond in the mLearning solution lifecycle.
- Maintain awareness of potential barriers to the success of an mLearning solution. An in-depth discussion of these barriers is beyond the scope of this project. However, IDs should at the very least be aware of the potential barriers that exist. Guidance for how to mitigate risks that these potential barriers present to an mLearning solution should be a focus of future research efforts. Some of these barriers are described in **Table 44**.

Table 44. Examples of potential barriers to the success of a mobile learning solution.

Organizational Barriers	
Security issues	What are the policies for treating unclassified, classified, sensitive information? Encryption? Downloading an app and getting approval from management or the administration? Protecting data at rest (i.e., the devices can protect this information, but guidelines need to be set up)? Are there specific components of the mobile device that cannot be used for security reasons (e.g., Bluetooth, cell connectivity)?
Upper-level management requests	Upper-level management may want to know the return on investment (ROI) up front before requirements or needs are given. They may also want to see similar situations where value was added by delivering training via a mobile solution.
Mobile solution policies	What are the policies specific to mobile solutions? Policy shaping (e.g., policy changes to include mobile concerns, updates to existing policy, etc.) needs to be going on so that an organization remains clear on what mobile initiatives entail.
Implementation Barriers	
Maintaining the mobile solution	How will the mobile solution be maintained over the life of the solution? Who will be responsible for updating the content or the software?
Resources and budget	What resources are needed to develop a mobile solution? What is the realistic cost for the effort? Many times, a lot of effort is not put into an mLearning solution because of a lack of resources, when a quick and dirty solution is needed.
Distribution of	Should the mobile solution be distributed in an app store, or should it be available online for simple Web access? There are distribution options for each mobile OS

mobile solution	within the organization, rather than on a public-facing app distribution location. Additionally, some customers may want an app because that's what they know, not necessarily because they know it would be a suitable distribution mechanism for a learning solution.
End-User Barriers	
Generational differences	How do users of different ages react to and use mLearning solutions? For example, older, more experienced employees may not be as comfortable with mLearning solutions as younger employees, and their behaviors with mobile devices may not be the same.
User and stakeholder expectations	End users expect to have access to content online, while stakeholders may see connectivity as an unnecessary option (which would bring about additional security issues). Stakeholders may also have unreasonable expectations regarding the appearance of content on the mobile device. Managing expectations of users and stakeholders is becoming more and more important.

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8.0   Mobile Learning Resources

8.1   *Mobile Learning Resource Library*

The Mobile Resource Library (see **Table 45**) contains a list of recommended external resources that IDs can consult to help them remain current on mobile technology, trends, and research. Also included are recommended apps because looking at what others have done and increasing exposure to a large number of good (and bad) apps can help IDs generate ideas. In fact, it's possible that some existing apps may be incorporated into learning instead of spending time and resources to build something completely new.

Table 45. Mobile Resource Library.

Books, Newsletters	Description/Additional Information
ADL mLearning Newsletter (current)	This newsletter provides links to pertinent news stories, other mLearning resources, and guidance for developers. Archived newsletters (along with information about subscribing) can be found here: http://ymlp130.com/archive_gewujsqgjgu.php
Designing mLearning: Tapping into the Mobile Revolution for Organizational Performance (2011) by Clark N. Quinn	This book discusses a model for mLearning, as well as Quinn's "four C's" of mobile capabilities (i.e., content, capture, compute, and communicate). The book also provides support and guidance for designing, delivering, and deploying mLearning solutions.
Mobile First (2011) by Luke Wroblewski	This book serves as a strategic guide to mobile web design, written by a former Yahoo! Design architect. Additional information can be found here: http://www.abookapart.com/products/mobile-first
Mobile Learning Handbook (current) created and maintained by ADL	An online resource that is updated regularly and includes a compilation of mLearning resources, best practices, examples to provide guidance in the design, development, and implementation of mobile solutions. The handbook can be found here: http://mlhandbook.adlnet.gov
Mobile Learning: Landscape and Trends (2011) by Clark N. Quinn	This report examines the current mobile landscape, as of 2011. It can be found here: https://commons.lbl.gov/download/attachments/77828943/mobile2011report-f2.pdf
Inspirational Examples from Working Group Meeting	**Web Address**
Children's Hospital of Pittsburgh App	Symptom care guide, request appointments, directory, advice: http://www.chp.edu/CHP/childrenspgh+app
CLEAR App	To-do lists: http://www.realmacsoftware.com/clear/
Coach's Eye Sports Video Analysis App	Instant video analysis and slow-motion review: http://www.coachseye.com/

Explain Everything App	http://www.explaineverything.com/
Flipboard App	http://flipboard.com/
Google Hangout	http://www.google.com/+/learnmore/hangouts/
Nike FuelBand App	http://nikeplus.nike.com/plus/setup/fuelband
Pair It App	Pairs wine with food: http://www.pairitapp.com/
Pocket App	http://getpocket.com/
Pocket First Aid & CPR Smartphone App Created for the American Heart Association	http://www.heart.org/HEARTORG/CPRAndECC/CommunityTraining/CommunityProducts/Apps---Pocket-First-Aid-CPR_UCM_308819_Article.jsp
Polar App	Polling app: http://www.polarb.com/
Readability App	http://www.readability.com/
Tapestry App	http://www.tapestry-app.com/
Vivino Wine Scanner App	https://play.google.com/store/apps/details?id=vivino.web.app&hl=en
Zite App	http://www.zite.com/
Tools, Apps, & Other Resources for Creating mLearning	**Description/Additional Information**
ADL mLearning Guide created by ADL Initiative's Mobile Learning Team	This mLearning Guide app is a resource for designing, developing, and implementing mLearning solutions. It is an official app of the U.S. Government ADL Initiative. Available for iPhone and Android devices here: http://apps.usa.gov/adl-mlearning-guide.shtml
ADL Mobile Training Implementation Framework (MoTIF)	ADL's MoTIF project will explore new types of learning and design approaches that take advantage of the capabilities of the mobile platform. The MoTIF project will result in interventions such as strategies, materials, products, and guidelines as solutions to the problems, but will also advance our knowledge about the characteristics of these interventions and the processes involved in designing and developing them. More information on ADL's MoTIF project can be found here: http://motif.adlnet.gov
Aurasma App	Helps users combine augmented reality with geographical locations: http://www.aurasma.com/#/whats-your-aura
DesignJot App	http://itunes.apple.com/us/app/designjot/id447686146?mt=8
Evernote App	Allows users to capture pictures, ideas, video, audio: http://evernote.com/
Float Learning Mobile Primer App	http://floatlearning.com/apps/float-mobileLearning-primer/
Google Analytics	Can capture extensive web analytics data: http://www.google.com/analytics/

HDhat Movie tools	Tools for capturing videos, audio with mobile devices: http://hdhat.com/
Learning Asset Technology Integration Support Tool (LATIST)	Web-based tool to guide users through evaluating, selecting, and integrating technologies into learning events: http://latist1.gmu.edu/
mLearning Decision Maker App	http://itunes.apple.com/us/app/mlearning-decision-maker/id513104879?mt=8
Snapguide App	Helps users create "how-to" guides. Users can also browse existing guides that were created by other users: http://snapguide.com/
Wikitude App	Users can add digital content, geographic location to produce augmented reality: http://www.wikitude.com
Yin Yang of Formal and Informal Learning [Survey]	Web-based survey used to determine whether an organization supports formal or informal learning: http://frankn.net/yinyang/

9.0   Worksheets

This section includes blank MLDP worksheets for use by IDs. To print these worksheets, select Print>Page Range>pages 224 to 279.

Table 46: Should you pursue a mobile solution?

Question	Explanation	Responses & Scoring	Your Project
1. Does your learning address Moment of Need 1: Learning something for the first time?	Mobile may be appropriate here as part of a **blended program**. The focus here is on new material. The user is being introduced and will be expected to do something as a result of the new knowledge. Mobile may play a part in that solution. For instance, perhaps the primary training is done via traditional classroom instruction. A mobile solution can complement this training by explaining why this material matters. Or it might introduce how they will be expected to use what they learn. For example, concepts can be first introduced in short mobile tutorials, and then discussed and applied in the classroom environment. Here, the lecture is on the mobile device, whereas interaction and application of knowledge are done in the live classroom.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
2. Does your learning address Moment of Need 2: Wanting to learn more?	Mobile can be suitable here, especially as a part of a **blended program**. A mobile solution here can augment instruction that already exists by providing users with the option to learn more. For example, a student may learn about a concept in the classroom, but owing to time constraints and curriculum, the instructor may not be able to teach extensively about the applications of that concept in the real world. A mobile tool that includes animations, case studies, and additional resources allows students to drill down into the details of the concept on their own time, when they are interested in learning more about how it applies to real-world environments.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
3. Does your learning address Moment of Need 3: Trying to remember?	Mobile is great here in the form of PS and learning aids, where just-in-time access to information and content is a capability (Kadle, 2010); for example, content retention should be reinforced or a job aid needs to be accessed for details that are not in memory. This information will likely be brief and serve as a memory jog. Mobile is being used more frequently as a standalone, just-in-time job aid, where individuals may or may not have previous exposure to the task at hand. Mobile can also be used here as part of a blended program. For instance, for a face-to-face course, the mobile solution can provide opportunities for drill and practice, for review, to check a policy, and to encourage students to be part of community, to link with others tackling similar concerns.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
4. Does your learning address Moment of Need 4: When things change?	Mobile devices allow people to learn continuously and support tasks that may be constantly changing or evolving. People can carry these devices with them at all times and turn them on instantly, regardless of where they are and when they need the information to help them perform (Kadle, 2010). This is a great way to make sure that contemporary views, ideas, events, and resources are there when needed.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
5. Does your learning address Moment of Need 5: When something goes wrong?	Here, just enough information is presented to help end users troubleshoot and move past a barrier to performance, enabling them to do something they otherwise could not. The users may also be experiencing time pressures and stress (Kadle, 2010), so it is critical to give them access to the right information at the right time.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

	Question	Explanation	Responses & Scoring	Your Project
6.	Will the end users have to know the information and content by heart?	If end users must know information by heart and apply this information, then a lot of practice will be required to learn and maintain that level of knowledge over time. Here, a mobile PS solution can be extremely helpful because it can aid end users in remembering information while they are performing or applying their knowledge in the field. In this way, mobile enhances performance on tasks and can help users sustain their training over longer periods between practice sessions. Even if end users do not have to remember information by heart, mobile is still a very viable solution as a PS tool. An important consideration for PS tools is the intention of the tool: (1) is the intent to help people remember information, or (2) is the intent to help people perform? If the tool was designed to help people remember information, the assumption is that users will gradually learn to the point which they no longer need the tool for assistance. Conversely, if the intent is to help people perform, those users will always have access to the tool without the need to ever commit anything to memory.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

