

# Encyclopedia of Mobile Phone Behavior

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# Mobile Literacies: Learning in the Mobile Age

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## INTRODUCTION

Over the last decade, consumer access to mobile phones has increased to the point where there are nearly as many mobile device subscriptions on the planet as there are people (International Telecommunications Union, 2013). The ubiquity of Internet-capable mobile devices in the lives of people around the world has given rise to new learning practices that occur in an increasingly complex digital ecosystem. Mobile learning enables teachers to deliver instructional materials to a student when they need them, at points where the relevance and value of the knowledge are highest. To achieve the promised benefits of mobile learning, instructional designers and developers will need guidelines for designing mobile learning systems and materials effectively. It is also important for instructional designers to master the skills required “to design multimedia messages that promote meaningful learning” (Mayer & Moreno, 2002, p.107). This article will examine the work of leading experts such as Dr. John Traxler (2009) at the University of Wolverhampton in the UK, Dr. James Gee (2011) of Arizona State University, and Dr. Aaron Doering (Doering, Veletsianos, Scharber, & Miller, 2009) at the University of Minnesota.

Current knowledge in the field of mobile message design comes from a number of sources, including theories of learning, perception, and communications theory. Early research in this

area (Wang & Shen, 2012) defined some of the formal characteristics of mobile learning such as captioning and font sizing, and offers guidelines for understanding the uses of particular constellations of mobile technologies. Other projects investigated psychological and pedagogical properties of mobile learning experiences, such as cognitive load and inquiry-based learning (Shih, Chuang, & Hwang, 2010). Further, many of the findings on cognition and eLearning, as presented by Clark and Mayer (2011), are applicable to learning with mobile devices.

In this chapter, we will present a brief examination of the new developments in the field of the Learning Sciences, and how these developments have opened new possibilities for the design of mobile learning experiences. We aim to expand the definitions of mobile learning message design to account for the growing presence of mobile Internet access in the lives of learners. We argue for the treatment of mobile learning as a fundamentally new form of literacy that is situated in the social fabric of the learner, enabled by technology, and supportive of spontaneous learning. As we propose in this chapter, mobile learning has evolved into a new phase of research that we call ‘mobile literacy.’ For the purposes of this discussion, mobile literacy may be defined as a system of meaning-making wherein learners use mobile technologies to achieve their goals and communicate with others in their communities of interest. This definition removes the study

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of mobile learning from a focus on a particular technology and places the focus on how people learn and achieve their goals through the use of mobile technologies.

To make this process relevant to practitioners and researchers, this paper will proceed through three parts. First, the literature review will outline the current trajectory of scholarly research on mobile learning, and the precedents that have given rise to this new, socio-cultural vision of mobile learning. Researchers such as John Traxler are currently engaged in this ongoing research. In the second part, we will offer an analytic perspective that compares cognitive literacy paradigms (associated with reading and writing) with a socio-cultural, New Literacies approach to mobile learning. This approach comes from the pioneering writings of James Gee (2011) Michael Knobel, and Colin Lankshear (2007) in the United States. The final section will provide a design framework for integrating three crucial strands of design decisions for mobile learning literacy into a learner-centered whole. This work is under continued development by researchers such as Aaron Doering (2006). These three sections will provide practitioners and researchers with the context, tools, and frameworks necessary to embark on deeper explorations of the new possibilities inherent in mobile literacies research in their own projects and endeavours.

## **OVERVIEW**

In this review of the current thinking in approaches to mobile learning, we explore the evolution of mobile learning research as it exists within the broader frame of the field of education, and outline the argument for mobile learning as a new form of literacy. Over the last decade, mobile learning research has reoriented from a technologically-focused area of research towards a practices-oriented area. An account of this shift will provide the necessary framing for a new approach to message design that takes into account

the concerns of instructional systems design and the Learning Sciences. This chapter examines three relevant sources of ongoing work that have emerged in the last decade. The first, Traxler's *Evolution of Mobile Learning* summarizes the recent historical context and changes in the field of mobile learning, and the directions proposed by one experienced researcher in the field. Second, we present Collins and Halverson's *Rethinking Education in the Age of Technology*, and examine how it connects to some of the larger changes that are occurring within the education system of the United States (a frequent test market for mobile interventions). In the summary, we connect these works to research in the New Literacies as a means of providing an expanded view of the opportunities inherent in taking new perspectives on mobile learning.

