Mobile Learning: Not Just Another Delivery Method

Peter Berking
Serco, in support of the
Advanced Distributed Learning Initiative
Alexandria, VA
peter.berking.ctr@adlnet.gov

Jason Haag
The Tolliver Group, in support of the
Advanced Distributed Learning Initiative
Orlando, FL
jason.haag.ctr@adlnet.gov

Thomas Archibald
The Tolliver Group, in support of the
Advanced Distributed Learning Initiative
Alexandria, VA
thomas.archibald@adlnet.gov

Marcus Birtwhistle
Katmai Support Services, in support of the
Advanced Distributed Learning Initiative
Alexandria, VA
marcus.birtwhistle.ctr@adlnet.gov

ABSTRACT

This paper summarizes a review of literature and a state-of-the-art assessment of instructional design principles, iterative process methodologies, and pedagogical models for mobile learning. The Advanced Distributed Learning (ADL) Initiative conducted previous research on the effectiveness of mobile course delivery. The implications from that research effort have led ADL to further explore which types of mobile learning require specific pedagogical models and accompanying instructional systems design (ISD) principles. The high level steps of the ISD analysis process may be applicable for specific types of mobile learning such as mobile courses and some types of performance support. Intensive research is needed to consider the ways in which mobile applications and pedagogical approaches can help improve military readiness. Based on the findings from this research study, this paper will provide background learning theory that will ultimately lead to new considerations for supporting mobile learning. Finally, this paper will propose a new framework for supporting mobile learning content within any instructional design (ID) model, but will use the traditional ADDIE model as a starting point.

ABOUT THE AUTHORS

Peter Berking has more than 17 years of experience in a broad base of instructional design and development activities, for products ranging from technology-driven e-learning products and performance support systems to instructor-led courses. He is a subject matter expert in instructional design and advanced learning technologies, publishing articles for industry publications and presenting at conferences. Peter has been an Instructional Designer at the ADL Co-Lab in Alexandria, VA since 2008. He has supported ADL through papers, articles, consultations, workshops, presentations, course design, and prototypes. Formerly a K-12 educator, he is embedded on staff at ADL through Serco, Inc. in Rockville, MD, and has been Principal Instructional Designer at Serco since 1995. He has an M.A. in Instructional Research and Curriculum Development from U.C. Berkeley and a Professional Certificate in Instructional Design from Marymount University.

Jason Haag's interest and background is in learning systems, web technology, and standards. He spent eight years supporting the U.S. Navy's eLearning program in both engineering and management roles before joining the Advanced Distributed Learning (ADL) Initiative. He is currently employed by The Tolliver Group, Inc. and provides Systems Engineering and Technical Analysis (SETA) support for the ADL, sponsored by the Office of the Deputy Assistant Secretary of Defense (Readiness). He took on the duties of ADL's Mobile Team Lead in 2012. His primary focus is mobile learning, mobile device platforms & technology, and best practices for implementation. Jason's professional affiliations include serving as chair of the DoD ADL (DADL) Working Group, member of the IEEE Education Society, and member of the eLearning Guild. Jason received his M. Ed. from the University of West Florida where he specialized in Education & Training Management and Instructional Technology.

Thomas Archibald is the Advanced Distributed Learning (ADL) Co-Lab Hub Director of Operations, under the Office of the Secretary of Defense. In this position, Dr. Archibald is responsible for the management and execution of the ADL Co-Laboratory Hub and partnership lab projects. Dr. Archibald assists in providing direction for the development and refinement of the Sharable Content Object Reference Model (SCORM®) and for the continued expansion of the ADL Initiative. Dr. Archibald has worked in private industry, government, and academia. Dr. Archibald also completed 8 years as a U.S. Navy Reserve Intelligence Analyst. Dr. Archibald has more than 10 years of experience in the educational technology and human performance technology field working on variety of training, education, modeling, and simulation projects.

Marcus Birtwhistle serves as a specialist and advisor on mobile technology and mobile learning for ADL's Mobile Learning Team. He provides a Certified Knowledge Manager background by way of the CASCOM Knowledge Management Office where he focused on integrating people, processes, and technology through mobile technology utilization and social media. He has a particular interest in strategic alignment of organizational and systems infrastructure components to foster a mobile technology and enables mobile learning, mobile and distributed workforce, and performance support in the military and government. He also applies his interest in process improvement to promoting effective mobile development, user interface (UI), and user experience (UX) principles to mobile learning implementations.