	Question	Explanation	Responses & Scoring	Your Project
7.	Does training need to occur anytime/anywhere? Will it require more ready access by users?	A mobile solution is the preferred solution when training needs to occur anytime and anywhere, as the learning should not be constrained to the workplace or classroom environment. For example, during his daily bus commute, a user may watch some podcasts to learn more about a new procedure at work . The user is not constrained by his environment and is able to learn when it is most convenient for him. Mobile access allows more ready learning to occur, in the moment of need (i.e., anytime the user requires it). For example, if an end user is completing a task with an automated system and experiences a system failure, a mobile tool could be utilized right then and there to guide the user through the steps necessary to mitigate the consequences of that failure. However, it is important to note that sometimes connectivity will be required to access certain content that does not reside on the mobile device itself. If training needs to occur at predetermined times and locations, it is likely that eLearning, CBT, face-to-face instruction, or another classroom-based method will be most appropriate. These instructional methods typically require students to learn during set times in specific locations. A mobile solution can certainly complement these approaches, with a blended approach.	**Yes:** While mobile could be used in a more constrained environment, it is very beneficial for situations where it can be used anytime and anywhere. Continue to next question. A score of 4 is attached to this response. **No:** Mobile may still be a viable option although it may not be completely necessary. Continue to next question. A score of 1 is attached to this response.	
8.	Will users be required or encouraged to contribute to the content of the learning?	Mobile can easily include user-generated content via the features of the mobile device, such as camera and global positioning system (GPS). For example, students enrolled in an art history class with both a lecture and a mobile component may be asked to take photographs in various cultural locations, such as museums, tag them with the geo-location, annotate them, and share them digitally with fellow users. The instructor can then highlight some of the user-generated content in the lecture portion of the course.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
9. Can the information be componentized and delivered as "nuggets" of information linked to tasks, questions, and conditions?	A mobile solution is appropriate when you can create bite-sized chunks of information, which is especially critical when using devices with very small screens (Stayton, 2011). Content from eLearning cannot simply be repurposed for a mobile device. The information and amount of information that will be presented to the end user will need to be condensed to make it more manageable for a mobile device format. For example, including a 10-page biomechanics paper may not be suitable for a mobile device because of its length and the complexity of information covered. However, the essay can be broken down into several key points and animations (if necessary); it still conveys the critical concepts found in the original paper but is more appropriate for an mLearning solution.	**Yes:** Continue to next question. A score of 9 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
10. Will your mobile solution require only **small** data transfers to move data/content to mobile platforms (via the Internet)?	Additional considerations about the types of devices and whether the mLearning solution will be BYOD will need to be addressed when the mLearning solution requires constant Internet connectivity, especially with large data transfers (e.g., high-volume video streaming, high-resolution graphics and images, and gaming). Many of the tablets purchased today are Wi-Fi only. For these devices, the mLearning solution is only accessible when there is a Wi-Fi connection. Although Wi-Fi is available in many places, such as homes, offices, hotels, airports, and coffee shops, the quality of connection and speed vary. Therefore, the mLearning solution may not function well in some situations. Smartphones and cellular-enabled tablets have lesser limitations on Internet connectivity. But with BYOD, users may incur additional costs for cellular data usage. Additionally, cellular data connection speed is generally slower than Wi-Fi, and that may impact the user experience of the mLearning solution. When Internet connection is not critical or the amount of data transferred is relatively small (i.e., you do not want users to spend hours downloading mobile content), mobile platforms offer a very reasonable option for delivering content. However, other alternatives, such as eLearning, web-based training (WBT), and instructor-led training (ILT) may also be considered.	**Yes:** Only small data transfers are necessary, or the Internet is not needed for this purpose. Continue to next question. A score of 9 is attached to this response. **No:** Large data transfers are necessary. Continue to next question. A score of 0 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
11. Will the learning experience benefit from features that are unique to mobile devices?	A mobile solution has advantages over other forms of training because of features unique to the mobile device, such as GPS, camera, QR Codes, accelerometers, and text messaging. An mLearning solution can incorporate touch-, motion-, and visual/sensory-based interactions at the time and location that is best for learning to occur. Not all mobile devices have the same features, sensors, and capabilities. Mobile may still be suitable, even when these features are not critical to learning. It is important for IDs to first analyze requirements and then conduct research to determine what features would be best for the given project. This involves looking at use cases, real-world examples, and current mobile literature (see **Section 8.0** for helpful resources). The level of effort needed to use these features should also be examined. **Examples of appropriate use of mobile device features include:** • **GPS** refers to a global positioning system and tracks the position on earth of the mobile device. This feature is appropriate to use when location and mapping are critical concepts within a given task. For instance, a scavenger hunt may help users learn important locations in a new city. • **Accelerometers** are features that measure acceleration and movement of the mobile device. These are appropriate to use with games or simulations, where users can move their mobile devices in order to perform certain actions within a game. • **Text messaging** or SMS allow users to send short text-based messages to other users. This can be used when you want to engage learners who are not collocated, encourage interactions, and facilitate social learning. • Many mobile devices have built-in **cameras** that allow users to take pictures and record short movies. These can be used when you want to engage learners who are not collocated and when you want include user-generated content (images, videos). • **QR Codes** are tagged artifacts in a learning space that display pertinent information when read and decoded by the user's camera. With this feature, the user is able to quickly access a website (without having to type in a URL) to receive additional details about a product, person, or concept, or even to automatically dial a phone number.	**Yes:** This is a situation where mobile may offer exceptional benefits because of its unique features. Continue to **recommendation**. A score of 2 is attached to this response. **No:** Mobile may still be a viable option, even though unique features are not necessarily needed. Continue to **recommendation**. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
Recommendation	After all questions are answered, scores are tallied. The overall recommendation of whether to pursue a mobile solution is based on the range that the total score falls into.	**Range of scores**: 9–35 **Acceptable range for mobile**: 27–35 A higher score reflects a greater probability that a mobile solution would work well and be appropriate for the given situation. A low score suggests that you may want to explore other solutions.	

Table 47: Is mLearning sufficient? Is performance support sufficient? Do we require a combination?

Question	Explanation	Responses & Scoring	Your Project
1. Will target users be learning the information for the first time (including changes to previous procedures/things they have learned)?	When designing mLearning content to deliver new knowledge, IDs should consider providing all related materials, including background information, without assuming that users can already perform or are performing the task at a certain level. The goal and outcome are to deliver the knowledge.	**Yes**: This suggests that an mLearning solution would be sufficient. Skip to question 5. **No**: Go to next question.	
2. Will target users need help recalling or remembering information they have previously learned?	When on the job or performing a task, not all users, even the experienced ones, can recall or remember all the details learned during training. When designing an mLearning solution to help users perform a task better, IDs should consider the best way to effectively and seamlessly provide just-in-time and targeted information without bogging down users with unnecessary information. The goal and outcome are to assist users in performing the task at hand, not to retrain the entire process.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.	
3. Will target users need quick access to it to perform everyday tasks or at the time of need?	A tool is an instrument used to perform a certain task or to help a user do a better job. An mLearning PS solution is a tool to help users perform a one-time task or an everyday job better, easier, or faster. A PS tool should be easy to access, available when and where it is needed, and work and be helpful every time.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Go to next question.	
4. Will the target users require this solution when they encounter an error or a failure during performance?	When users make mistakes or fail a task after they have applied all the knowledge they have learned, they need assistance to identify the causes and to correct them. An mLearning PS solution can provide just-in-time information to refresh users on relevant information, reinforce procedures, provide alternatives, and suggest possible solutions to improve user performance.	**Yes**: This suggests that a **PS** solution is sufficient. Skip to **Recommendation**. **No**: Continue to next question.	

Question	Explanation	Responses & Scoring	Your Project
5. Does content material already exist in another format (e.g., WBT manuals, paper-based training)?	As a part of the analysis process for an mLearning solution, IDs should gather all the existing relevant information and content. If relevant materials exist, IDs should evaluate the materials to ensure they are current, correct, and complete. Designing a mobile solution based on existing materials can save time and resources over designing a solution from scratch, which may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: Continue to next question. **No**: This suggests that you will need to start designing content from scratch to include in the mobile solution.	
6. Is the existing content material high quality?	The quality of content will definitely impact the quality of a learning solution, including an mLearning solution. When analyzing existing content for its quality, IDs should pay special attention to determine whether it is suitable for use in designing an mLearning solution. The existing content may have to be redesigned (i.e., reducing the amount of information conveyed, as well as formatting) and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to next question. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to improve the quality of the content in the process. Continue to next question.	
7. Is the existing content material up to date?	The existing content may have been created some time ago and may be outdated. When designing an mLearning solution, IDs should examine the existing content to make sure that it is up to date and accurate. Creating a learning solution with out-of-date information cannot achieve the desired learning outcomes. If the existing content is out of date, IDs will need to update the content, and this may require extensive work up front from SMEs to ensure that the content is accurate and meets the necessary learning objectives.	**Yes**: This suggests that you can **redesign the content** to make it suitable for mobile. Continue to **Recommendation**. **No**: This suggests that you may still **redesign the content** to make it suitable for mobile. However, you will need to make sure to update the content in the process. Continue to **Recommendation**.	

Question	Explanation	Responses & Scoring	Your Project
Recommendation	Based on responses to the questions here, an ID can receive guidance on whether PS is appropriate, and considerations to think about when an mLearning solution will require content redesign.	**You should create a PS tool if:** You answered "yes" to questions 2, 3, or 4. **You have taken into account necessary considerations for mobile content redesign if:** You answered "yes" to questions 6 and 7. You already have high-quality content that is ready to be redesigned for your mobile solution. **You should do further analysis if:** You answered "no" to questions 5, 6, or 7. You should do further analysis because it seems that you may need to either create new material or heavily update the quality and information in material before starting the mLearning project.	

Table 48: Questions to consider for including video in mLearning.

Question	Explanation	Responses & Scoring	Your Project

1. Do you plan to use video in the mLearning solution?	Video is a familiar format. Using videos in a mobile solution may require some special considerations. Those include:
	• Size of the videos. The size of the videos impacts an mLearning solution in two ways:
	    o The amount of memory taken by videos on a mobile device
	    o The connection throughput and data usage
	• Mobile device screen size. Mobile devices, especially smartphones, have limited screen size. Videos showing small details may be difficult for learners to see clearly.
	• Videos will also not be appropriate in all learning environments (e.g., environments prone to distractions).
	
	Will video be the best way to show the information? Video may be appropriate when:
	• Users are not motivated
	• The content is nuanced, emerging
	• Details of motion sequences (e.g., machinery in operation) need to be shown, which still images cannot properly convey
	• The material is complex, even controversial
	• The organization needs compliance
	
	Videos are **not** appropriate and a waste of resources when:
	• The video is just a "talking head," which does not add value to the solution (unless it is for inspiration, coming from a highly respected authority figure; P. Berking, personal communication, April 19, 2013).
		Yes: Continue to next question.
		
		No: Stop here. Go to next sequence of questions on audio (**Table 49**).	

Question	Explanation	Responses & Scoring	Your Project
2. Will you be designing mLearning or PS?	Some PS may not be ideal for videos because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch a video).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the environment will allow users to view videos effectively. Proceed to next question. A score of 1 is attached to this response.	
3. Will the end users be provided with a device to use?	If people will be using their own devices (BYOD), there will be a lot of variety in devices. Although most mobile devices today have video playback capabilities, ensuring the video format used in the mLearning solution works on all mobile devices requires a huge amount of work. Consequently, video formats may not work well for all users.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
4. Will you be using/redesigning existing training content?	If there are existing video clips designed for computer-based eLearning, questions five through eight in this table should be asked when considering using existing videos in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are designing videos from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
5. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing video content, IDs should evaluate the videos to see whether they can be divided into smaller units. More redesign efforts should be given when video reproduction is needed in order to divide existing videos into smaller and shorter clips. Mobile learners expect short, focused answers to problems. If videos are used, five-to-ten-minute clips should be more than sufficient to convey the content and pose fewer bandwidth issues. Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible (Udell, 2012).	**Yes:** Continue to next question. A score of 6 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	
6. Are existing videos in proper format already?	Videos for computer-based eLearning content may have been produced with high resolutions and high-quality audio without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, videos should have a resolution and audio quality that is proper for the content and mobile devices. IDs should consider lowering the video and audio quality (within the limits of the design requirements) to reduce the size. Videos should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP4. When including videos in a Web App, another suggestion is to include video in two formats: MP4 (which Android users will be able to view), and Quicktime (which iPhone/iPad can recognize and play) (see Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
7. Does the existing content contain Adobe Flash multimedia components?	The current situation is that many mobile devices do not support Adobe Flash content. Adobe announced that it would not no longer develop or support on any mobile platform. If the existing videos are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Videos may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	
8. Are existing videos included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing videos are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If videos are streamed, a constant data connection is required to deliver these videos to mobile devices. Users are more likely to abort mobile apps if they take more than five seconds to load. For heavy content like video, the mobile device could either allow users an option to download and view the content later, or reduce the resolution of the video for faster download (Training Partners, ND).	**Yes, part of the learning content:** It is easier to package videos into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, streamed in real time:** Videos may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.	
Video Recommendation	The aggregated scores will tell the ID how challenging it may be to include video in the mLearning solution, based on the responses to the questions.	**Range of scores**: 6–17 **Acceptable range for including videos in mLearning**: 12–17 Lower scores suggest that it may be challenging (and possibly inappropriate) to incorporate video in your mLearning solution.	