This selection of research approaches to mobile learning illustrates the development of a 'socio-cultural turn' (similar to Bonnell, Hunt, & White, 1999), a perspective now endemic to American research perspectives on Education. This socio-cultural turn, instigated by research from Lev Vygotsky (1974), Lave and Wenger (1991), and Yrjo Engestrom (2003), has fundamentally shifted how researchers understand the learning process. Whereas research in the 1980s and 1990s focused on individual cognitive approaches to learning, this socio-cultural turn has begun to refocus on how learners develop their cognition within a social context. This reorientation of the field away from a purely cognitive stance mirrors the 'cognitive turn' of the 1970s and 1980s, when researchers pivoted away from Behaviorist models of learning and moved towards research in cognition.

This turn has manifested as a growing appreciation of the social and phenomenological aspects of mobile learning, and an acknowledgement of the role of the mobile medium's capacity for supporting situated learning (Lave & Wenger, 1991; Wenger, 2009). Following this review of the evolving socio-cultural turn in the field, we present a new message design heuristic for instructional designers who hope to create rigorous and high-

quality mobile learning materials. This model will ideally prompt researchers to think more deeply about their selection of technology, and to dig more deeply into the mobile learning experience.

## EXPANDING THE DEFINITION OF MLEARNING

An early pioneer of research in the field, Traxler (2009) described the product of the evolution of research and thinking in mobile learning as “a distinctive, but ill-defined entity” (p.2). Traxler illustrates the emergence of mobile learning initiatives from a variety of disciplines, perspectives, and contexts within education. The arc of this evolution in the research began with a focus on the use of mobile technologies in classroom settings. While many valuable discoveries resulted from the focus on technologies, Traxler critiques these perspectives as “too technocratic and imprecise.”

Later research grew to focus on the physical mobility of learners. For example, research and design projects conducted at Shanghai Jiao Tong University explored the role of the technological components of mobile learning development, and learners’ ability and desire to achieve specific ends (Shen, Wang, & Pan, 2008; Wang, Shen, Novak, & Pan, 2009; Wang & Shen, 2012). Traxler lauds several of these projects, indicating that mobile learning may successfully bring learning to geographically distant communities, and improve the activities of learning in those communities. However, he also notes that these research and design projects suffer from unresolvable issues of scale, sustainability, and inclusiveness that require new directions and new ways of understanding mobile learning.

In outlining contemporary trends in mobile learning research, Traxler points to the convergence of mobile learning with renewed interest in learning that occurs across informal and formal contexts and environments. The increasingly ubiquitous presence of mobile devices, and the integration of the devices into the lives of their

owners have made informal learning a part of the achievement of peoples’ daily goals. From this vantage, Traxler sees life as full of informal learning opportunities that are embedded in experience, and indispensable mobile tools have become another way to navigate those learning events. Traxler and several other researchers advocate for the readjustment of the study of mobile learning to refocus on the realities of ‘learning in the mobile age,’ as opposed to studying the mobile technology itself. This realigns the field towards the study of how mobile learning transforms the teaching and learning in society, and away from technocentric approaches to mobile learning research.

## LEARNING IN THE MOBILE AGE: HOW, WHERE, AND WHEN

At the heart of Traxler’s argument is the idea that mobile technologies, as an integral component of the reality of social life, will continue to provide new opportunities for learning as they are woven into the meaning-making and learning practices of all societies where these technologies appear. Collins and Halverson (2009) support this idea in the United States’ context in their book *Rethinking Education in the Age of Technology*. In their even-handed text, the authors argue that schooling (a foundational part of lifelong learning) is undergoing a fundamental change as a result of the introduction of technology into other spheres of society, including entertainment, government, and workspaces. The growth of use of these devices throughout and across the lifespan (and the new kinds of thinking and work that attend this growth) has created the need for lifelong learners who can continue to adapt to rapid changes in practical and disciplinary knowledge (Bransford, 2007).