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BACKGROUND

In 2011, one of the authors, on behalf of the ADL Initiative, published an I/ITSEC paper titled "From eLearning to mLearning: The Effectiveness of Mobile Course Delivery." This paper reported on findings from a study that investigated the conversion and delivery of an existing DoD-wide eLearning course. The primary finding was that there was a high degree of satisfaction with the mobile course. Eighty-five percent of the participants said they would complete their annual mandatory training on mobile devices if an alternative option were provided, and seventy percent of the participants that had previously completed the eLearning course actually preferred the mobile version. This study provided positive implications for use of mobile devices for delivering mandatory eLearning courses. (Haag, 2011)

The author of last year's paper proposed new research investigating instructional design theories and models for mobile content as "the development of structured training content will undoubtedly require new approaches to address the unique design constraints exhibited by mobile devices." (Haag 2011) This paper builds on the proposed research suggestion and focuses on how learning theories and instructional design (ID) models can best support mobile learning (also commonly known as mLearning).

INTRODUCTION

As the title suggests, mobile learning does not simply amount to a different mechanism for delivering content to learners; it represents an emergent way of thinking that implies a paradigm shift, and at the very least requires new design strategies based on sound underlying learning theories. The inference here is that a paradigm shift occurs when a community as a whole accepts and practices the changes it brings (Rajasingham, 2011). The paradigm shift is due not only to the unique design constraints and opportunities of mobile devices, but also by the promise of "anywhere, anytime" learning that mobile devices enable.

Mobile Learning

ADL believes that a fixed definition of "mobile learning" could be limiting to some organizations' overall training and education strategy. Many of the existing definitions of mobile learning are usually too learner-focused or device-focused. A universally accepted definition seems improbable. ADL believes that both the learner and the device should be considered to provide a more flexible view of mobile learning. Therefore, ADL describes mobile learning as "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, 2012). It is important to note that this broad description is inclusive of informal learning, performance support, and other solutions outside of the concept of training courses. Mobile learning should be viewed as a way to augment the learner through the use of ubiquitous technology that can provide access to learning content and information, anytime and anywhere.

Some may believe this mobile paradigm shift requires ID models be significantly changed or new ID models created. Instead, ADL proposes a framework that leaves ID models intact but augments them by injecting concepts, considerations, decisions, and guidelines specific to the mobile learning paradigm. The specific

concepts, considerations, decisions, and guidelines are driven by the particular design strategy used in the mobile learning experience and its underlying learning theory, not simply by the features of the mobile device.

Mobile learning, in most cases, does not affect "what" you do in the high-level steps of an ID model, and "when" you do them; it affects "how" you do them. If it is determined that a mobile learning solution is desired, this strategy and its underlying learning theory may populate the ID model steps with both philosophical and practical considerations.

Our premise (emphasized by ID model authors such as Dick and Carey (2009)) is that robust ID models are carefully designed to be relatively agnostic of instructional strategies, learning theories, and delivery methods. ID models are planning tools for making decisions regarding these items. Invoking a mobile learning strategy does not change the requirement for conducting a needs analysis; however, if it is predetermined that you will use mobile learning, adjustments may need to be made to how you conduct your needs analysis. For example, mobile learning requires many more questions regarding the range of end user platforms and mode of use than you would need to ask in a desktop WBT training solution.

We place emphasis in our framework on making the particular learning theory underlying the mobile design strategy explicit, and using the implications of that theory to guide the "hows" of accomplishing the mobile design strategy. This emphasis serves to:

- Intellectually couple learning theories more tightly and explicitly with design strategies
- Promote greater awareness of the philosophical, empirical, and personal biases that can significantly influence learning designs (and determine whether they are valid)
- Stimulate production of ideas for the mobile learning design through consideration of how the principles of learning theories could, and have been, expressed

Research Goals in Regards to ID Models

It is important to differentiate between learning theories and ID models within the larger ID process. Clarifying this differentiation will help to better understand how mobile learning may be influenced by, or influence, learning theories and ID models. Learning theories are most commonly used in the ID process at the point where instructional strategies need to be determined; ID models lay the groundwork for the selection of instructional strategies, answering the many practical questions about what learning is needed, how it will be assessed, and so forth. Learning theories rely on epistemology and scientific research, whereas ID models rely mostly on business efficiency models (empirical data supporting the validity of ID models is rare (Cooper, 2011)).