Table 49: Questions to consider for including audio in mLearning.

Question	Explanation	Responses & Scoring	Your Project
1. Do you plan to use audio in the mLearning solution?	There are several considerations for including audio in the mLearning solution. The contextual learning environment and the end users must be taken into account to determine whether audio is an appropriate feature to use. Audio may be appropriate when: • The user will be multi-tasking (i.e., "travel time" learning, where modules can be taken while riding the metro bus or multi-tasking) • Users are not motivated • The content is nuanced, emerging • The material is complex, even controversial • The organization needs compliance	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on graphics (**Table 50**).	
2. Will you be designing mLearning or PS?	Some PS may not be ideal for audio because of the nature of the learning environment (e.g., a Soldier consulting PS tool in the field may not be able to hear audio).	**mLearning solution:** Continue to next question. A score of 2 is attached to this response. **PS tool:** Carefully consider whether the user environment will allow users to hear audio effectively. If so, then proceed to next question. A score of 1 is attached to this response.	
3. Will users be using mLearning in environments that are free from a lot of distractions or external noise?	Make sure that if users cannot hear the sound (technology issues, or external noise in the environment), it will not severely impact their training of the task.	**Yes:** Continue to next question. A score of 3 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
4. Do you have a small set of sound effects associated with actions in the mLearning solution (e.g., button clicks, buzzers)?	It is important not to have too many competing sound effects (i.e., between the environment and the mLearning). This can be distracting and obnoxious. Select a few of the most important actions that will have sound effects associated with them for good feedback.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
5. Do you intend to use music in your mLearning solution?	Adding music to your mLearning has the potential to be distracting, and can also cause some processing issues depending on the mobile device being used and the necessary connectivity. IDs should carefully consider the effects of music when designing the solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
6. Have you taken precautions to make sure that music will not be played on a loop?	Be cautious about adding continuous or looping background music in your mLearning content. This may be distracting to the learning process. It also increases the processing requirements for the mobile device, especially if the music is streaming. It may be more effective to present intermittent music in conjunction with your other mLearning content.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
7. Do you intend to incorporate verbal feedback in your mLearning?	Verbal feedback may not be appropriate in environments that are very distracting. If you want to use verbal feedback, make sure that it is short and simple.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
8. Will the verbal feedback be short and brief?	Utilizing verbal feedback can be effective, as long as it is chunked appropriately. Extended verbal feedback is not advised.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
9. Will you be using/redesigning existing training content?	If there are existing audio clips designed for computer-based eLearning, questions ten through thirteen in this table should be asked when considering using existing audios in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating audio from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	
10. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially in an environment where audio content is not well received. Therefore, it is recommended to design learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing audio content, IDs should evaluate the audio to see whether they can divide it into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when audio reproduction is needed in order to divide existing audio into smaller and shorter clips.	**Yes:** Continue to next question. A score of 10 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
11. Are existing audio files in proper format already?	Audio files for computer-based eLearning content may have produced with high-quality stereo audio without compression. Although they play very well on a computer, they may have large file sizes, need more processing power for playback, and/or be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, audio should have a quality that is proper for the content and mobile devices. IDs should consider (within the limits of the design requirements) lowering the audio quality and removing stereo sound (many smartphones do not have stereo speakers) to reduce the size. Audio should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as MP3, and it should be tested to make sure the files will actually work on the target mobile device(s) (Rosen, 2012).	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
12. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing audio is contained in a multimedia Flash object, IDs have to redesign it for mobile delivery.	**Yes:** Audio may still be used, but it will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
13. Is the existing audio included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing audios are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The audio is still available to a mobile user even when the device is not online. If audio is streamed, a constant data connection is required to deliver it to mobile devices.	**Yes, part of the learning content:** It is easier to package audio into a mobile solution when it is part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Audio may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.	
Audio Recommendation	The aggregated scores will tell the ID whether audio is appropriate for the mobile solution, based on the responses to the questions.	**Range of scores**: 10–29 **Acceptable range for including audio in mLearning**: 20–29 Higher scores suggest that audio may be appropriate for the mobile solution. Lower scores suggest that including audio may be challenging and/or inappropriate. Regardless of score, you should also consider the context of use, such as where/when users will be accessing the mobile solution.	

Table 50: Questions to consider for including graphics in mLearning.

Question	Explanation	Responses & Scoring	Your Project
1. Do you intend to use icons/clip-art in your mLearning?	IDs might choose to use icons from existing materials, websites, existing CBT, and other applications (e.g., Microsoft Word®). However, the IDs need to take into account how well these icons will translate to smaller mobile devices.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 3. A score of 1 is attached to this response.	
2. Are the icons familiar to the user and simple?	Icons should be familiar and should not be complex. They should be simple enough to translate onto small mobile devices while identifiable. For example, you don't want to use an intricate icon that is only fully visible on a 15-inch laptop monitor. Also, be aware that different mobile devices may display colors differently. However, icons should not save space at the expense of user understanding.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
3. Do you intend to use photographs in your mLearning?	IDs need to take into account how well photographs will translate to smaller mobile devices, which may limit how well a user is able to see details, complexities, etc.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 5. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
4. Are the photos lower resolution with no or minimal small details?	If you intend to use high-resolution photographs, keep in mind several things: (1) the screen sizes of the devices that may potentially be accessing the mLearning content; (2) the added processor requirements necessary to store and utilize photos that are large in data size. Details in photos that can be detected on a laptop screen may be hard to see on smaller mobile devices. Make sure no critical content is contained within images that could be hard to see on smaller devices. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution photo: (1) is there value in including high-resolution photos, and (2) what is the target platform for delivery? Only include high-resolution photos when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in photos.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
5. Do you intend to have background images in your mLearning?	IDs need to take into account how well backgrounds will translate to smaller mobile devices. Use of backgrounds may not be preferable if it proves to be a distraction. Make sure that background art is not distracting from the main mLearning content. On smaller mobile devices, it may not be necessary to use background art, as the screen size is a very limiting factor when presenting the critical instructional content of the mLearning.	**Yes**: Continue to next question. A score of 1 is attached to this response. **No**: Continue to question 7. A score of 1 is attached to this response.	
6. Is your background image lower resolution with few small details?	When working with a small screen, large CSS (Cascading Style Sheet) background images or infographics can be problematic. Reduce resolution and dimensions of images when you can because it saves bandwidth. **Note**: IDs need to consider two things if they want to include a high-resolution background: (1) is there value in including high-resolution backgrounds, and (2) what is the target platform for delivery? Only include high-resolution backgrounds when absolutely necessary. Also, certain platforms may have high-resolution displays, which enable users to clearly see smaller details in images.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	

	Question	Explanation	Responses & Scoring	Your Project
7.	Will you be using/redesigning existing training content?	If there are existing graphics designed for computer-based eLearning, questions eight and nine in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating graphics from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	
8.	Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing graphics, IDs should evaluate the graphics to see whether they can be divided into smaller units. Simply reducing the size of a graphic may make it hard to read. More redesign efforts should be given when graphics re-creation is needed in order to divide or restructure existing graphics into smaller parts. Cropping and scaling are two methods used to reduce the size of an existing image. To get the right combination of image size and display area, these two methods can be used together to achieve a good result. This technique is called "Relevance-Enhanced Image Reduction" (for more detail, see Nielsen, 1996).	**Yes:** Continue to next question. A score of 5 is attached to this response. **No:** Continue to next question. A score of 0 is attaché to this response	

Question	Explanation	Responses & Scoring	Your Project
9. Are existing graphics in proper format already?	Graphics for computer-based eLearning content may have been produced with high resolution and color depth without compression. Although they display very well on a computer, they may have large file sizes, need more processing power for playback, be in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers), or require separate software to open. To be more suitable for mLearning, graphics should have a quality and color depth that is proper for the content and mobile devices. IDs should consider lowering the graphics resolution and color depth (within the limits of the design requirements) to reduce the size. Graphics should be in a format that is widely accepted on most mobile devices with a good compression ratio, such as JPG/JPEG.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	
Graphics Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding graphics to mLearning.	**Range of scores**: 7–16 **Acceptable range for including graphics in mLearning**: 12–16 Higher scores suggest that you have adequately addressed aspects of including graphics in your mLearning solution and that they may be appropriate to use. Lower scores suggest that there are still things you should consider and address before trying to incorporate graphics in your mobile solution.	

Table 51: Questions to consider for including animation in mLearning.

Question	Explanation	Responses & Scoring	Your Project
1. Do you intend to use animations of any kind in your mLearning?	If you are using animations, you need to consider their length, complexity, and frequency when developing your solution. There are many reasons to use animation (P. Berking, personal communication, April 19, 2013): • Show continuity in transitions • Indicate dimensionality in transitions • Illustrate change over time • Show how elements combine or interact dynamically • Multiplex the display • Enrich graphic representations • Visualize three-dimensional structures • Attract attention	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on social learning components (**Table 52**).	
2. Will you be designing mLearning, or PS in particular?	Some PS may not be ideal for animations because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to watch and understand an animation).	**mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS tool:** Carefully consider whether the use environment will allow users to view animations effectively. Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
3. Have you created short animations that are easily digestible?	It is preferable to utilize shorter animations to show trainee status (e.g., sending email, turning a page), provide useful feedback, enhance the sense of direct manipulation of the app, or to help people visualize the results of their actions (Dannen & White, 2011). Smartphone users tend to interact with their devices ten seconds to four minutes at a time. With this in mind, try to make your format as short and digestible as possible, (Udell, 2012).	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	
4. Have you simplified the animations that you will be using?	Added complexity in animations can confuse trainees, and it can also place added processing power requirements on the mobile device. Keep animations as simple as possible to convey the necessary information.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
5. Do you plan to use animations conservatively?	Use animations conservatively because they have the tendency to be annoying if used frequently. Also, make animations consistent with other animations incorporated into the app (Dannen & White, 2011).	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	
6. Will you be using/redesigning existing training content?	If there are existing animations designed for computer-based eLearning, questions seven through eleven in this table should be asked when considering using existing graphics in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating animations from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
7. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing animations, IDs should evaluate the animations to see whether they can divide the animations into smaller units and reduce the amount of information so that only critical information is conveyed. More redesign efforts should be given when animation reproduction is needed in order to divide or restructure existing animations into smaller units.	**Yes:** Continue to next question. A score of 7 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	
8. Are existing animations in proper format already?	Animations for computer-based eLearning content may have been produced with high resolutions and high frame rates without compression. Although they play very well on a large monitor, they may have large file sizes, need more processing power for playback, and/or play in a format that is suitable for one OS only (given that Microsoft Windows OS is the predominant computer OS on desktop and laptop computers). To be more suitable for mLearning, animations should have a resolution and frame rate that is proper for the content and mobile devices. IDs should consider lowering the resolution and frame rate (within the limits of the design requirements) to reduce the size. Animations should be in a format that is widely accepted on most mobile devices.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
9. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing animations are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Animations may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
10. Does the existing content contain programmed interactions that use rich media-like animations?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries from those for computers. Animations developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing animations in an mLearning solution, IDs need to examine existing animations closely, then redesign or reproduce them for mobile devices. In addition to using the right technologies for producing the animations, IDs need to pay attention to UI and User Experience (UX) design because mobile devices use different input methods.	**Yes:** Rich animations can be used in mobile, but they are more challenging to design. Continue to next question. A score of 1 is attached to this response. **No:** Simpler animations are easier to include in mobile solutions. Continue to next question. A score of 2 is attached to this response.	
11. Are existing animations included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing animations are included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The content is still available to a mobile user even when the device is not online. If animations are streamed, a constant data connection is required to deliver these videos to mobile devices.	**Yes, part of the learning content:** It is easier to package animations into a mobile solution when they are part of the learning content. Continue to **Recommendation**. A score of 2 is attached to this response. **No, streamed in real time:** Animations may still work in this case, but a constant data connection is required. Continue to **Recommendation**. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
Animation Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding animation to mLearning solutions and the appropriateness of animations for the mobile solution.	**Range of scores**: 7–27 **Acceptable range for including animations in mLearning**: 21–27 Higher scores suggest that you have addressed important considerations and it may be appropriate to include animations in the mobile solution. Lower scores suggest that there are still things you should consider before trying to incorporate animations in your mobile solution.	