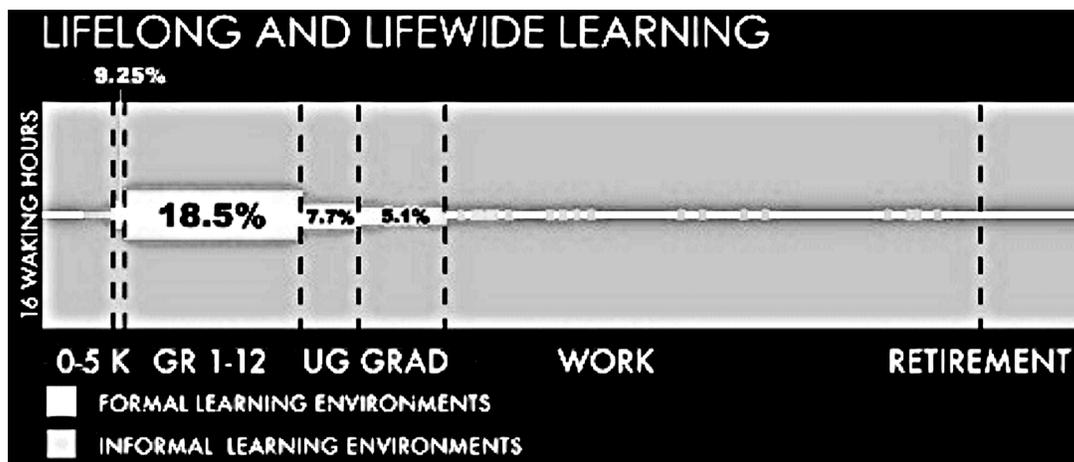
Unfortunately, according to Collins and Halverson, systems of schooling in the United States focus on ‘just-in-case’ approaches to teaching and learning, whereas mobile and digital technology promote a ‘just-in-time’ approach. They claim that schools must be reconfigured to provide

children with the skills necessary to function in a knowledge economy that demands a mastery of multiple technologically supported competencies. Implicitly, a failure to integrate these technologies and new ways of learning will lead to the emergence of ever-greater gaps between the skills needed by 21<sup>st</sup> Century learners and those provided by the United States' system of education. Collins and Halverson acknowledge that there are many risks to realigning the educational system towards the creation of adaptive learners through digital technology, including issues of equity, social cohesion, diminished diversity, and narrower bands of knowledge. However, they also present a range of possibilities that are enabled by intensive technology use in schools. For example, mobile learning may transform schoolwork into more collaborative and structured activities through the use of scaffolding technologies. Equally, personalized learning technologies like those described in the US National Educational Technology Plan for 2010-2015 (US Department of Education, 2010) may serve to provide children with access to adaptive tools that help them to overcome skills deficits and education debt (Landson-Billingsly, 2006).

This 'rethinking' of education places a new emphasis on learner-centered approaches to technology implementation, and personal mobile devices

will play an ever-larger role in this new paradigm. Most importantly, Collins and Halverson provide researchers with an opportunity to disaggregate three essential concepts that are relevant to mobile learning as viewed from the Learning Sciences: Schooling (*the economic, political, environmental, and social environments of large-scale formal learning environments*), teaching (*the deliberate structuring of learning experiences and meaning for others*), and learning (*the human process of the acquisition of knowledge through experience*). In understanding that these concepts are related, but by no means mutually inclusive or exclusive, technologically enabled pedagogical models like mobile learning may facilitate a broader understanding of how learning takes place in the real world. This is further supported by research from the University of Washington's Learning in Informal and Formal Environments (LIFE) Center. Figure 1, provided by the LIFE Center (Stevens, Bransford, & Stevens, 2005), illustrates the estimated number of waking hours that people spend in informal and formal environments across the lifespan, based on statistics gathered from each period. On this timeline, learners spend a maximum of 18.5% of their 16 waking hours in formal environments during their formative years. However, before and after this period, learners

Figure 1. Number of waking hours spent in informal and formal environments across the lifespan (LIFE Center, University of Washington: Stevens, R., Bransford, J., & Stevens, A., 2005). Formal learning experiences are shown along the center line, nested within informal learning experiences across the lifespan.



spend the bulk of their life engaging in informal learning experiences that include hobbies, learning from and with family members, and other kinds of authentic learning experiences that originate from their own goals and interests. In this way, the LIFE Center notes, learning is not merely a ‘lifelong’ process, but also one that is ‘lifewide.’ Figure 1 illustrates this concept of lifelong and lifewide learning.