An ID model is essentially a series of steps that helps an instructional systems designer (ISD) to conceptualize, choose strategies for, and validate appropriate instruction (Gustafson & Branch, 2002). ID models are not predicated on use of a particular learning technology or instructional strategy. In fact, an ID model is the very thing that helps lead the ISD, objectively, without premature bias towards a particular solution, to choosing the appropriate learning technology and instructional strategy.

There is therefore an inherent contradiction in the concept of an ID model for mobile learning, since, by its very name, the solution is already determined before due diligence is conducted to determine the true needs of the audience and stakeholders (which may actually rule out any kind of training solution). We recognize however, that often the instructional strategy and technology to be used are established at the outset of the project (and often for valid reasons). We have accounted for this in our proposed mobile learning framework (see Proposed ADL Framework section).

The approach taken in this paper is different from Cooper (2011), who attempted to develop an ID model specifically for mobile learning, assuming that "...no single instructional development [in our lexicon, instructional design] model is well matched for all situations…" (Gustafson & Branch, 2002).

Instead, it is our experience that robust ID models are agnostic to particular technologies and design strategies. Above all, ID models are meant to be planning processes, not philosophical systems that, used correctly can lead to the most rational, effective outcome and are thus theoretically well matched for all situations. This is also the position taken by authors of prominent ID models such as Dick and Carey (2009) and Rothwell and Kazanas (2008).

Learning technologies and instructional strategies are determined by the ISD at a level of detail and judgment that usually goes beyond the ID model. The ID model leads the ISD to the doorstep of this decision, armed with data collected during earlier phases of the process about the audience, environment, need, and content. The ISD must use judgment based on his or her own knowledge and experience with currently available technology and strategy options, how they are best used, and the particular pros and cons of using each.

What we present here is a framework that allows ISDs and other planners to both use the capabilities and paradigm of mobile learning to drive the generation of ideas for design strategies and understand and leverage the learning theory assumptions behind these strategies. It does not interfere with the high-level activities specified within an ID model and the flow of these activities; it merely plugs a framework of mobile learning-centric principles into the appropriate parts of the ID model, to expose considerations for mobile learning projects.

LITERATURE REVIEW

Most of the literature that appears in web searches on ID in regards to mobile learning focuses on rationales for specific functional features and interface design best practices (Elias, 2011, Tillett and Woodill, 2011), not high level approaches or models for designing instructional strategies. There have been few attempts to discern or invent appropriate ID models for mobile learning strategies. Quinn (2011), Metcalf (2006), Shih and Mills (2007), and Parsons et al. (2007), though focused at a higher level than "how to" guides, still mainly focused on identifying taxonomies of design principles, appropriate types of learning (remedial, informal, etc.), and practical considerations, not integrated, systematic ID models.

There have been even fewer attempts to identify how particular learning theories underlie or result in particular instructional strategies for mobile learning, partly because there isn't a universally accepted definition for mobile learning. Two notable examples are Cooper (2011) and Uden (2007). Cooper focused only on certain aspects of learning theory (learning style, instructional and information processing preferences), which we determined were too limited for our focus in this study. Uden (2007) based her proposed ID model on Activity Theory (Vygotsky, 1978), which relies exclusively on a single learning theory, constructivism, and is thus limited.

Park's Pedagogical Framework for Mobile Learning (2011) presents a categorization scheme for mobile learning that is based on Transactional Distance Theory (Moore, 2007). His framework has value in providing the foundation for a principled method for making decisions and stimulating ideas about design strategies, but it does not directly address the central question of an ID model: "What steps should I follow in designing mobile learning?"

LEARNING THEORIES

As stated earlier, learning theories are central to our purposes in this paper because they directly inform choice of learning strategies for mobile learning and, to some extent, influence other steps in the ID process. They are organizing principles of our framework.

Naismith (2005) discusses ways that mobile technologies support instruction based on theories of learning, including:

- Behaviorist
- Constructivist
- Situated
- Collaborative
- Informal and Lifelong
- Learning and Teaching Support

These seem appropriate for describing the types of learning experiences that the mobile paradigm enables. However, some of these are not truly learning theories but rather categories of instruction, and should not be confused with the major learning theories developed over many years by psychologists and others involved in learning science. Learning professionals (Dick and Carey, 2009) think of learning theories in terms of basically three major categories:

- Behaviorist
- Cognitivist
- Constructivist

This paper will not discuss these learning theories, but plentiful information can be found on each. For a more detailed treatment of them, see Learning theory (education) (2012, April 14).