Table 52: Questions to consider for including social learning components in mLeanring.

Question	Explanation	Responses & Scoring	Your Project
1. Are you aware of the existing social learning components that can be used as part of mLearning solutions?	There are many different ways to incorporate social aspects of learning into an mLearning solution, including: • Email (including group lists) • Whiteboarding and learner-to-learner whiteboard (i.e., not just instructor to learner) • Chat/Instant messenger (IM), text messaging, and multimedia messaging • Blogs, microblogs, and journals • File and desktop sharing • Threaded discussion (aka forums or discussion boards) • Community calendar • Social networking (e.g., Facebook, Twitter, LinkedIn) • Student-created and posting of personal webpages, wikis • Communities of practice (CoPs) or dedicated team spaces. Members/teams can comprise either learner cohorts taking the same course, or functional teams within the organization. • Surveys • Peer rating of content • Webcasting, with the ability for learners to initiate sessions among themselves (i.e., not just one-way, instructor-to-learner webcasting)	**Yes**: Continue to next question. **No**: Stop here and familiarize yourself with the common social learning components listed here. For more information on each, please consult the resources listed in **Section 8.0** of this document. Then continue to next question.	

Question	Explanation	Responses & Scoring	Your Project
2. Do you plan to use any social learning components in your mLearning (e.g., having students create content, or having them communicate with their peers)?	If planning to use social learning components, there are some considerations that IDs should be aware of. Some of these considerations are highlighted here. In general, social learning is better for higher-order learning outcomes and problem-based, project-based, or team-based learning. Social learning may be appropriate when: • Users are motivated • They know a lot about the topic • They are accustomed to working independently • The content is nuanced, emerging • The material is complex, even controversial • Internet access is not reliable • Supervisors do not know about or necessarily support this material	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on e-books (**Table 53**).	

Question	Explanation	Responses & Scoring	Your Project
3. Have you weighed the **pros** and **cons** of including social learning components in your solution?	IDs must understand the benefits and drawbacks of using social learning components as part of their mobile solution. Some examples of pros and cons are outlined here. **Pros (Osborne, 2012):** • Familiar tool with most students and appeals to wide range of learners • Virtually limitless amounts of information available online for students to consult • Can improve students' abilities to do online research • Can improve student/instructor communication • Students learn how to leverage social media in everyday life • Digital citizenship: students learn about appropriate online presence and behavior • Can engage students: especially Generation Y and younger • Encourages user-generated content, and learning materials can be easily shared • Encourages active participation, and shy students may become more involved when they interact virtually • Supports collaborative activities **Cons (Osborne, 2012):** • Can become a waste of time if it doesn't relate directly to a learning objective (incorporating it because it is available, not because it enhances learning) • Students may get distracted more easily • There is a risk of cyber-bullying • Face-to-face interaction is limited • Tracking student contributions and learning with social media can be difficult • Mobile platforms are constantly changing • Potential for sharing of inappropriate content • Need for Internet access for some social media • Potential privacy violations can occur	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
4. Do you intend to use text messaging or instant messaging capabilities in your mLearning?	SMS is a way to deliver content very simply. Texting is cheap and almost universally accessible. It can be designed to not only give information but to collect information (Elias, 2011). SMS applications can work on any mobile devices nearly instantaneously (e.g., for sending timely alerts). However, they're typically limited to 160 characters, provide a limited text-based experience, and can be very expensive (Fling, 2009). Users may also interact with each other using instant messaging programs on devices that are connected to the Internet.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
5. Do you intend to use multimedia messaging capabilities in your mLearning?	Multimedia messaging capabilities (e.g., audio/visual recording capabilities) are required. The mobile device must be able to read and decode the format that the images/video/audio messages are in to be of any use to the end user.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
6. Do you intend to use blogs, micro-blogging, discussion forums, white boards, or wikis in your mLearning?	These social learning components encourage users to be active learners and to participate in collaborative activities. Users contribute to the content of training, or a course, by sharing personal insight, having discussions with peers, and collaborating with others. Using this type of social learning activity encourages users to have open discussions from various perspectives.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
7. Do you intend to use email in your mLearning?	Email requires access to the Internet and requires users to be familiar with email on their mobile devices. Email is easy to use, fast, and practical to use for communication. However, email is also impersonal and can have security issues when content is sensitive.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
8. Do you intend to use social networking features in your mLearning?	Social networking apps require access to the Internet, and they also require users to be familiar with how they work. Some examples include Facebook, Twitter, and LinkedIn. Also, community calendars and CoPs provide networking functions. Users can share information, collaborate on research with similar-minded individuals, and interact with others.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
9. Will users be creating content?	Users are able to generate content to add to the mLearning solution via the features on their mobile devices. For example, users can take pictures, make videos or webcasts, create and post websites, share files, complete surveys, and even rate the content of an mLearning solution. The content from users can create a much richer, more meaningful learning experience because users take more responsibility for their learning and feel as though they are contributing in unique ways. However, it is also possible that some users may attempt to add inappropriate content. Thus, it would be a good idea to have someone monitoring the user-generated content for quality assurance.	**Yes:** Continue to next question. A score of 2 is attached to this response. Mobile platforms are especially useful in this context. **No:** Continue to next question. A score of 1 is attached to this response.	
10. Will you be using/redesigning existing training content?	If there are existing social learning components designed for computer-based eLearning, questions eleven through thirteen in this table should be asked when considering using existing social learning components in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating social components from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
11. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing social learning components are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Social components may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	
12. Does the existing component contain programmed interactions?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Social learning components developed and programmed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing components in an mLearning solution, IDs need to examine existing social learning functions closely, and to redesign and reproduce them for mobile devices and mLearning behaviors. In addition to using the right technologies for producing the functions, IDs need to pay attention to UI and UX designs because mobile devices use different input methods and users use mobile devices differently than they use computers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	
13. Is it reasonable to only use social learning components with online capabilities?	Social learning requires users to be online, but not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When redesigning social learning components for mLearning, IDs need to be aware that not all mobile devices are online everywhere, all the time.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	

Question	Explanation	Responses & Scoring	Your Project
Social Learning Components Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding social learning components to mLearning solutions and the appropriateness of social learning components for the mobile solution.	**Range of scores**: 11–15 **Acceptable range for including social learning components in mLearning**: 11–15 You may find that you need to do some additional research on social learning components before making a decision to include them in the mLearning solution. However, you may find that you have adequately considered aspects of social learning components and have a good understanding of what is involved. Higher scores suggest that you have addressed important considerations and it may be more appropriate to include social learning components in the mobile solution.	

Table 53: Questions to consider for including e-books in mLearning.

Question	Explanation	Responses & Scoring	Your Project
1. Will you include an e-book in your solution?	Creating an e-book requires specific considerations. These include (Koeller, 2012; JISC Digital Media, 2013): **Design considerations:** • Structure and layout • Navigation through pages (linear format vs. allowing multiple reader "journeys" through the content) • Graphic design requirements **Digital content considerations**: • Format (e.g., basic text, files that use ePub and Adobe PDF standards) • Interactivity, hyperlinking, inclusion of multimedia • Editorial requirements • Quality assurance and focus group testing **Development considerations:** • Level of technical expertise required • Degree of review • Conversion and production **Publishing and distribution considerations:** • E-book delivery: email, downloaded, part of an app, retrieved from a virtual library • Digital content preparation • Submission and content updates	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on mobile games (**Table 54**).	

Question	Explanation	Responses & Scoring	Your Project
2. Do you intend to create an e-book from existing materials?	It is relatively easy to translate from existing manuals/books, as long as it is mostly text based. Images may be taxing to the system if the book contains a lot of them. If you are creating a new book (from scratch) for this purpose, it could be a time-consuming process. One of the ways that e-book content differs from paper books is that e-books can include multimedia to enhance the user experience; it is important to note that the type, format, and sizing of the multimedia components depends on which format the e-book will be produce in, as well as what mobile platforms will be accessing it (JISC Digital Media, 2013). Consider that: • Cover images can be added • Illustrations, diagrams, and videos can be included to provide additional context for the user • Audio for "text to speech" can be a feature • Audio versions of the e-book can be created	**Yes:** Continue to next question. No score is attached to this response. **No:** Even if you are creating an e-book from scratch, the same factors should still be considered. Continue to next question. No score is attached to this response.	
3. Do you intend to have the e-book be the primary mLearning component?	If the e-book is the primary component, make sure that it is not too long, which can be boring for users. Present information in well-formed and chunked chapters/sections. If the e-book is a supplement, make sure that it adequately supports the primary content.	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.	
E-book Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of e-books that can impact how you choose to incorporate them into mLearning solutions.	

Table 54: Questions to consider for including mobile games in mLearning.