When learning and schooling are understood as separate phenomenon, new approaches to informal and formal learning present an opportunity to place more of the power (and responsibility) to learn in the hands of the learners themselves. This transfer of power from teachers (as sole vectors for information acquisition in formal schooling) to learners necessitates a new and learner-centered approach to the development of technological innovations. Much more than this, the changes to learning that are facilitated by mobile technologies have the capacity to expand not just access to content knowledge, but access to new ways of making meaning from that content.

## NEW LITERACIES FOR THE MOBILE AGE

During the same time period recounted in Traxler’s evolution and Collins and Halverson’s push for ‘rethinking education,’ a field known as ‘the New Literacies’ emerged as a critical response to contemporary models of literacy in light of new developments in digital technologies (Coiro, Knobel, Lankshear, & Leu, 2010; Gee, 2011, Knobel & Lankshear, 2007; Lankshear & Knobel, 2006; New London Group, 1996). During this early period, the New Literacies aligned itself with the field of Information Literacy, defined by Doyle (1994) as the ability to access, evaluate and use information from a variety of sources. As researchers in the New Literacies proposed, pre-digital education perceptions of literacy focused too narrowly on the traditional elements of literacy, such as the

mechanics of reading and writing and the quality of being literate in printed text (Bawden, 2001).

In the opinion of the New London Group, a multidisciplinary team of scholars that began the research agenda of the New Literacies in 1996, the emergence of digital and mobile tools had opened this definition to new possibilities. These included the reconceptualization of literacy as a set of socially-situated practices and as an information evaluation competency. Most importantly, these researchers sought to shift research in literacy within the Learning Sciences towards a broader focus on how students use images, video, text, audio, and interactive software to make meaning in ways that are comprehensible to others. Expanding the definition of literacy from a purely mechanical area to a meaning-making perspective has allowed researchers such as James Gee (2011) to examine issues of domain-based discourse (how knowledge domains use media and narrative to structure knowledge) and how digital tools scaffold and support thinking in activity. In one example of this intersection between literacy practices and technology, Gee (2011) performed a media analysis of video games that identified opportunities for using the medium in ways that scaffold informal learning experiences. In Gee’s work, the learner is an active participant in the construction of meaning from media as they navigate the specific narratives, constraints, and affordances of video games.

Over time, the New Literacies has taken on a more expansive lifelong, life-wide, and life-deep stance that focuses on the implications of socio-culturally situated knowledge on the development of meaning-making practices. As a result, research in the New Literacies (Knobel & Lankshear, 2007) has focused on diverse areas such as the literacy practices of teenage bloggers, online fantasy role players, student artistic communities that were expanded by technology, and amateur Rap musicians. Research from this area has foregrounded overlooked spaces of meaning-making that exist in the physical and digital world, the importance

of identity development in the learning process, the roles of visual culture and multimedia thinking in contemporary learning practices, and the integration of multiple strands of content knowledge. In looking at these border spaces in education, researchers in the New Literacies have begun to build a new set of critical perspectives on learning. Some of these perspectives include new methodologies (such as Gee's *Discourse Analysis*, 2014; Design-based Research Collective, 1999) that can enable the theoretical and practical research of 'learning in the mobile age,' in all of its formal and informal environments.

From this frame, mobile and digital technologies provide learners with the ability to connect ideas across media, context, and 'affinity groups.' Affinity groups, an idea engendered by Gee and Knobel and Lankshear, are social knowledge sharing communities that arise around specific topics, genres, and modalities that support learners' goals, and often lead to creative new approaches to learning. This concept emphasizes the socially situated nature of learning as it applies to media, as socially-real affinity groups can exist wholly online or in any kind of blended space. Implicit in this idea is a new approach to mobile learning. Whereas the early mobile learning design approaches described by Traxler (such as the creation of 'content modules' or 'online classrooms' for consumption on mobile phones) focused on the medium, these ideas have evolved to focus on the capacity of learners to make (and remake) meaning in a socially-situated mobile virtual space.

