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A Model for Framing Mobile Learning

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Abstract

The Framework for the Rational Analysis of Mobile Education (FRAME) model describes mobile learning as a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction. It addresses contemporary pedagogical issues of information overload, knowledge navigation, and collaboration in learning. This model is useful for guiding the development of future mobile devices, the development of learning materials, and the design of teaching and learning strategies for mobile education.

Introduction

Research in the field of mobile learning is on the rise. Visionaries believe mobile learning offers learners greater access to relevant information, reduced cognitive load, and increased access to other people and systems. It may be argued that wireless, networked mobile devices can help shape culturally sensitive learning experiences and the means to cope with the growing amount of information in the world. Consider, for a moment, an individual who is learning English. There is a myriad of available resources on grammar, vocabulary, and idioms; some resources are accurate and useful; others less so. Equipped with a mobile device, the learner can choose to consult a web page, access audio or video tutorials, send a query via text message to a friend, or phone an expert for practice or guidance. She may use one or several of these techniques. But, how can such a learner take full advantage of the mobile experience? How can practitioners design materials and activities appropriate for mobile access? How can mobile learning be effectively implemented in both formal and informal learning? The Framework for the Rational Analysis of Mobile Education (FRAME) model offers some insights into these issues.

The FRAME model takes into consideration the technical characteristics of mobile devices as well as social and personal aspects of learning (Koole 2006). This model refers to concepts similar to those as found in psychological theories such as Activity Theory (Kaptelinin and Nardi 2006) – especially pertaining to Vygotsky's (1978) work on *mediation* and the *zone of proximal development*. However, the FRAME model highlights the role of technology beyond simply an artefact of "cultural-historic" development. In this model, the mobile device is an active component *in equal footing* to learning and social processes. This model also places more emphasis on constructivism: the word *rational* refers to the "belief that reason is the primary source of knowledge and that reality is constructed rather than discovered" (Smith and Ragan 1999, 15). The FRAME model describes a mode of learning in which learners may move within different physical *and* virtual locations and thereby participate and interact with other people, information, or systems – anywhere, anytime.

The FRAME Model

In the FRAME model, mobile learning experiences are viewed as existing within a context of information. Collectively and individually, learners consume and create information. The interaction with information is mediated through technology. It is through the complexities of this kind of interaction that information becomes meaningful and useful. Within this context of information, the FRAME model is represented by a Venn diagram in which three aspects intersect (Figure 1). [2]

2. The nomenclature used in the Venn diagram has been altered from previous publications. Previously the *device aspect* was called the *device usability aspect*, the *device usability intersection* was called the *learner context intersection*, and the *social technology intersection* was called the *social computing intersection*.

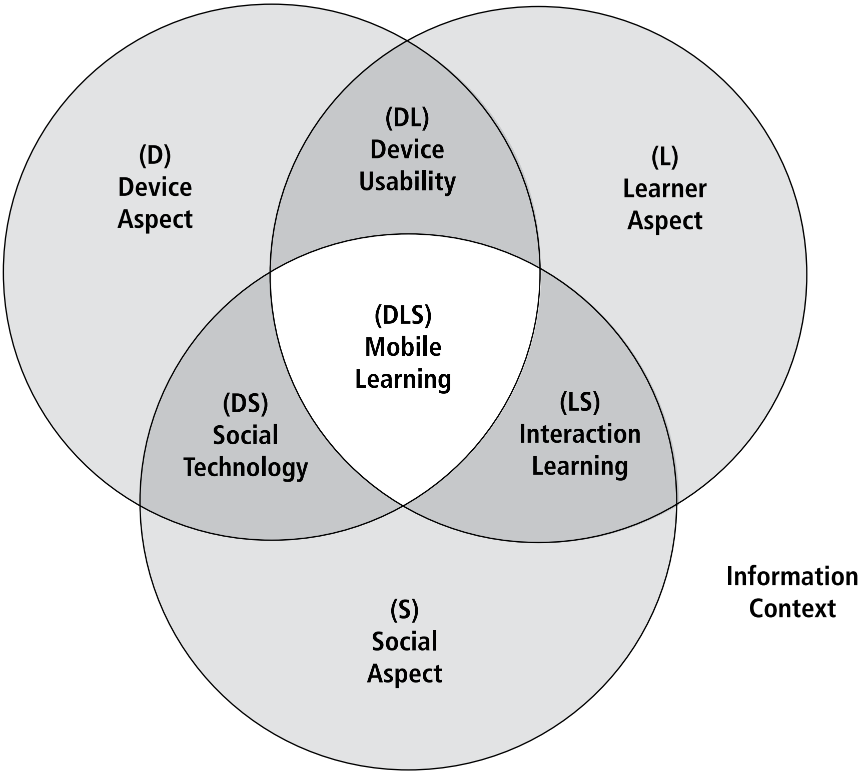
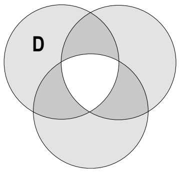