Question	Explanation	Weigh/Decision Point	Your Project
1. Do you intend to use games in your mLearning?	Games may be appropriate when users are not motivated, or for Generation Y individuals who play a lot of video games.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on augmented reality (**Table 55**).	
2. Will you be designing general mLearning or PS?	PS may not be ideal for games because of the nature of the environment (e.g., a Soldier consulting PS tool in the field will not have time to play a game). People want quick access to a PS tool (just enough information, just in time, just for "me"). They do not want (or have time to) play a game to get the information that they need.	**General mLearning solution:** Continue to next question. A score of 1 is attached to this response. **PS Tool:** Game is not suitable. A score of 0 is attached to this response. Go to next sequence of questions on augmented reality (**Table 55**).	
3. What level of fidelity do you want to include in your mobile game?	May not need a high level of fidelity for students to learn effectively. Only use the necessary level of fidelity, as increased fidelity may cost additional time, resources. Furthermore, a high level of fidelity can take up valuable processing resources. It may force you to design the game to be significantly shorter and less complex in content. Some devices may not be able to fully support high-fidelity games.	**Low:** Continue to next question. A score of 2 is attached to this response. **Mid to High:** Games with higher fidelity are more challenging to incorporate into mobile solutions. Continue to next question. A score of 1 is attached to this response.	
4. How interactive will your mobile game be?	Minimal interaction: This means you will be taking a more cognitive approach in that the student will be passively learning more than actively participating. Very interactive: Constructivist approach where users actively construct their own knowledge.	**Low:** Continue to next question. A score of 1 is attached to this response. **High:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Weigh/Decision Point	Your Project
5. Do you intend to include quiz games?	Quiz games (periodic knowledge checks). Make sure to keep the quizzes short and to give immediate feedback on the answers.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
6. Do you intend to include surveys in your game?	Make sure to keep the surveys short and to give immediate feedback on progress through the survey.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	
7. Will you be using/redesigning existing training content?	If there are existing games designed for computer-based eLearning, questions eight through 13 in this table should be asked when considering using existing games in an mLearning solution.	**Yes:** Continue to next question. A score of 1 is attached to this response. **No:** Even if you are creating a game from scratch, the same factors should still be considered. Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Weigh/Decision Point	Your Project
8. Is the existing content easily "chunk-able"?	For mLearning, users will not be spending a long period of time going through content on a mobile device, especially on the mobile device with a smaller screen, such as a smartphone. Therefore, it is recommended to divide learning content into smaller units, often called "chunks," to be more suitable for mLearning. When designing an mLearning solution based on existing games, IDs should evaluate the games to see whether they can be divided into smaller units or levels to reduce the amount of information conveyed. More redesign efforts should be given when game redesign and reproduction are needed in order to divide existing games into smaller units or levels. Game play should be modified and simplified to be suitable for mobile platforms. For example, the games designed for PC are traditionally played using a mouse and a keyboard. Mobile devices do not have these physical components, and so different types of interactions are required to play games on mobile platforms.	**Yes:** Continue to next question. A score of 8 is attached to this response. **No:** Continue to next question. A score of 0 is attached to this response.	
9. Is the existing game in HTML format already?	Most mobile devices today come with mobile browsers pre-installed or as a part of the mobile OSs. That makes the delivery of HTML-based games possible and easier on mobile devices. Special considerations should still be given to the following when using/redesigning existing games for an mLearning solution: • Do existing games require plug-ins? Many plug-ins made for computer OSs will not work on mobile devices or don't have a mobile equivalent. • Do existing games require a large display? With high processing power and graphics capabilities on today's computers, games display large amounts of detail. When this detail is displayed on a mobile device, it becomes hard to see. • Do existing games require changes in interface and control? Mobile devices largely use touchscreen input. Game interfaces and interactions design for mouse and keyboard on a computer may not function as well on a mobile device.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Weigh/Decision Point	Your Project
10. Does the existing content contain Adobe Flash multimedia components?	The current situation is that most mobile devices do not support Adobe Flash content. If the existing games are in Flash format, IDs have to redesign them for mobile delivery.	**Yes:** Games may still be used, but they will be more challenging to include owing to redesign for mobile delivery. Continue to next question. A score of 1 is attached to this response. **No:** Continue to next question. A score of 2 is attached to this response.	
11. Can existing game's code be recompiled for mobile OSs without major recoding?	In most cases, desktop and laptop computer OSs, mostly Microsoft Windows today, are different from OSs on mobile devices. Programming for mobile OSs requires different programming languages and/or software libraries than those for computers. Games developed for computer-based learning content may not behave properly or work at all on mobile devices. When considering using existing games in an mLearning solution, IDs need to examine existing games closely, and to redesign and reproduce them for mobile devices. Some game engines are capable of producing games on multiple platforms, including mobile, by simply recompiling the game. In addition to using the right technologies for producing games, IDs need to pay attention to UI, UX, and game content design because mobile devices use different input methods and a much smaller display.	**Yes:** Continue to next question. A score of 2 is attached to this response. **No:** Continue to next question. A score of 1 is attached to this response.	

Question	Explanation	Weigh/Decision Point	Your Project
12. Are existing games stand alone and included as a part of the learning content?	Not all mobiles devices can maintain constant data connectivity anywhere and anytime. A large portion of tablets sold today is Wi-Fi only. Although Wi-Fi availability and coverage have been improving quickly, these Wi-Fi only tablets still cannot maintain constant data connection at all times. When existing games are stand alone and included in the learning content, it is easier to package them into a mobile solution that can reside locally on a mobile device. The games are still available to a mobile user even when the device is not online. If these are online games, a constant data connection is required to deliver them to mobile devices.	**Yes, part of the learning content:** It is easier to package games into a mobile solution when they are part of the learning content. Continue to next question. A score of 2 is attached to this response. **No, online:** Games may still work in this case, but a constant data connection is required. Continue to next question. A score of 1 is attached to this response.	
13. Are IDs ready to change assessment methods?	Owing to the changes in interface, navigation and control, and display size, and details mentioned above, assessments (scoring) designed in the existing games for computers might not be accurate or correct once the games are redesigned and deployed in the mobile form. Assessments (scoring) need to be redesigned while redesigning games or to match the redesigned games.	**Yes:** Continue to **Recommendation**. A score of 2 is attached to this response. **No:** Continue to **Recommendation**. A score of 1 is attached to this response.	
Mobile Games Recommendation	The aggregated scores will tell the IDs whether they have adequately considered factors involved in adding games to mLearning solutions and the appropriateness of games for the mobile solution.	**Range of scores**: 0–25 **Acceptable range for including games in mLearning**: 18–25 Higher scores suggest that there is a greater likelihood that games can be more easily incorporated in your mobile solution Lower scores suggest that it will be more challenging to incorporate games, and there may be considerations that you need to re-assess.	

Table 55: Questions to consider for including augmented reality in mLearning.

Question	Explanation	Responses & Scoring	Your Project
1. Are you planning on using some form of augmented reality (AR) in your mLearning solution?	**YES:** You must ALWAYS be connected to the Internet; technology is in early stages and does not have full capabilities yet; high cost of development; software design/development is complex and difficult; requires a lot of battery life, computational power, cameras, and tracking sensors (hardware); requires sophisticated AI (artificial intelligence) and 3D modeling applications (software); smartphones provide limited screen space for displaying AR; slow network speeds can be a problem; app developers lack easy authoring tools for creating mobile AR content. Users have to be comfortable and familiar with technology. An AR system must be able to recognize what users are looking at (ARTags, GPS, etc.), and acquire and overlay the appropriate virtual graphics. AR requires a high-end video-capable phone or smartphone/device as well as a fairly high amount of processing power.	**Yes**: Continue to next question. **No**: Stop here. Go to next sequence of questions on what type of app to use (**Table 56**).	
2. Do you intend to include virtual overlays using GPS/location tracker?	While this can help students get real-time help and support, GPS may not work well indoors, which could cause misaligned visual representation of data.	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response. This is a consideration that is dependent on context of use.	

Question	Explanation	Responses & Scoring	Your Project
3. Do you intend to use AR games?	AR games can be very time consuming and complex to create. Many factors need to be considered, including (Herbst et al., 2008): • Understanding how to keep user attention • Simplifying the interaction scheme • Understanding user safety during use • Understanding the environment of use • Understanding when and how to involve interaction with others • Creating a seamful design that accounts for technology related errors • Understanding how to use both real and virtual objects • Understanding how to maintain constant gameplay	**Yes:** Continue to next question. No score is attached to this response. **No:** Continue to next question. No score is attached to this response.	
4. Do you intend to include virtual overlays with QR Codes?	QR Code is a 2D code and ISO (International Organization for Standardization) standard that can encode information (e.g., text, URLs and other data) (Yoon et al., 2011). Some of advantages of using QR Codes are: • Low computational complexity allows much faster decoding; data are self-contained, and encoded data capacity is high; suitable for mobile environments; robust and scalable; easily created and deployed • QR Codes are useful now for delivering information and wayfinding, but as computer vision improves, QR Codes will essentially become unnecessary (Udell, 2012).	**Yes:** Continue to **Recommendation**. No score is attached to this response. **No:** Continue to **Recommendation**. No score is attached to this response.	
Augmented Reality Recommendation	There are no scores here, as this is educational in nature.	Regardless of responses, you have been prompted to consider aspects of augmented reality that can impact how you choose to incorporate it into mLearning solutions. Context of use becomes very important here.	

Table 56: Questions to consider for determining what type of app to use.

Question	Explanation	Responses & Scoring	Your Project
1. What is a Mobile Web App?	**WHAT IS IT?** A website that you access from your device's browser, but that is made to resemble an app rather than a traditional webpage. It can be accessed by any mobile device with a browser. HTML5, CSS3, and JavaScript are being used for this purpose.	Continue to Question 2	
2. What is a Native App?	**WHAT IS IT?** A native mobile app is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices.	Continue to Question 3	
3. What is a Hybrid App?	**WHAT IS IT?** It is built using web technologies, then wrapped in a platform-specific shell that allows it to be installed as a Native App. It is a native, downloadable app that runs all or some of its UI in an embedded browser component. Instead of rewriting app from scratch for each mobile OS, developers write at least some of their app code in HTML, CSS, and JavaScript and reuse it across devices (Jones, 2012).	Continue to Question 4	
4. Do you need a mobile solution that has cross-platform compatibility?	Mobile platform independence is important when a lot of different mobile devices will be accessing the mLearning content. It directly ties to BYOD preferences: if the mobile solution is BYOD, then you will need an app that allows platform independence. Mobile Web Apps are easy to deploy across multiple devices (ADL, 2012). IDs must also consider the mobile platforms that collaborating or partnering organizations will be using. In particular, this should be considered when: - The mobile project is part of a **joint-project initiative**, where multiple agencies collaborate to jointly develop the solution which will then be used across agencies, or - The mobile project is developed by one agency with the intent that the mLearning solution will deploy across **multiple agencies**.	**Yes:** You must use either Hybrid Apps or mobile Web Apps. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +0 **No:** Any app may be appropriate. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1	

Question	Explanation	Responses & Scoring	Your Project
5. Does your solution require the use of internal features of the mobile device (e.g., camera, GPS)?	Only certain apps (hybrids and Native Apps) allow users to access internal features of the mobile device. However, a Hybrid App's performance is dependent on the device's browser capabilities. Web Apps do not have the same access to the device's hardware and OS features, and don't have full access to all the methods exposed by the device's OS compared to a Native App, meaning you are limited to the APIs made available by the browser (Jones, 2012).	**Yes:** You must use either Hybrid Apps or Native Apps. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +1 Native App: +1 **No:** Any app may be appropriate. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1	

Question	Explanation	Responses & Scoring	Your Project
6. What is your relative budget for developing and implementing the mobile solution?	Certain apps require more resources to develop. Your estimated budget will constrain what you can do. A native mobile application is specifically designed to run on a device's OS and machine firmware. It typically needs to be adapted/adjusted for different devices. Deloitte estimates the cost of developing for two OSs is 160 percent of the cost of developing for one (ADL, 2012). Costly to develop. Industry analysts provide cost estimates that range from $20,000 to build a simple mobile app, to $150,000 or more for a complex app. These costs are largely replicated for each mobile OS the app must support (Sybase, Inc., 2012). Mobile Web Apps are low-cost solutions in comparison, especially when designing for more than one mobile device. Hybrid Applications can be built by web developers familiar with HTML, CSS, and JavaScript. Many companies already have web developers in house. It becomes a low-cost solution to create a team of in-house Hybrid App builders (Sybase, Inc., 2012). **Note:** Those IDs developing mobile for internal training may see different costs than those IDs developing mLearning for wide use.	***Low budget:** <$20k (mobile Web App is likely to fall into this budget). Continue to next question. **Scoring:** Web App: +1 Hybrid App: +0 Native App: +0 ***Medium budget:** $20k-$150k (mobile Web App, Hybrid App, and possibly Native App). Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +0 ***High budget:** >$150k (you can likely build any type of app with this budget). Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1 *These estimates are based on information obtained from Sybase (2012). These are recommendations. Actual budget required to develop is based on nature of project and learning outcome to be achieved.	