The growth of New Literacies perspectives has also intersected with a number of mobile technology design initiatives in education, and has produced viable tools that support meaning-making practices in mobile communities. For example, Lewis, Pea, and Rosen (2010) of Stanford set out to design a mobile-capable Web 2.0 application that supported the creation of 'generative learning communities' based on affinity groups and learner-derived objectives. In creating a tool that they called 'Mobltz,' the researchers sought ways to promote participatory meaning making

skills (like those described by New Literacies researchers) through the development of an online platform that deliberately supported those practices. Specifically, the tool used a mobile-capable platform to provide students with opportunities to create and reuse learning artifacts (photos, videos, books) that are gathered from the real world and shared with others in their learning community. As a result of this work, Lewis and colleagues offer a set of design heuristics for creating an online and mobile experience that creates a rich and interactive meaning-making experience for learners. The heuristics include designing systems that:

1. Support generative learning communities with social media in ways that create a 'doxa' (Bourdieu, 1972), or a naturalistic representation of social order. This includes opportunities for learners to connect their experiences in informal learning environments with an online social order.
2. Support ownership, collaboration, and the remixing of artifacts in ways that promote learners' motivation, engagement, and understanding of contextual meaning. Remixing, or the use of existing symbols to signify new meanings, is a crucial feature added by the New Literacies and supported by many new mobile applications.
3. Support a 'global media snowball' effect, or the continued growth of the community's content sharing abilities along lines of affinity groups that are interested in common topics or approaches. Spontaneous growth (virality) is a new element also identified by the new literacies and supported by mobile devices, as sharing is facilitated by the technology.

In designing their system according to these principles, Lewis and colleagues hoped to create a technology that could foster the creation of communities that actively share ideas and information in informal and novel ways across the myriad devices. More importantly, the heuristics provided

by the researchers focus on the issue of how designers might develop technologies that support meaning-making practices that are embedded in learners' contexts and are as natural as any other kind of social order.

## PRECEDENTS FOR A SHIFT IN MOBILE LEARNING

In outlining mobile learning as a learning process that is situated in a myriad of contexts, we will examine some of the features of message construction as it relates to the idea of mobile learning as a literacy practice. To clarify the potential of a New Literacies approach to mobile technologies as a message design and construction vector, we may compare this socio-cultural perspective to a framework developed during the transition from behaviorism to cognitivism in the educational research literature. In comparing these models, readers will have an opportunity to see how this new perspective both describes and expands the concept of mobile learning as a literacy domain.

In his 2012 article on the course of his career as a pioneering researcher in the field of cognitive literacy research, John Hayes described the consequences of changing paradigms through his work on the study of writing production. As Hayes relates the story, psychological researchers in the 1950s (including B.F. Skinner) began to approach the study of readings and writing from a behaviorist standpoint. Researchers in this paradigm favored experimental designs based on strictly defined behavior-response schedules. Consequently, researchers rejected the possibility that non-observable phenomena (like cognition) could serve as evidence for learning. Following the period of rapid growth in cognitive science in the 1970s through the 1990s, research shifted from behaviorism to cognitivism, and researchers intensified their experimental study of literacy as a series of interlocking cognitive processes supported by neural-correlate regions of the brain. Hayes notes that this line of thinking evolved from

the emerging computer metaphors and Structuralist theories that began to take shape in the wake of Noam Chomsky's writing on linguistics and semiotics in the 1960s. It was in this cognitivist paradigm that Hayes developed a framework of writing production using protocol analysis methods (as in Hayes & Flowers, 1980) that we will examine in this section.

The cognitive model that Hayes and Flowers outlined in 1980 is now being challenged by the New Literacies model of 'multiliteracies,' and this may have productive implications for researchers in the area of mobile learning. As Hull and Nelson (2005) note, the goal of this paradigm is the study of the interplay and intersection between verbal, visual, cultural, and technological literacies in ways that lead to more engaging learning activities and environments.

## UNDERSTANDING MOBILE LEARNING AS A LITERACY PRACTICE

Designers interested in developing innovative solutions for learning in the mobile age may do well to draw from a deeper understanding of how the cognitive and socio-cultural paradigms differ. To explore the differences between the two paradigms, this section describes and reconfigures the Chenoweth and Hayes model of the cognitive processes of writing to reflect the socially-situated nature of the multiliteracy paradigm that is supported by the technological components of mobile learning. A clear understanding of the Chenoweth and Hayes model of literacy will provide the necessary aspects of communication that we will examine from a new literacies perspective. Through this shift and the writings of Hayes (2011), Hull and Nelson (2005), and others, we attempt to understand the tensions between the cognitive and socially-situated perspectives of mobile learning as they apply to the roles of three key elements of the model: The author, the product, and the interpreter. These three components

of cognition look different through the lenses of the cognitive and multiliteracy paradigms, and by arraying them in apposition to one another, researchers will learn more about the process of the symbolically encoded expression that can occur in the mobile age.