FIGURE 1 The FRAME Model

The three circles represent the device (D), learner (L), and social (S) aspects. The intersections where two circles overlap contain attributes that belong to both aspects. The attributes of the device usability (DL) and social technology (DS) intersections describe the *affordances* of mobile technology (Norman 1999). The intersection labelled interaction learning (LS) contains instructional and learning theories with an emphasis on social constructivism. All three aspects overlap at the primary intersection (DLS) in the centre of the Venn diagram. Hypothetically, the primary intersection, a convergence of all three aspects, defines an ideal mobile learning situation. By assessing the degree to which all the areas of the FRAME model are utilized within a mobile learning situation, practitioners may use the model to design more effective mobile learning experiences.

Aspects



Device Aspect (D)

The device aspect (D) refers to the physical, technical, and functional characteristics of a mobile device (Table 1). The physical characteristics include input and output capabilities as well as processes internal to the machine such as storage capabilities, power, processor speed, compatibility, and expandability. These characteristics result from the hardware and software design of the devices and have a significant impact on the physical and psychological comfort levels of the users. It is important to assess these characteristics because mobile learning devices provide the interface between the mobile *learner* and the *learning task*(s) as described later in the device usability intersection (DL).

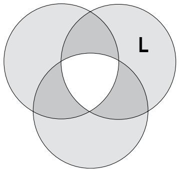
TABLE 1 The Device Aspect

Criteria	Examples & Concepts	Comments
Physical Characteristics	Size, weight, composition, placement of buttons and keys, right/left handed requirements, one or two-hand operability[1].	Affects how the user can manipulate the device and move around while using the device.
Input Capabilities	Keyboard, mouse, light pen, pen/stylus, touch screen, trackball, joystick, touchpad, hand/foot control, voice recognition[1].	Allows selection and positioning of objects or data on the device[1]. Mobile devices are often criticized for inadequate input mechanisms.
Output Capabilities	Monitors, speakers or any other visual, auditory, and tactile output mechanisms.	Allows the human body to sense changes in the device; allows the user to interact with the device. Mobile devices are often criticized for limitations in output mechanisms such as small screen-size.

File Storage and Retrieval	Storage on the device (RAM or ROM) or detachable, portable mechanisms such as USB drives, CDs, DVDs, and SD cards.	Consistency and standardization of storage and retrieval systems greatly affect usability.
Processor Speed	Response rates; speed with which the device reacts to human input.	Determined by the amount of RAM, file storage speed, user-interface speed, and system configuration. Unusually long or short response rates may affect error rates as the user may forget initial goals and/or task sequences[1].
Error Rates	Malfunctions resulting from flaws in hardware, software, and/or interface design.	Users may not be able to perform desired tasks and may lose confidence in the device.

1. Shneiderman and Plaisant (2005).

As the bridge between the human being and the technology, devices must be constructed so as to maintain high physical and psychological comfort levels. In other words, the device characteristics have a significant impact upon usability. In order for a device to be portable, for example, the size, weight, structure, and composition must match the physical and psychological capacities of the individual users. In particular, input and output capabilities must be suited to human perception and motor functions. Similarly, the capacity and speed of the device memory, processor, file storage, and file exchange require error-free response rates appropriately timed to the human user's needs and expectations. Learners equipped with well-designed mobile devices should be able to focus on cognitive tasks such as those described in the learner aspect (L) rather than on the devices themselves.