Question	Explanation	Responses & Scoring	Your Project
7. What level of design and programming expertise can your organization support?	Some apps require more complex programming. If these skills are not available in house, you will need to consider using external software engineers to program certain types of apps. **Mobile Web Apps** use basic HTML, CSS, and JavaScript, which are arguably easier to learn than native languages such as Objective-C or Java. "Using basic HTML via Adobe Dreamweaver to develop a mobile website is easier for the average user, as they do not need to understand advanced programming and can focus on design rather than programming" (Martin et al., 2012). Mobile Web Apps can be challenging (but not impossible) to support across multiple browsers (ADL, 2012). **Hybrid Apps can also be somewhat complex to build:** Mobile developers need to know HTML, and web developers need to know mobile phone APIs. People who build hybrids need to know both (Jones, 2012). **Native Apps: More difficult programming.** In general, developing a Native App from the ground up using native code for a mobile OS requires in-depth knowledge of that particular mobile platform, higher programming experience and skills, and longer development time. Building Native Apps requires specific development skills associated with the targeted mobile platforms. Developing a mobile solution that can be deployed to multiple mobile platforms not only requires in-depth knowledge of all targeted platforms, but also design considerations that will minimize the differences between mobile platforms so the solution will function similarly to achieve the same learning outcomes. Many companies cannot justify the cost of building large teams of these specialists in house, so they outsource this work to high-cost contractor resources (Sybase, Inc., 2012).	**Simple programming:** A Web App can be created. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +0 Native App: +0 **Mid-level programming:** A Web App, and maybe a Hybrid App in some cases. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +0 **High level, complex programming:** Can support Web App, Hybrid App, and Native App. Continue to next question. **Scoring:** Web App: +1 Hybrid App: +1 Native App: +1	

Question	Explanation	Responses & Scoring	Your Project

8. Are you on a quick timeline to develop and implement the mobile solution?	Native Apps take a longer time to develop and implement than Mobile Web Apps and Hybrid Apps, which is important to consider if you have strict time constraints for the project.
	
	A typical Native App takes three to six months to build (Gill, 2012). Because the codebase needs to be reworked for each OS, the time to build an app for multiple devices can also be extensive (Jones, 2012).
		Yes: Use Web App or Hybrid App. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +0
		
		No: Native App can be an option, but it takes longer to build. Hybrid Apps and Web Apps are options too. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +1	

9. Will users need to access materials offline?	Connectivity: Mobile Web Apps have to be online in order to access information. IDs need to take the online requirement of a Web App into consideration when it is going to be deployed in a BYOD setting, since users may incur additional costs for using additional mobile data.
	
	If there is a chance that people need to access material offline, a Native App is probably "safer" to use, since all material can be accessed without an Internet connection. If people will definitely need access to content offline, you should probably use a Native App. However, a Hybrid App is also able to access some content offline.
		Yes: Native App is best option. Continue to next question.
		
		Scoring:
		  Web App: +0
		  Hybrid App: +0
		  Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		  Web App: +1
		  Hybrid App: +1
		  Native App: +1	

Question	Explanation	Responses & Scoring	Your Project

10. Does the app need to be particularly fast?	The speed of different types of apps varies. For a given set of features and functions, if you require a fast app, then a Native App may be ideal. If the speed of the app is not the primary concern (as long as it is an acceptable speed), then a Mobile Web App or a Hybrid App may be sufficient.
	
	Native Apps have better performance (at least for now), snappier animations and transitions, and faster load times. The performance difference between Native and Web Apps is far more pronounced on slower devices (e.g., iPhone 3G running iOS4) (Jones, 2012).
	
	This is due to different techniques and technologies used in developing the apps. A Web App uses web programming technologies, meaning that it uses interpreted code as opposed to compiled code used in Native Apps. Technically, interpreted code used for Web Apps will always be slower than compiled code used in Native Apps on the same mobile device (Jones, 2012).
	
	Additionally, a Native App's performance is dependent on the mobile device's local resources, such as processing power. For a given device, local resources remain constant. Therefore, the performance of a Native App remains relatively constant. As for a Web App or a Hybrid App, its performance is affected by the Internet connection speed. A slow Internet connection will reduce the performance for a Web App or a Hybrid App.
		Yes: Native App offers faster performance. Continue to next question.
		
		Scoring:
		
		   Web App: +0
		
		   Hybrid App: +0
		
		   Native App: +1
		
		No: Any type of app may be appropriate. Continue to next question.
		
		Scoring:
		
		   Web App: +1
		
		   Hybrid App: +1
		
		   Native App: +1	

Question	Explanation	Responses & Scoring	Your Project

11. Does your mLearning solution require advanced graphics?	Native and Hybrid Apps deliver more advanced graphics than a Mobile Web App.
	
	For this reason, a Mobile Web App is not recommended for game development.
	
	If your goal is to create a mobile game, then you need to create a Native App. It can be ported to other devices fairly quickly (Fling, 2009).
		Yes: Native and Hybrid Apps are preferable. Continue to next question.
		
		Scoring:
		
		   Web App: +0
		
		   Hybrid App: +1
		
		   Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		   Web App: +1
		
		   Hybrid App: +1
		
		   Native App: +1	

Question	Explanation	Responses & Scoring	Your Project

12. Does your mobile solution require push/pull features?	**Push**: New events, messages, or data are sent to the mobile device as they occur without the user of the device first requesting them.
	
	Pull: The user of the mobile device makes a request for data or events.
	
	The Push/Pull design should also take into account whether users are allowed to provide input, such as file upload.
	
	A Native App allows both push and pull.
	
	Pull benefits: Client and server are both simpler to engineer. It allows user to determine when the action occurs and when bandwidth is used (AT&T, 2007).
	
	Push benefits: The user is notified in near real time when an event occurs; can reduce bandwidth consumption if events are infrequent; significantly more complex to engineer (AT&T, 2007). Resist the temptation to put everything into push-mode because this can discourage people from learning how to search the content to find the answers they need and from being self-reliant (Griffin, 2011).
	
	In addition to the technical differences described above, IDs need to consider how the push and pull features will help serve and achieve desired learning outcomes. The pull feature is better for users to search and retrieve information when they are ready and need the information. Users have control of what to receive and when. The push feature may be better used for prompting users with feedback, such as texts, at spaced intervals, which may help reinforce learning over time, prevent skill decay, and lead to better transfer of knowledge.
		Yes: Native App or Hybrid App has this capability. Continue to next question.
		
		Scoring:
		
		  Web App: +0
		
		  Hybrid App: +1
		
		  Native App: +1
		
		No: Any type of app will work. Continue to next question.
		
		Scoring:
		
		  Web App: +1
		
		  Hybrid App: +1
		
		  Native App: +1	

Question	Explanation	Responses & Scoring	Your Project

13. Is the solution for commercial release (for sale)?	A Native App and a mobile website solution use totally different distribution methods. This impacts how the solution is delivered and how much control the organization has on the distribution. A Native App type of solution is much easier for public, commercial distribution and accounting than a mobile website type of solution.
	
	A Native App and a Hybrid App are normally distributed from a third-party distribution service, such as Apple App Store or Google Play Store, so the organization does not need to manage and track the distribution. This is easier for commercial release.
	
	A Web App is like a website. Users use a URL to launch the app, making it harder to manage and track the distribution.
		Yes: A Native App is applicable here. Continue to next question.
		
		Scoring:
		   Web App: +0
		   Hybrid App: +0
		   Native App: +1
		
		No: Any type of app would work. Continue to next question.
		
		Scoring:
		   Web App: +1
		   Hybrid App: +1
		   Native App: +1	

14. Will the mobile device have constant Internet access while being used for mLearning?	A mLearning solution with the need of having constant data connectivity defines the target mobile devices, especially when allowing BYOD, and the availability of the solution. Today, a large portion of tablets purchased is Wi-Fi only. Those devices will only be able to use the solution when they are connected to a Wi-Fi network. Even with the Wi-Fi networks getting more and more accessible, they are still far less than "anywhere, anytime."	**Yes**: Any type of app would work. Continue to next question.
		
		Scoring:
		   Web App: +1
		   Hybrid App: +1
		   Native App: +1
		
		No: Native Apps do not require constant Internet connectivity. Continue to next question.
		
		Scoring:
		   Web App: +0
		   Hybrid App: +0
		   Native App: +1	

Question	Explanation	Responses & Scoring	Your Project
15. Does your client/organization have policies that govern both Web and App publications?	A Native App and a mobile website solution use totally different distribution methods. With the long history and good understanding of publishing content on websites, most organizations have policies, process/procedures, and dedicated resources managing website content. App publications and releases are still relatively new. Many organizations do not have policies and process/procedures in place to manage that. This may raise certain issues, such as security.	**Yes:** You should research the existing policies that your organization has so that you can create a mobile solution that aligns with these policies. Continue to next question. **Scoring:** Web App: +1 (if policy exists) Hybrid App: +1 (if policy exists) Native App: +1 (if policy exists) **No:** You should approach the leadership of your organization about creating policies to guide future mobile projects. Continue to next question. **Scoring:** Web App: +0 Hybrid App: +0 Native App: +0	

Question	Explanation	Responses & Scoring	Your Project
Recommendation for Type of App	The ID should have a better understanding of the factors involved in making decisions about what type of app would be most appropriate for his or her mobile solution. **Table 18** below can provide more guidance. A frequency count will be given for the number of times a Native App, Hybrid App, and Web App applied to a user's response to questions 4, 5, 7, 8, 9, 10, 11, 12, 13, and 14. For example, the user answers "no" and discovers that in that particular instance, a Hybrid App would be the best option. The frequency counts will be listed here so that users can see what type of app has the highest/lowest frequencies, which may suggest what type of app(s) the user may want to explore further for his or her mobile solution, and which type of app(s) the user may want to avoid (i.e., the one with the lowest frequency).	**Frequency count for response:** Mobile Web App: # Hybrid App: # Native App: # The type (or types) with the highest frequency count(s) may be best suited for your needs.	

10.0 Glossary

Term	Explanation
3G	The third generation of mobile telecommunication technology is a way mobile devices connect to their mobile service providers in order to send and receive data at speeds of at least 200 Kb/s.
44 Pixel Rule	A unit of measure in developing iOS apps. An icon or a button should be at least 44 pixels in size for easy touchscreen operations.
4G	The fourth generation of mobile telecommunication technology is a way mobile devices connect to their mobile service providers in order to send and receive data at speeds of up to 100 Mb/s.
Accelerometer	A sensor of a mobile device that measures the acceleration of the device. The accelerometer is used to present landscape or portrait views of the device's screen, based on the way the device is being held.
Ad hoc distribution	Ad hoc distribution allows developers to test a mobile solution, such as an app, before making it available in the Apple App Store. Developers can use this method to share iOS apps with beta users.
AJAX	Asynchronous JavaScript and XML (AJAX) is a group of interrelated web development methods used on the client-side to create interactive Web Apps. With AJAX, Web Apps can retrieve data from the server asynchronously in the background without interfering with the display and behavior of the webpage. It's used frequently in mobile web development.
Alternate reality	An interactive narrative that uses the real world as a platform, often involving multiple media and game elements, to tell a story that may be affected by participants' ideas or actions.
Amazon Appstore for Android	An Amazon store for Android apps where you can download apps for Android-based mobile devices.
Android	Android, developed by Google, Inc., is an open-source software suite for mobile devices that includes an OS, middleware, and apps.
API	Application Programming Interface (API) is a set of rules and specifications that a software program can follow to access and make use of the services and resources provided by another software program that implements the API. It serves as an interface between different software programs and facilitates their communications and data exchanges.
App	Short for "application," an app is computer software designed, mostly for mobile devices today, to help the user perform a set of tasks.
App store	A digital distribution platform intended to provide mobile software to mobile devices. Some common app stores are the Apple App Store, the Android Market (now Google Play Store), Blackberry AppWorld, Amazon Appstore for Android, and Windows Marketplace.
Apple App Store	Apple's distribution platform for thousands of apps. Users can find apps for devices running iOS and Mac OS, and can also download apps through iTunes.