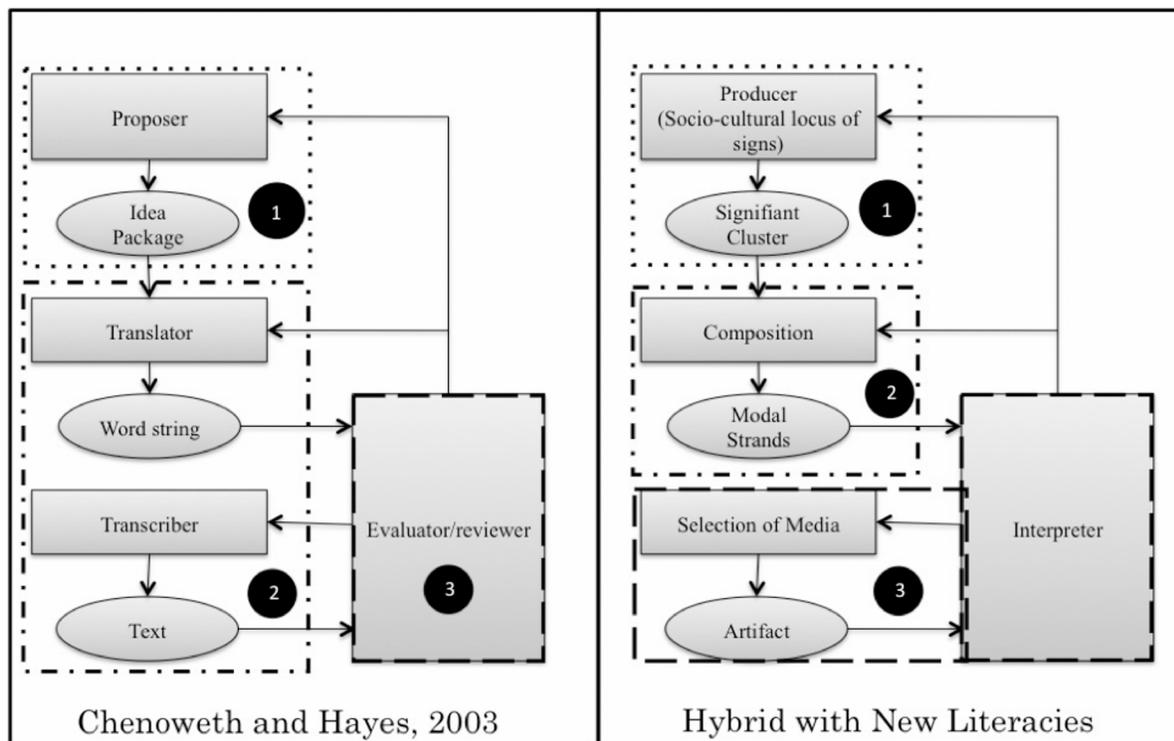
In Figure 2, we have presented the cognitive model of literacy that Chenoweth and Hayes (2003) codified to represent how learners engage in the writing process. As we illustrate in our ‘Hybrid with New Literacies’ model, a literacies approach to mobile learning provides a framework for understanding a new set of interactions between individuals and communities as they co-develop meaning from new or existing symbols and using mobile and digital technologies. This hybrid model provides a pathway to legitimizing informal modes of learning (such as mixed-media representations of knowledge) that have become endemic to research in mobile learning and the

New Literacies. Figure 2 also highlights differences between these paradigms in (1) the role of the ‘author’ in creating meaning, (2) the role of the ‘text’ created by the learner, and (3) the role of an external interpreter of the text.