Learner Aspect (L)

The learner aspect (L) takes into account an individual's cognitive abilities, memory, prior knowledge, emotions, and possible motivations (Table 2). This aspect describes how learners use what they already know and how they encode, store, and transfer information. This aspect also draws upon learning theories regarding knowledge transfer and learning by discovery.

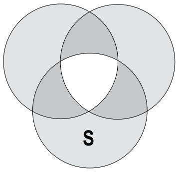
TABLE 2 The Learner Aspect

Criteria	Examples & Concepts	Comments
Prior knowledge	Cognitive structures already in memory, anchoring ideas[1], schema theory, Gagne's conditions for learning[2].	Affects how easily a learner can comprehend new concepts. Potential problems include "assimilation bias" (a reluctance to adopt new procedures)[3].
Memory	Techniques for successful encoding with the use of contextual cues: categorization, mnemonics, self-questioning, semantic & episodic memory[5], tactile, auditory, olfactory, visual imagery[4], kinaesthetic imagery, dual coding[6], and encoding specificity[4].	Inclusion of multimedia by providing a variety of stimuli may help learners understand and retain concepts more easily.
Context and Transfer	Inert vs. active knowledge.	Actively using information aids for learners to remember, understand, and transfer concepts to varied contexts.
Discovery Learning	Application of procedures and concepts to new situation; solutions for novel problems.	May stimulate learner to develop skills to "filter, choose, and recognize" relevant information in different situations[7].
Emotions and Motivations	Feelings of the learner towards a task; reasons or accomplishing a task.	A learner's willingness or ability to adopt new information may be affected by his/her emotional state or desire to accomplish a task. Activity Theory may provide additional avenues of investigation into motivation.

1. Ausubel (1968), 2 Gagne (1977), 3. Caroll and Rosson (2005), 4. Driscoll (2005), 5. Tulving and Donaldson (1972), 6. Paivio (1979), 7. Tirri (2003, p. 26).

While it is recognized that prior knowledge (Ausubel 1968) and past experience will influence learning, so too will a learner's environment, task authenticity, and presentation of content in multiple formats. Tulving and Donaldson (1972) proposed that *semantic* memory is composed of general, non-contextually based concepts. Mobile learning, however, can help learners utilize *episodic* memory. This type of memory is grounded in actual, authentic experiences such as traveling to foreign countries, visiting museums, visiting historic sites, and case studies in professional settings. Using concepts makes them *active*, and the ability of a learner to remember a concept is largely dependent upon the learner remembering its use (Driscoll 1994). Remembering the use of a concept or tool may also aid the learner in transferral of the concept into other contexts. Finally, some theorists recommend that materials be presented in different formats – as proposed in Dual Coding Theory – allowing the brain to actively process content through various channels (Paivio 1979).

The learner aspect (L) is grounded in the belief that the learner's prior knowledge, intellectual capacity, motivation, and emotional state have a significant impact upon encoding, retaining, and transferring information. Actively selecting or designing learning activities rooted in authentic situations as well as encouraging learners to discover laws within physical and cultural environments are powerful pedagogical techniques. Mobile learning may help to enhance encoding, recall, and transfer of information by allowing learners to access content in multiple formats and highlighting the contexts and uses of the information.



Social Aspect (S)

The social aspect takes into account the processes of social interaction and cooperation (Table 3). Individuals must follow the rules of cooperation to communicate – thereby enabling them to exchange information, acquire knowledge, and sustain cultural practices. Rules of cooperation are determined by a learner's culture or the culture in which an interaction take place. In mobile learning, this culture may be physical or virtual.