Performance Support

Performance support is the discipline that harnesses informal learning and makes it intentional (Gottfredson & Mosher, 2011). Quinn (2011) describes three types of performance support for mobile (termed "performance augmentation"):

- Media capability – user generated content (using camera, etc.)
- Data and processing ability – calculators, decision trees, etc.
- Communication – ways to connect with other learners.

An important design principle in performance support is to use the principles of performance-centered design; that is, designing the application around the way that mobile performers do their work, not based on the

inherent organization of the domain of knowledge used for learning applications.

Performance support can be designed for use before, during, or after performance. Rossett and Schafer (2007) describe these differential design considerations for each. Performance support solutions can also stand-alone and are often provided at any of the five moments of learning need:

1. When learning for the first time
2. When wanting to learn more
3. When applying and remembering
4. When things go wrong
5. When things change

(Gottfredson & Mosher, 2011). Mobile performance support and mobile learning are related, but they are not the same. Mobile performance support solutions can be part of a larger mobile learning strategy that may or may not include instruction. Many of the best examples of learning implementations on mobile devices today are actually mobile performance support.

Combining Learning Theories in Instructional Strategies

Dick and Carey (2009), whose planning framework and recommendations for instructional strategies has an admitted cognitivist slant, nevertheless advocate using constructivist learning environments (CLEs) within their ID model when discovery, inquiry-based, or problem-based instructional strategy elements are called for. They cite researchers such as Dede (2008) who suggest that certain types of learners and learning outcomes call for a combination of "top down" (cognitive) and "bottom up" (constructivist) learning strategies. We suggest that behaviorist learning theories can be combined with either of these or both for some types of mobile learning content.

We have proposed that a robust ID model should be learning theory agnostic (and we contend that most are). More than the other two learning theories, however, constructivism can be seen to interfere with the learning theory neutrality of ID models, since the orientation of the design phases of a typical ID model are somewhat different (generally less ISD planning-centric and more learner-centric). Dick and Carey (2009) address this in their textbook, showing how constructivist instructional strategies can be combined into their model.

PROPOSED ADL FRAMEWORK

As described earlier, this framework is meant to inject concepts, considerations, decisions, and guidelines specific to mobile learning into appropriate points in the ID model. We use the ADDIE model here only as frame of reference because it is the most generic, universal, and simple ID model; the tradeoff is that ID planning activities with it are quite loosely defined. The intent here is for instructional designers to apply our conceptual framework to their own ID model or strategy through the generic steps of ADDIE. (ADDIE is an acronym referring to the five major phases that comprise the generic ISD process.) We recognize that some of the ADDIE steps will not be applicable to every type of mobile learning project. Our intent with this conceptual framework is to simply use ADDIE as an example "interchange format" that could map to some or all of the steps of other ID models, agile approaches, or strategies.

Instructional models are not static but are continually being adapted to align with changes in society and technology. Figure 1 below shows the framework. A distinction is made between instructional macrostrategies and microstrategies. Dick and Carey (2009) define a macrostrategy as the complete instructional plan that includes everything the instructor or instructional designer does to bring about learning, including learning objectives, assessment strategy, motivating components, content presentation, practice activities, etc. It includes what is traditionally termed the "delivery method."

Microstrategies are the particular learning activities and designed learning experiences within the macrostrategy. These microstrategies are usually mixed, either in a sequence or concurrently, within a single instructional event. Mobile learning is an important enabler for these microstrategies. We maintain that mobile learning is a macrostrategy in itself, especially since it includes many unique microstrategies that could not easily be achieved using any other technological medium or "delivery method."

In many cases, a mobile solution is desired for reasons other than purely how well it enables or fits with the microstrategy. For instance, it may simply be that the users are mobile most of the time and need to use their mobile device as their main access point to learning information and resources. This is sometimes obvious at the outset of a project and may precede answering the questions in the "Analysis" decision node at the top of the diagram.

Our framework also accounts for performance support solutions as part of a blended or independent

approaches, since, as stated earlier, they are not usually based solely on a measurable learning strategy but can be part of one. As explained earlier, learning theories are accounted for prominently in this framework, because they can have a great impact on the kind of mobile strategies chosen. It may be that an ISD would arrive at the same mobile learning microstrategies whether the learning theories behind them are considered or not. However, we present the "mLearning microstrategies" node in our diagram as an explicit step to provide an intellectual framework that may be helpful in organizing thinking about these microstrategies. (mLearning is used in the diagram for brevity.)