Term	Explanation
AT&T	One of the largest wireless communications providers in the United States. AT&T was the first wireless provider that offered Apple iPhones.
Augmented reality	Augmented reality (AR) is a term for a real-time direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated input, such as sound, text, and/or graphics.
Auto-correct	A common feature on most mobile devices today to help users correct misspelled words while typing.
Back button	A button in a browser to take users back to the previous page. With mobile browsers, there may not be a back button. This becomes a design consideration.
Barometer	A sensor that measures atmospheric pressure. It can help forecast weather changes and improve GPS altitude positioning. This feature is starting to be included in mobile devices.
BlackBerry	BlackBerry is a line of mobile devices and a mobile OS developed and designed by the Canadian company Research In Motion (RIM) since 1999.
BlackBerry App World	BlackBerry's official app store.
Bluetooth	Bluetooth allows you to exchange data over short distances with low amounts of power. Bluetooth is not the same as WiFi, and can be used to connect wireless headsets to your mobile device, as well as sync with other devices. Today, Bluetooth's specifications are laid out by the Bluetooth Special Interest Group.
Brew MP	Binary Runtime Environment for Wireless (Brew MP, Brew, or BREW) is an app development platform created by Qualcomm, originally for code division multiple access (CDMA) mobile phones, featuring third-party apps, such as mobile games. It is offered in some feature phones but not in smartphones. It debuted in September 2001.
Brick phone	In the 1980s, Motorola® introduced the first cell phones to the public. They were very large compared to most phones today. Given their heavy weight, which was about 2 pounds (0.91 kg), their considerable size, and rectangular aesthetics, they earned the amusing name "brick phone."
Bring Your Own Device (BYOD)	A policy where businesses let employees use their own personal phones or tablets for business purposes.
Candybar	Also known as a bar, slab, or slate block phone, a candybar phone is normally in the shape of a rectangle and resembles a candy bar. These mobile phones typically have the screen and keypad on one face.
Capacitive touchscreen	One of the main ways users can interact with a device (the other is resistive). This model relies on electrical properties of the human body to determine when and where a user is touching. The screens are made of a material that holds electric charge, and touching them changes the amount of the charge. Because human contact is necessary, it's not possible to use this screen when the user is wearing gloves.
Carrier	Companies that provide services to mobile phone subscribers. A carrier is also known as a mobile network operator, mobile phone operator, carrier service provider, or wireless service provider.

Term	Explanation
CDMA	Code division multiple access (CDMA) is a channel access method which allows for multiple frequencies to transmit signals over a wireless service. CDMA is used by carriers to provide mobile phone services.
Certificate	Various mobile platforms require an app's code to be signed by a certificate. Essentially, code signing is a way to guarantee the authenticity of an app. This provides security by verifying there have been no modifications to the app.
Check in	Many social networking services, such as Foursquare, Google Latitude, Google+, Facebook, VK (social network), Gowalla, GetGlue, and Brightkite, allow users to "check in" to a physical place and share their locations with their friends. Users can check in to a specific location by text messaging or by using a mobile app on a smartphone—the app will use the phone's GPS to find the current location. Many apps have a "Places" button or tab where a user can see a list of nearby places into which the user can check in. If a location is not on the nearby places list, the user can add the location directly from the phone. Once users have checked in, they have the option of sharing their location with friends in services such as Twitter or Facebook.
Cloud computing	The use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The name comes from the common use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software, and computation. End users access cloud-based apps through a web browser or a light-weight desktop or mobile app while the business software and user's data are stored on servers at a remote location.
CMS	A Content Management System (CMS) is a computer system that allows publishing, editing, modifying, and maintaining content from a central interface. CMS provides procedures to manage workflow in a collaborative environment.
Cocoa Touch	Cocoa Touch is an API developed by Apple, Inc., for building software programs to run on iOS devices.
Component	A reusable piece of program logic or user interface. When used to refer to mobile development, the word component is often used to refer to a functional widget or form element.
Control	A reusable piece of program logic or user interface. When used to refer to mobile development, the word control is often used to refer to a functional widget or form element.
CSS	Cascading Style Sheets (CSS) is a style sheet language that determines how to display a document written in a markup language. CSS is most commonly used to style webpages written in HTML and XHTML, but the language can also be applied to any kind of XML document, including SVG and XUL.
CSS animations	CSS animations allow an author to modify CSS property values over time.

Term	Explanation
	They are a key component and significant improvement added to CSS in version 3 of the standard.
Design for Mobile (D4M)	Design For Mobile describes itself as "a conference, resource, and community focused on the mobile user experience. The designers, researchers, developers, marketers, advertisers, strategists, and product managers who participate are amongst the leading thinkers in the mobile design field."
Design pattern	A general reusable design solution to a commonly occurring problem. A design pattern is not a finished design that can be transformed directly into code. It is a description or template for how to solve a problem that can be used in many situations.
Deutsche Telekom	Deutsche Telekom AG (aka DTAG or German Telecom) is one of the largest telecommunications companies in the world with more than 200 million customers in 50 countries as of December 2010.
Disabled	A state of an interface element that lets users know it is unavailable because of the user's state or context.
EDGE	Enhanced Data rates for GSM Evolution (EDGE) is an enhanced version of GSM. It is not as fast as 3G services. Also known as Enhanced GPRS (EGPRS), IMT Single Carrier (IMT-SC), or Enhanced Data Rates for Global Evolution.
eLearning	Learning and teaching using electronic devices with content delivered via computers over a network such as the Internet. The coursework can be completed at the learner's pace or through instructor-led training (ILT). More specific than eLearning is mobile learning (mLearning). mLearning is not eLearning on a mobile device.
Emulator	Software that imitates running one system on another system. In mobile design and development, use of an emulator may be required in order to test on prerelease hardware, or as builds, or in order to test on a wide variety of systems to which you may not have direct access. For example, it's possible to run an iOS emulator on an Apple computer using the Mac OS.
Enterprise Development Agreement (EDA)	Apple's Enterprise Development Agreement (EDA) allows you to distribute your in-house apps and bypass the iTunes store. This allows for distribution of your proprietary, in-house apps to employees or members of your organization.
EVDO	Evolution Data Optimized (EVDO) is a 3G standard that allows users to be connected at a transfer rate ten to fifteen times faster than EDGE. It utilizes a CDMA signal. The connection may have advantages over Wi-Fi in that there is seamless roaming, it is secure, and your phone is its own hotspot.
Feature phone	Often called dumbphones in comparison to smartphones. Although they still do offer features, feature phones are typically low-end devices capable of mobile Internet and email, SMS, and MMS, and likely have a camera and a few vendor- or carrier-specific apps.
Feed	Automatic updates of many types of information. One of the most popular uses of feeds is to syndicate news from a website. Many blogs use feeds to spread news. Feeds are typically synonymous with RSS.

Term	Explanation
Finger size	The average tap size or hit area needed for a touchscreen app to prevent misclicks, and is a key consideration in mobile design and usability. On most mobile device displays, a recommended hit area, a button for example, is at least 37 pixels in width and height. For iOS devices, 44 pixels are recommended.
Flash	A multimedia platform allowing authors to build interactive content with text, images, audio, and video. Typically, Flash has been used to create advertisements, games, and animations. Flash's use has shifted to also include rich Internet applications (RIAs), in which a Web App behaves as a desktop app. Flash content is displayed through Flash Player, which will be discontinued for mobile devices in order for Adobe to focus its efforts on HTML5.
Flash Lite	A slimmer version of Adobe Flash Player intended for mobile devices and other devices that don't meet Flash Player's minimum requirements. With the end of Flash on mobile platforms, Flash Lite's future is uncertain.
Flip	A mobile phone form factor. Unlike a candybar phone, a flip or clamshell phone consists of two or more sections connected by hinges. The speaker and microphone are close to the user's ear and mouth, respectively, when flipped out, and the phone is more compact and portable when closed. One of the examples is the Motorola RAZR.
Galaxy	Galaxy is Samsung's brand that includes different models of smartphones and tablets that operate on the Android mobile OS.
Gaming	The action of playing a game.
Geocoding	A process that allows users to find location coordinates from given information, such as street addresses or zip codes, and embed them in certain data.
Geolocation	The geographic location of an object, such as a mobile device, in the real world.
Gesture	Input interpreted by a device or OS in response to touchscreen events. For example, a user rotates two fingers simultaneously on screen and the device or OS interprets that touch input as a rotation gesture. Some gestures are performed with one finger or touch point, while other gestures require multiple touch points.
Gingerbread	Version 2.3 of the Android OS.
GSM	Global System for Mobile Communications (GSM) is a mobile phone communication standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It became the de facto global standard for mobile communications with over 80% market share.
Gyroscope	A tool that either measures or maintains the orientation of a device. The gyroscope feature in smartphones and tablets can be used by apps to either measure the device's orientation or use changes in orientation as input.
Haptics	Haptic feedback, often referred to as simply "haptics," is the use of the sense of touch in a user interface design to provide information to an end user. When referring to mobile phones and similar devices, this generally

Term	Explanation
	means the use of vibrations from the device's vibration alarm to denote that a touchscreen button has been pressed.
Honeycomb	Version 3.0-3.2 of the Android OS.
HTML5	A language for structuring and presenting content for the World Wide Web, a core technology of the Internet. It is the latest revision of the HTML standard. Its key improvement is the support for the latest multimedia content.
Icon	A small pictogram representing an object in graphical user interfaces (GUIs).
ILT	Instructor-Led Training (ILT) is the typical classroom setting in which an instructor or facilitator guides learners through a set of material.
Immersive	Highly engaging user experience of an app or program.
In-app purchase	A purchase made through an app while it is running. It offers the convenience of not needing to use a difference app for payment processing. In-app purchases can offer things like additional content, added functionality, and newer or more services and subscriptions.
iOS Packager	The Packager for iPhone, a feature of Adobe Flash Professional CS5 software and the Adobe AIR SDK 2.0.1, offers Flash developers a fast and efficient method to reuse existing code from ActionScript 3 projects to deliver iOS apps for devices including the iPhone.
iPad	A tablet from Apple, Inc., first released in April 2010.
iPhone	A smartphone from Apple, Inc., first released June 2007.
iPod	A portable media player from Apple. Inc., first released in 2001.
iPod Touch	A portable media player from Apple, Inc., with a multi-touch interface.
Java ME	Java Platform, Micro Edition (Java ME) is a Java platform developed by Sun Microsystems for embedded systems, such as mobile devices.
JavaScript	An interpreted programming language with object-oriented (OO) capabilities.
jQTouch	A jQuery plugin with native animations, automatic navigation, and themes for mobile web development.
jQuery	A multi-browser JavaScript library intended to simplify the client-side scripting of HTML.
jQuery Mobile	Spun off from jQuery, the jQuery Mobile framework allows developers to create one Web App that's accessible across all smartphones and tablets.
JSON	JavaScript Object Notation (JSON) is an open, text-based data exchange format similar to XML.
Just-in-time learning	The just-in-time learning model gives learners the information they want when they want it.
Keypads, virtual	A keypad that allows users to enter characters by tapping directly on the screen, as opposed to pressing physical buttons on the device.