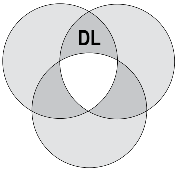
TABLE 3 The Social Aspect

Criteria	Examples & Concepts	Comments
Conversation and Cooperation	Social constraints; 4 maxims (rules): quantity, quality, relation, and manner[1].	Affects quality and quantity of communication; miscommunications may occur when any of the 4 maxims are not met[1].
Social Interaction	Conversation as a cooperative activity, sharing of signs and symbols.	Agreement on the meaning of signs and symbols may affect reinforcement of social and cultural beliefs and behaviours[2].

1. Wardhaugh (1968), 2. Kearsly (1995).

It is important to realize that there may be constraints upon participants in a conversation. Such constraints provide guidelines and predictability for behaviour that enable effective communication. When a person joins a new community, he must share his own "sign systems" and learn those of the new community (Driscoll 2005, 173). Cooperative communication requires that contributions are as informative as necessary, accurate, relevant, and sufficiently clear. When a participant neglects to follow one or more of the rules, miscommunication may occur (Wardhaugh 1986). Participants may also purposely break rules about procedures and etiquette in order to achieve certain effects (Preece, Rogers, and Sharp 2002). It is important that participants pay attention to each other during conversations in order to detect breakdowns and interpret them appropriately (Preece, Rogers, and Sharp 2002). It is through interaction that people receive feedback which, in turn, reinforces social and cultural beliefs and behaviours (Kearsley 1995).

Intersections



Device Usability Intersection (DL)

The device usability intersection contains elements that belong to both the device (D) and learner (L) aspects (Table 4). This section relates characteristics of mobile devices to cognitive tasks related to the manipulation and storage of information. These processes, in turn, can affect the user's sense of psychological comfort and satisfaction by affecting cognitive load, the ability to access information, and the ability to physically move to different physical and virtual locations.

TABLE 4 The Device Usability Intersection

Criteria	Examples & Concepts	Comments
Portability	Portability and durability (dependent on physical characteristics, number of components, and materials used to construct the device).	Affects the user's ability to move the device to different environments and climates.
Information Availability	Anytime, anywhere access to information stored on a device. (This is a distinct from information transfer, a characteristic of social technology (DS).)	Enables just-in-time learning; information accompanies the user; the user can retrieve stored information when and where it is needed.
Psychological Comfort	Learnability1, comprehensibility, transparency, intuitiveness, memorability[1], and metaphors.	Psychological comfort affects cognitive load and the speed with which users can perform tasks. Metaphors, chunking information, mnemonics, simplification of displays, and reduction of required actions may reduce cognitive load.
Satisfaction	Aesthetics of the interface, physical appearance of the device, functionality, preferred cognitive style.	Because satisfaction and enjoyment is highly personal and culturally determined, it is very difficult to predict.

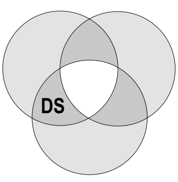
1. Nielsen, 1993.

Portability and access to information are significant concepts in mobile usability. Device portability is dependent upon the physical attributes of the device such as size and weight, the number of peripherals, and the materials used in the construction of the device. Highly portable devices must resist humidity, dust, and shock. Information access complements portability, and it enables information to travel with the user rather than the user moving to the information. In the past, learners were required to learn information just in case they needed it in the future. Now, learners can access stored information anytime or anywhere, making just-in-time learning possible.

Psychological comfort refers to how intuitive the device is or how quickly a learner can understand and begin using the device. Users should be able to learn the main functions quickly so they can accomplish desired tasks as soon as possible (Nielsen 1993). A high degree of transparency suggests that the device is easy to use and that the user can concentrate on cognitive tasks rather than the manipulation of the device itself. Some ways to increase transparency and reduce cognitive load include lowering the number of actions necessary to complete a task, using mnemonic devices, providing sufficient training, and using simple displays (Shneiderman and Plaisant 2005). Interfaces based on carefully considered metaphors that draw on learners' prior experiences or social-cultural knowledge are, hypothetically, more learnable and memorable. Flexibility permitting the user to select themes and functionality may help to increase satisfaction and comfort.