The question you may ask at this point is: what are the considerations represented by the dotted line ovals within the ADDIE phases? It is beyond the scope of this paper to enumerate them fully, but the bullet list after the diagram provides examples that the reader is invited to build upon. We hope that our framework serves as a starting point and organizing principle for collecting best practices, guidelines, principles, questions to ask, etc. related to each of the five phases.

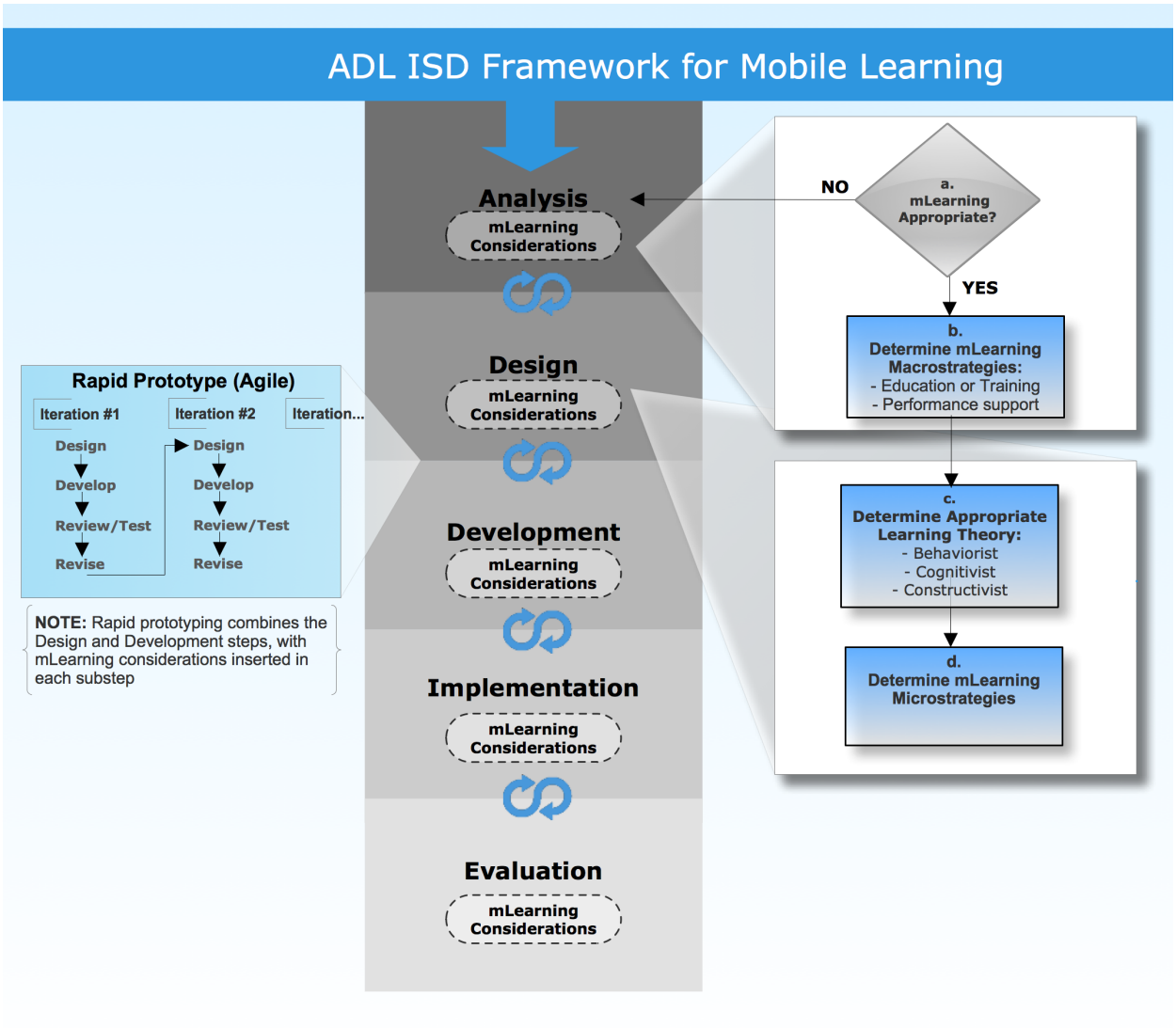

Figure 1. ADL Mobile Learning Framework

Figure 1 description

The phases of ADDIE may be followed in a linear order, but in fact are highly interrelated and typically not performed in a linear but in an iterative and cyclic fashion. Performance solutions outside of learning would require a completely different model from ADDIE (Human Performance Technology (HPT) or the like) and are thus not included in this framework or diagram.