Term	Explanation
Landscape	A screen orientation with greater width than height.
LCMS	Learning Content Management System (LCMS) is a multi-user environment where learning developers can create, store, reuse, manage, and deliver learning content from a central repository.
LMS	A Learning Management System (LMS) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, eLearning programs, and learning content. LMSs range from systems for managing training and educational records, to distributing courses over the Internet with features for online collaboration.
Local vs. remote data	Data that is stored locally on the mobile device or remotely in the cloud.
Long press	Similar to "tap and hold" where the user presses the touchscreen for a period of time (somewhere between one and three seconds) to bring up additional navigation or content.
LTE	Long-Term Evolution (LTE) is a standard for wireless communication of high-speed data for mobile devices. It is based on the GSM/EDGE and UMTS/HSPA network technologies with increased capacity and speed.
Magnetometer	An instrument used to measure the strength and/or direction of the magnetic field. A magnetometer in a mobile device allows users to use the mobile devices as a compass.
microSD	Secure Digital (SD) is a non-volatile memory card format developed by the SD Card Association for use in portable devices. microSD is a smaller format of an SD card.
mLearning	Mobile Learning.
MMS	Multimedia Messaging Service (MMS) is a way to send messages that include multimedia content using mobile phones. It extends the SMS capability, which only allowed exchange of text messages with up to 160 characters. A popular use of MMS is to send photos from camera-equipped phones.
Mobile app	Applications that are developed to run on mobile devices running mobile OSs. These apps are either pre-installed or downloaded by customers from app stores and other mobile software distribution platforms.
Mobile Web	Access to the World Wide Web from a mobile device, such as a smartphone or a tablet computer, connected to a mobile network or other wireless network.
Modal	A child window that requires users to interact with it before they can return to the parent window. Modal windows are commonly used as dialog boxes in GUI systems to command user's awareness and to display critical states.
Multitask	A computing device's capability, both hardware and software, to handle multiple tasks with shared common processing resources, such as a Central Processing Unit (CPU).
Native app	An app that is installed and executed on the mobile device itself and written in a programming language that can access the full features of the device.
Objective-C	A programming language that is a superset of C allowing for Object

Term	Explanation
	Oriented Programming (OOP). Objective-C is used to write native apps for iOS devices and is used in the Mac OS X Cocoa API.
Operator	A mobile network operator also known as mobile phone operator (or simply mobile operator), carrier service provider, wireless service provider, wireless carrier, or cellular company, is a telephone company that provides services for mobile phone subscribers.
Orange	The brand representing France Telecom Group. It is a global provider for mobile phone, landline, Internet, mobile Internet, and IP television services.
OS	An operating system (OS) is software that runs on computers and manages computer hardware resources and provides common services for efficient execution of various application software. A mobile OS, such as iOS and Android, is an OS that runs on and manages a mobile device.
PhoneGap	An open-source mobile development framework developed by Nitobi Software. It enables software programmers to build apps for mobile devices using JavaScript, HTML, and CSS, instead of languages such as Objective-C. The resulting apps are hybrid, meaning that they are neither truly native nor purely web based.
Pinch and zoom	A multi-touch input gesture for touchscreen devices. The user uses two fingers on the screen and moves them together (pinch) or apart (zoom). The most common use for pinch and zoom for mobile devices is to expand text and/or images for easier reading and viewing.
Pixel density	Pixels per inch (PPI) or pixel density is a measurement of a device's display resolution.
Platform	A combination of hardware and software that allows apps to run. Some of the mobile platforms include Android, iOS, BlackBerry, and Windows 8.
Podcast	A series of audio or video recordings that are broadcast via the Internet. People receive podcasts through an aggregator (such as iTunes) that will regularly check RSS feeds of a podcast to which a user subscribes. When the aggregator detects a new episode, it will automatically download it.
Portrait	The screen orientation that has a greater height than width.
Progress bar	A component in a GUI used to indicate the progress of a task, such as a file download. Often, the graphic is accompanied by a percentage in text.
Provisioning	The process of preparing a network or a service to allow it to provide new services to devices.
Publishing	The process to deploy and/or update your app in a marketplace, such as the Apple App Store or Google Play.
Realism	The degree of resemblance or how closely the graphical rendering of objects in an app resembles the objects in the real world.
Remote wipe	An operation that can be performed on a mobile device remotely to remove all data and restore the settings to the factory defaults. This is useful if the device has been lost or stolen.

Term	Explanation
Resistive touchscreen	Touch-sensitive displays composed of two flexible layers separated by an air gap or microdots. When contact is made to the touchscreen, the two layers are pressed into contact. Horizontal and vertical lines on these layers register the precise position of the touch. Because the touchscreen senses input from contact, resistive touchscreen is a "passive" touchscreen and works well with almost any stylus-like object. Resistive touchscreen technology can be made to support multi-touch input.
RIM	Research in Motion (RIM) is the maker of the BlackBerry platform.
Rogers	Rogers Communications, Inc., is one of Canada's largest communications companies, particularly in the field of wireless communications and cable television, with additional telecommunications and mass media assets. It is headquartered in Toronto, Ontario.
S60	The S60 Platform (formerly Series 60 User Interface) is a software platform for smartphones that runs on the Symbian OS. It was created by Nokia in 2001, and was first released in 2002 with the Nokia 7650 smartphone. The OS platform has since seen five updated editions. In 2010, S60 was replaced by the new Symbian^3.
Screen rotation	On most mobile devices, the screen will rotate from portrait to landscape depending on the orientation in which the user is holding it. The built-in gyroscope detects the orientation of the device and apps use that information to change the display orientation to match the device orientation.
Scrolling	Moving text, images, or video across a monitor or display by using touch gestures, keyboard, or mouse.
SDK	A software development kit (SDK) is typically a set of software libraries and development tools that allows for the creation of apps for a certain software framework, OS, and/or hardware platform.
Semi-connected	An app that will behave the same whether or not it is connected to a network. Data created while offline will be resynchronized with the cloud data when a network connection is re-established.
Sensors	A device that measures a physical quantity and converts it into a signal that can be read by an observer or by an instrument. For instance, the GPS sensor in a mobile device measures the geographic location so a mapping app can read the measurements, locate the device on the map, and display the map with the location marker on the screen.
Settings	The function of a mobile device that allows the user to change specific behaviors of that device. Notifications, Wi-Fi, and sound parameters can be adjusted with the settings function.
Shake gesture	An event caused by a user moving or shaking a device in a certain way. Apps can use shake gestures to perform certain functions, such as playing music.
Sharing	The practice of distributing or providing access to digital information, such as multimedia (audio, video), documents, e-books, and/or apps.
Sideloading	A term similar to "upload" and "download" but in reference to the process of transferring data between two local devices, in particular between a

Term	Explanation
	computer and a mobile device.
Simulator	A software version of a hardware device used for development and testing.
Slate	A mobile phone form factor. See Candybar above.
Slider	A mobile phone form factor. A slider phone is composed of usually two, but sometimes more, sections that slide past each other on rails. Most slider phones have a display segment which houses the speaker used for calls and the phone's screen, while another segment contains the keypad or keyboard, which slides out for use.
SMS	Short Message Service (SMS) is the text communication service that allows the exchange of short text messages between mobile phone devices.
Social media	The means of interaction among people in which they create, share, and exchange information and ideas in virtual communities and networks.
	When social media is used in combination with mobile devices it is called mobile social media. While traditional social media offer a variety of opportunities for companies in a wide range of business sectors, mobile social media makes use of the location- and time-sensitivity aspects of them in order to engage in marketing research, communication, sales promotions/discounts, and relationship development/loyalty programs.
Soft key	A programmable button able to invoke a number of functions rather than being associated with for single fixed function. A soft key is often located alongside a display of a mobile device where the button invokes the function described by the text on the display adjacent to the button.
Spinner	A graphic component, often with animations, in a GUI that informs the user that a program is performing an action (e.g., a webpage is loading).
SpringBoard	Springboard, or Home Screen, is the standard app that manages the iOS home screen.
Sprint	Sprint Nextel Corporation is a telecommunications company based in Overland Park, Kansas. The company owns and operates Sprint, the third-largest wireless telecommunications network in the United States.
Swipe	A multi-touch gesture that allows users to move two fingers across a multi-touch surface to navigate through media content.
Symbian	An open-source OS and software platform designed for smartphones and currently maintained by Nokia.
T-Mobile	A wireless service provider owned by German telecommunications company Deutsche Telekom. T-Mobile USA is headquartered in Bellevue, WA.
Tab bars	A navigation method for mobile devices that allows users to switch among app modes or subsets of app data. Usually depicted as a set of easily identifiable icons on the top or bottom of the screen, the tab bar allows instant access to the app's most-used features.
Tablet	A computing device with a touchscreen as the primary input device. Tablets normally run on mobile OSs with GUI designs focused on touch and gesture input.

Term	Explanation
Tap	A gesture for a touchscreen surface where the user's finger touches the surface briefly.
Tap and hold	An input gesture for touchscreen devices where the user's finger touches the screen but does not release until additional options become available.
Tap target	A visual representation, such as a button, that denotes where touch will occur on touchscreen devices.
Throbber	Like a spinner, a throbber is a graphical component, often with animations, in a GUI that informs the user the program is performing an action. See also *spinner*.
Titanium	A platform for developing mobile, tablet, and desktop apps using web technologies. Appcelerator Titanium is developed by Appcelerator Inc. and was introduced in December 2008. Support for developing iPhone- and Android-based mobile apps was added in June 2009. Support for developing iPad-based tablet apps was added in April 2010. BlackBerry support was announced in June 2010, but it was not released.
Twist	Twist is an input gesture for touchscreens where users use the thumb and index finger in a twisting motion (like unscrewing a bottle cap). Twist can be used to rotate an image or a map, for example.
Twitter	A social networking and microblogging service enabling its users to send and read messages called tweets. Tweets are text-based posts of up to 140 characters.
Two-finger gesture	An input method for touchscreens. Users use two-finger gestures to do advanced actions, including pinch-zoom, rotating images, and scrolling.
UI	A user interface (UI) is the space on a mobile display where a user interacts with a mobile device. A good UI design allows a user to effectively operate a mobile device by using various visual components, such as buttons, lists, text boxes, and sliders, displayed on the screen. This is also known to many as the "look and feel" of the experience.
User experience	User experience (UX) is about how a person feels when using an app. It also includes a person's perceptions of the practical aspects, such as utility, ease of use, and efficiency of the app.
UX	See User experience.
Verizon	Verizon Communications, Inc., is a global broadband and telecommunications company.
WAP	Wireless Application Protocol (WAP) is an open, global specification that allows mobile users to access data.
WebGL	WebGL is a web-based Graphics Library. It extends the capability of the JavaScript programming language to allow it to render interactive 3D graphics within any compatible web browser.
webOS	webOS is a mobile operating system running on the Linux kernel, initially developed by Palm, which was later acquired by HP. The software was introduced by Palm in January 2009 as the successor to the legacy Palm OS.

Term	Explanation
Windows Marketplace for Mobile	The official place to get your apps on Windows devices.
Windows Phone 7	Windows Phone 7 is a mobile operating system developed by Microsoft, and is the successor to its Windows Mobile platform.
Xcode	A toolset for building Mac OS X and iOS apps. The main application of Xcode is the integrated development environment (IDE), which includes most of Apple's developer documentation and Interface Builder, an app used to construct GUIs.
XHTML	XHTML (eXtensible HyperText Markup Language) is a family of XML markup languages that mirror or extend versions of the widely used Hypertext Markup Language (HTML), the language in which webpages are written.
XML	Extensible Markup Language (XML) is a simple text-based markup language for representing structured information in a format that is self-describing and both human readable and machine readable.
Xoom	An Android-based tablet computer made by Motorola.