Designers should strive to minimize memory load on the user (Shneiderman and Plaisant 2005; Bransford, Brown, and Cocking 2000). A commonly cited rule is the seven-plus-or-minus-two rule. Miller (1956) proposed that most people are capable of retaining approximately seven chunks of information give or take two. More information can be stored depending up the person's familiarity with the chunk patterns and with the information (Shneiderman and Plaisant 2005; Bransford, Brown, and Cocking 2000).

The device usability intersection (DL) bridges needs and activities of learners to the hardware and software characteristics of their mobile devices. Highly portable, intuitive, and transparent devices can help to reduce cognitive load and increase task completion rates because the learner can concentrate on the tasks rather than the tools.



Social Technology Intersection (DS)

While the device usability intersection (DL) in the FRAME model describes the relationship between *one* learner and a device, the social technology intersection (DS) describes how mobile devices enable communication and collaboration amongst *multiple* individuals and systems (Table 5). Device hardware and software provide various means of connectivity. Many mobile devices come equipped with various technical capabilities, such as short messaging service (SMS), telephony, and access to the Internet through wireless networks. What is of greater importance here, however, are the means of information exchange and collaboration between people with various goals and purposes.

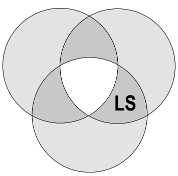
TABLE 5. The Social Technology Intersection

Criteria	Examples & Concepts	Comments
Device Networking	Personal area networks (PANs), wide area networks (WANs), wireless local area networks (WLAN), synchronization software, wireless fidelity (WiFi), cellular connectivity.	The various connectivity standards allow users to connect to other users, systems, and information. Networking in mobile systems is often hindered by low bandwidth on wireless networks.
System Connectivity	Internet access and document transfer protocols.	Users must be able to exchange documents and information within and across systems. This affects the organization of individuals and systems that are attempting to interact.
Collaboration Tools	Shared tools such as calendars, authoring tools and project management tools.	Collaboration tools allow co-authoring documents; coordinating tasks; attending or providing lectures and demonstrations; holding meetings synchronously or asynchronously, voting, decision-making, performing commercial transactions; and accessing laboratory or other rare equipment[1].

1. Shneiderman & Plaisant (2005).

Devices should include mechanisms for connecting to a variety of systems through multiple means. Networks often require various types of wired (such as telephone lines and/or Ethernet cables) or wireless frequencies. Common wireless technology standards that are important for mobile learning include WiFi, infrared, Bluetooth, GSM, and CDMA. The Internet and the World Wide Web have become a central gateway to scientific, procedural, and cultural information. Speed and quality of data transfer can suffer without adequate standards. The rules and constraints of data exchange may affect workflow in that it can force certain types of organization upon the individuals who are interacting. Coordination of activity can be accomplished through various electronic technologies such as "shared calendars, electronic schedulers, project management tools, and workflow tools" (Preece, Rogers, and Sharp 2002, 122). Using such tools, users can engage in a number of different types of collaboration.

Wireless networking is, perhaps, the most significant feature of mobile tools within the social technology intersection (DS). When people are able to exchange relevant information at appropriate times, they can participate in a variety of community and collaborative situations that normally could not take place by distance. Therefore, the socio-cultural setting becomes an integral part of interaction. Mobile learning practitioners must consider providing mobile "media spaces" or computer mediated communications environments that will assist learners to communicate even though they are physically and temporally separated (Preece, Rogers, and Sharp 2002).



Interaction Learning Intersection (LS)

The interaction learning intersection (LS) represents a synthesis of learning and instructional theories, but relies very heavily upon the philosophy of social constructivism. In this view, "[learning] is collaborative with meaning negotiated from multiple aspects" (Smith and Ragan 1999, 15). Adherents to social constructivist philosophy vary in the degree to which they place emphasis on social interaction. Some support the idea that learners indirectly negotiate the meaning of materials by comparing their interpretation with that of the author's. Others contend that learners interact and negotiate meaning with other individuals directly (Smith and Ragan 1999). It seems clear that individuals do both, depending on the circumstances. The interaction learning intersection (LS) presented here is balanced between these viewpoints (Table 6). This intersection takes into account the needs of distance learners as individuals who are situated within unique cultures and environments. Such settings impact a learner's ability to understand, negotiate, integrate, interpret, and use new ideas as needed in formal instruction or informal learning.