During the Analysis phase, if a mobile learning solution is determined ("YES" line coming out of a), he or she determines a macrostrategy that includes education or training elements, performance support elements, or combination thereof. He or she also considers the affordances of mobile devices to support the desired learning, in terms of macrostrategy components such as assessment method, motivation enhancement, and opportunities for practice.

After determining the mLearning macrostrategy, the designer (during the Design phase) determines the appropriate learning theory given the objectives, learning domain, learning environment, and learning audience (c). The microstrategies are then determined (d). These microstrategies describe the learning activities and how learners will interact with content on the mobile device, based on the learning theory chosen.

Once the decision is made that an mLearning approach is appropriate (a), the designer injects the appropriate mobile learning considerations (ideally a "ready to go" list that the designer has developed through experience and research) into the steps of ADDIE (shown by the dotted line "mLearning Considerations" objects). The designer and team leverages these considerations as they encounter them in all phases of the ADDIE process.

If the designer determines that a mobile approach is not called for ("NO" line coming out of a), he or she continues through the Analysis phase and the rest of the ADDIE process steps as he or she normally would (i.e., ignoring the dotted line "mLearning Considerations" boxes and the callouts on the right).

The cyclical arrows between steps indicates that the phases of ADDIE do not have to be sequential. Phases or tasks within phases can and are often done concurrently. This is further emphasized by the Rapid Prototype (Agile) box on the left.

Guidelines for Determining Whether a Mobile Learning Strategy is Appropriate

This is a sample list of considerations that can be used to help make the decision in the "mLearning Macrostrategy" decision node.

- Learning needs to be accessible due to learners' mobility or requirements of the learning environment
- Learners are to make field observations as part of the learning activities
- In a case where learning may need to change depending on the actual location (i.e., leveraging "location awareness" of smartphones)
- Where learners do not have time to take learning modules during their work schedule, and instead prefer to take it during "on the fly" and/or "offline" moments

Example Mobile Learning Considerations for Each of the Five ADDIE Phases

This is a sample list of mobile learning-related questions to ask for each of the five phases of ADDIE. As described earlier, we use the ADDIE model here only because it is the most generic, universal representation of ID models. Some other generic models, including agile or rapid prototyping, are often thought of as separate models, although, as shown in Figure 1, they can be subsumed within the ADDIE model.

The following are only a few example questions adapted from the ADL Mobile Handbook at http://mlhandbook.adlnet.gov/

- **Analysis -** Are there sufficient resources for a mobile project?
- **Design -** What will the user interface look like?
- **Development -** Are you going to develop a native app or a web app?
- **Implementation -** How will availability of the mobile learning application be marketed?
- **Evaluation -** How will you track how the mobile learning application is being used?

CONCLUSION

Our literature review uncovered the fact that very few actual ID models for mobile learning exist. One that perhaps comes close only accounts for particular constructivist mobile learning activities (Uden, 2007).

Instead of creating a new ID model, we have presented a framework that can be used to incorporate mobile learning considerations into existing ID models (which

theoretically are neutral) and agile approaches, to optimize them for the paradigm of "anywhere, anytime" mobile learning.

Rather than focus on lists of specific design considerations for mobile (which are now commonly available), we created a framework that provides an organizing principle for these design considerations.

True to the title of this paper, we believe that mobile learning has the potential to be influenced by every aspect of the ISD process, not just a delivery method that is a small "piece of the puzzle." Within our framework, we explicitly call out the learning theory that underlies the mobile learning strategy as an important determinant of considerations for a new or existing ID model. Ideally, instructional designers should now consider focusing on new opportunities for improving performance and augmenting skills, not just on knowledge transfer. The flexible approach proposed by our framework takes both instruction and performance support into consideration for the mobile learning task or challenge at hand.

IMPLICATIONS FOR FURTHER RESEARCH

Further research efforts, both as design research and literature reviews, could focus on the following:

- Appropriate specific low-level considerations and best practices that can be injected into the ADDIE model as well as considerations for other models and methodologies
- The detailed decision tree for determining that mobile is the best solution (the decision diamond titled "mLearning macrostrategy?" in Figure 1)
- A comprehensive list of mobile learning microstrategies (the "Determine mLearning microstrategies" step in Figure 1) and how they influence or translate into considerations that are injected into each of the ADDIE steps.
- The creation of an ID model for mobile learning
- Considerations for creating mobile learning content materials that may be used for various types of informal learning

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