TABLE 6 The Interaction Learning Intersection

Criteria	Examples & Concepts	Comments
Interaction	Learner-learner, learner-instructor, learner-content[1]; computer-based learning (CBL); intelligent tutoring systems, zone of proximal development[2].	Different kinds of interaction can all stimulate learning to varying levels of effectiveness depending on the situation, learner, and task.
Situated Cognition	Authenticity of context and audience.	A real purpose and audience for a learning task may serve to increase learner motivation.
Learning Communities	Cognitive apprenticeships, dialogue, problem solving, communities of practice.	Learners work with others in an effort to achieve mutual goals. Learners have varying degrees of control over the learning process.

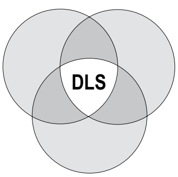
1. Moore (1989), 2. Vygotsky (1978).

Moore (1989) proposed three types of interaction in distance education: learner-content, learner-instructor, and learner-learner. Learner-content interaction refers to the cognitive changes that occur as a result of a learner actively engaging with course materials. While a learner can access a variety of information through textbooks, audio tapes, and video tapes, the learner cannot have a dialogue directly with these media. Neither CBL nor intelligent tutoring systems can adequately stimulate metacognitive skills necessary for decision making, information selection, and self regulation (Kommers 1996; Sharples 2000). The significance of context and social negotiation of meaning is highlighted by Vygotsky's (1978) *zone of proximal development*. The zone of proximal development is the gap between what a learner is currently able to do and what she could potentially do with assistance from more advanced peers. Hence, interaction with other people provides a potentially more powerful form of learning.

The main precept of situated cognition is that learning tasks should be situated within authentic contexts (Smith and Ragan 1999). Authenticity does not necessarily imply that the learners must interact directly with other learners, but that the products of learning activities are intended for members of a real and larger community. In such situations, then, the learner is not passive, but "action-oriented" (Farmer, Buckmaster, and LeGrand 1992, 47).

Learning communities and cognitive apprenticeships are two examples of highly social methods of learning offering varying degrees of learner control. Learning communities may be thought of as collections of learners who work together toward mutual goals (Reigeluth and Squire 1998). Through technology, they can enter into dialogues and problem solving activities with other learners in different locations. In a cognitive apprenticeship situation, a learner has the opportunity to observe a human model operating within a real and relevant situation. The learner then has opportunities to try the techniques in a similar situation. Part of the process requires the learner to plan, reflect upon, and articulate her actions during the process. The learner receives gradually less support from the mentor as she gains competence and confidence until, finally, the learner is able to work independently (Farmer, Buckmaster, and LeGrand 1992).

While social constructivism can be taken to extremes, few can deny the impact of interaction on human learning. Encouraging learners to participate in communities and cognitive apprenticeships permits them to utilize a greater variety of situations in which to negotiate meaning. Combining these socially grounded learning practices with the affordances of wireless, mobile devices completes the FRAME model in the centre of the Venn diagram.



Mobile Learning Process (DLS)

Effective mobile learning, the primary intersection of the FRAME model, results from the integration of the device (D), learner (L), and social (S) aspects. Mobile learning provides enhanced collaboration among learners, access to information, and a deeper contextualization of learning. Hypothetically, effective mobile learning can empower learners by enabling them to better assess and select relevant information, redefine their goals, and reconsider their understanding of concepts within a shifting and growing frame of reference (the information context). Effective mobile learning provides an enhanced cognitive environment in which distance learners can interact with their instructors, their course materials, their physical and virtual environments, and each other (Table 7).

TABLE 7 The Mobile Learning Process

Criteria	Examples & Concepts	Comments
Mediation	Task artefact cycle[1], mediation[2].	The nature of the interaction itself changes as learners interact with each other, their environments, tools, and information.
Information Access and Selection	Information noise, identification of patterns and relationships, relevancy, and accuracy.	As the amount of information available increases, learners must increase their efforts to recognize and evaluate the appropriateness and accuracy of information.
Knowledge Navigation	Knowledge production vs. knowledge navigation[3].	In knowledge production, teachers determine what and how information should be learned. In knowledge navigation, learners acquire skills to appropriately select, manipulate, and apply information to their own unique situations and needs.

1. Caroll, Kellogg, and Rosson (1991), 2. Vygotsky (1978), 3. Brown (2005).

The concept of mediation is crucial for understanding the integration of the three aspects of the FRAME model. According to Vygotsky (1978), the nature of the interaction itself changes as learners interact with each other, their contexts, tools, and information. In keeping with the concept of mediation, the *task-artefact cycle* posits that the artefacts themselves introduce possibilities and constraints that, in effect, redefine the uses for which the artefact was originally intended (Carrol and Rosson 2005). The process of mobile learning is itself defined and continuously reshaped by the interaction between the device (D), learner (L), and social (S) aspects.

As the amount of information available on the Internet grows, it is increasingly important for learners to be able to identify relevant and accurate information. They must be able to identify patterns and relationships between facts amongst a growing variety of resources. "When knowledge is subject to paucity, the process of assessing worthiness is assumed to be intrinsic to learning. When knowledge is abundant, the rapid evaluation of knowledge is important" (Siemens 2005, 3). In addition, both the relevance and the accuracy of the information may shift as other information becomes available. Educators need to respond with more flexible methods of knowledge management in order to prepare learners to navigate within an information rich world. Because the mobile learning process is defined by social, cognitive, environmental, and technological factors, mobile learning can help learners gain immediate and ongoing access to information, peers, and experts (not necessarily teachers) who can help them determine the relevance and importance of information found on both the Internet and in their real-world environments. This kind of access to other learners and experts can help to mitigate the negative effects of information noise and assimilation bias (Marra 1996) in which learners may be overwhelmed by the volume of information or may be reluctant to learn new procedures.

Kommers (1996, 38) posits that while student control is beneficial for motivation and empowerment, "both simulation and explorative information retrieval need some navigational assistance to prevent the student from being lost or trapped in misconceptions." Brown (2005) documents the transition from a knowledge production paradigm to a knowledge navigation paradigm. In knowledge production, teachers determine what should be learned and how information should be learned. In knowledge navigation, teachers or experts help learners understand how to navigate through knowledge in order to select, manipulate, and apply already existing information for unique situations. In this paradigm, formal and informal learning techniques may blend and teachers' roles shift that of coaches and mentors.

Towards More Effective Mobile Learning Environments

While learners may not actually share the same physical environment, they can use mobile devices to share aspects of their personal and cultural lives. To solve problems unique to their situations, learners can readily choose from a seemingly unlimited quantity of data. The Internet has ushered in an era in which information has become easy to access and easy to publish. Now, learners must acquire the skills and tools to navigate through this growing body of information. Mobile learning enables learners to interact using additional tools such as text messaging, mobile Internet access, and voice communications – all through wireless networks. Although this medium may be hindered by low bandwidth and limited input and output capabilities, there are some distinct advantages:

- Wireles s, networked mobile devices can enable learners to access relevant information when and where it is needed. Mobile learners can travel to unique locations, physically *with* or virtually *through* their mobile devices.
- The ability to access a variety of materials from anywhere at anytime can provide multiple cues for comprehension and retention.
- Learning within specific contexts can provide authentic cultural and environmental cues for understanding the *uses* of information which may enhance encoding and recall.
- Well-implemented mobile education can assist in the reduction of cognitive load for learners. While it is difficult to determine how to chunk information, differing patterns of presentation and amounts of information can potentially help learners to retain, retrieve, and transfer information when needed.

The FRAME model can help practitioners and researchers to leverage these benefits and to better comprehend the complex nature of mobile learning. For example, in attempting to repair a carburetor on a car, can the learner retrieve appropriate instructions at the exact time it is needed? If she can, indeed, access information when it is needed, is she able to choose the best resources? Is the information easy to hear or view on the device? Is the underlying networking infrastructure adequate? Is the learner fully utilizing the affordances of the device? If this learning task is taking place in a formal educational system, are the learning tasks designed in a way that encourages meaningful interaction with peers or experts? The checklist in Appendix A can help answer such questions and guide the development and assessment of mobile learning environments. While reading through the remaining chapters in this book, one can refer to the FRAME model and this checklist to assess the extent to which learners are engaged in balanced and effective mobile learning experiences.

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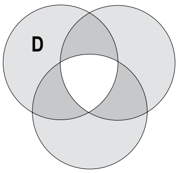
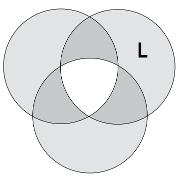
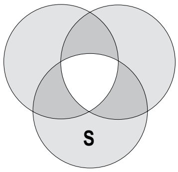
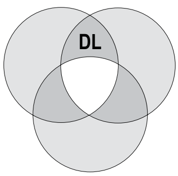
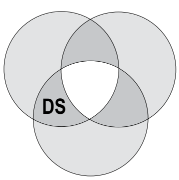
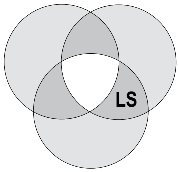
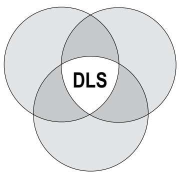
Appendix A

CHECKLIST Planning and Analysis of Mobile Learning Environments

Device Aspect 	**In the selection and use of mobile devices, have you considered** ❑ selecting a device with comfortable physical characteristics? ❑ allowing users to adjust input and output settings (i.e., font sizes, addition of peripherals)? ❑ selecting devices with processing speeds and input and output capabilities that will best complement user tasks? ❑ providing instructions for storing and retrieving files? ❑ taking measures to identify and limit perceived and real error rates of the mobile hardware and software?
Learner Aspect 	**In designing mobile learning activities, have you considered** ❑ assessing the learners' current level of knowledge (if possible)? ❑ using schemas, anchoring ideas, advance organizers, or other instructional techniques? ❑ using contextual cues and multimedia to provide a variety of stimuli to assist comprehension and memory? ❑ structuring learning activities around authentic contexts and audiences? ❑ designing learning situations to stimulate *active* transfer of concepts and procedures to different contexts? ❑ allowing learners to explore, discover, select information relevant to their own unique problems?

Social Aspect 	**In terms of culture and society, have you considered** ❑ clarifying definitions, cultural behaviours (etiquette), or symbols that participants might require while interacting? ❑ providing methods or guidance for ensuring sufficient, accurate, and relevant communications among participants in the mobile media space?
Device Usability Intersection 	**While using mobile devices in learning activities, have you considered** ❑ the locations and climates in which the learner may wish to carry a device? ❑ if the learner's device will permit access to information whenever and wherever needed (just-in-time learning)? ❑ reducing cognitive load by chunking content, reducing the number of required actions to complete tasks, using mnemonic devices, and simplifying displays? ❑ making the device aesthetically pleasing and functional for learners by allowing them to choose themes and adjust preferences?
Social Technology Intersection 	**In accessing or providing networks for interaction, have you considered** ❑ selecting appropriate wireless standards in light of the amount of data, speed, and security with which the data must be transferred? ❑ selecting appropriate collaboration software to meet the needs of the learning or social tasks?

Interaction Learning Intersection 	**With regard to interaction, have you considered** ❑ the learner's relationships with other learners, experts, and systems? ❑ the learner's preferences for social interaction and for learning information and/or skills? ❑ providing mobile media spaces for the development of communities of practice, apprenticeships, and mentorship between learners and experts?
Mobile Learning 	**In a mobile learning system, have you considered** ❑ how use of mobile devices might change the process of interaction between learners, communities, and systems? ❑ how learners may most effectively use mobile access to other learners, systems, and devices to recognize and evaluate information and processes to achieve their goals? ❑ how learners can become more independent in navigating through and filtering information? ❑ how the roles of teachers and learners will change and how to prepare them for that change?