### THE ROLE OF MOTIVATION IN MOBILE LEARNING

In Chenoweth and Hayes’ cognitive model of writing production, the construct known as the ‘Proposer’ represents the combination of several cognitive processes, including a writer’s long-term memory, knowledge of audience and topic, and their metacognitive faculties (Hayes & Flowers, 1983). Implicit to this system is the idea of generation, or the development of ideas, based on socially and environmentally and internally contextualized cues. The proposer, as

Figure 2. Apposition of Chenoweth and Hayes (2003) with ideas from the New Literacies paradigm as they apply to mobile learning. (1) Indicates the role of the ‘author,’ (2) indicate the roles of the ‘text,’ and (3) indicate the role of the ‘receiver.’



either a function or an individual, puts forth an Idea Package that contains encoded information. As Hayes notes, the motivation of the Proposer is an area that warrants further study, and the multiliteracy paradigm provides a window into the kinds of activities that inspire the production of a multimedia artifact.

In the hybrid-New Literacies model, the Proposer is re-envisioned as a Producer, someone who is in the process of creating a message that carries meaning to others in their affinity groups and beyond. This Producer has a socio-cultural and physical context that is unique to their personal history, and their motivation to produce meaningful communication may be deeply tied to the Producer's identity. Further, the Producer's locations and affinity groups drive their desire to engage in the process of learning through creating new forms of meaning. It is this motivation that drives learners to use mobile devices to create and share these new forms with others over mobile networks. In the New Literacies literature, authors such as Stone (in Knobel & Lankshear, 2007) locate a Producer's self-motivation to communicate within the norms, vocabulary, and discourse structures of those affinity groups. Thus, an individual's online and offline life has substantial effects on their level of effort and the form of their communication.

Since artifacts created by learners in the mobile age are symbolic but not necessarily textual in nature, the New Literacies hybrid model of mobile learning has redefined Chenoweth and Hayes' "Idea Package" as a "Signifiant Cluster" to better reflect the symbolic nature of the encoded ideas and the formal attributes of those symbols. The idea of a 'signifiant' comes from the field of semiotics, and refers to a broad range of formal attributes artifacts that a learner has encoded with meaning based on the shared norms of their affinity groups. These might include the use of memes to represent a new take on world events, or a more formal assignment involving the use of mobile photography to encourage learners to engage with their local place and time. The Signifi-

ant Cluster in this model carries this idea further by recognizing that several significant artifacts can be brought together to form a larger cluster of ideas and meaning. This also emphasizes the potentially serial nature of engagement in these learning experiences, as the production of multiple small activities provides more opportunities for feedback and engagement with the social learning community.

D

## THE ROLE OF THE PRODUCT IN SYMBOLIC EXPRESSION

After the generation of the Idea Package, Chenoweth and Hayes represent the composition of a written product as the interplay between three cognitive processes. The Translator process (a mental subroutine that turns ideas into language) generates 'word strings' that represent the Proposer's ideas as syntactically valid text. Second, Transcriber processes in the mind of the Proposer turn the text into a recognizable visual form (handwritten or typed) that can be made visible to internal or external evaluators. Finally, as a result of presenting these 'texts' to evaluators, Proposers revise and develop a final version of a text that accurately conveys meaning to others. As shown in the model, the Proposer's written text is evaluated and reviewed recursively during each of the phases. However, in their explication of the model, Chenoweth and Hayes did not acknowledge the social situation of both the evaluator (a real person with biases and cultural predilections, be they teacher or peer) and the social situation of the Proposer. This is a crucial gap between a reading/writing perspective of literacy and an understanding of multimodal capabilities of mobile learning. This process makes sense in the context of classroom-based writing lessons, or in the context of adult learning, but does not necessarily describe the broader range of symbolic expressions that people may produce via mobile technologies. For example, if the final 'text' contains a synchronization of written text, spoken text, and audio (as in Hull & Nelson's 2007

analysis of *Life-n-Rhyme* in *The New Literacies Sampler*), can we truly consider the ‘word string’ the basic unit of meaning?

For this reason, a New Literacies or multiliteracy hybrid model for mobile learning would replace the idea of ‘Translation’ with the idea of ‘Composition.’ In this sense, Composition refers more to the idea of a symphonic Composer that balances and unifies many disparate ideas, and treats the work of mobile learning as a kind of teaching through synthesis (as in Gardner’s idea of the ‘synthesizing mind,’ 2006). It is in this process that many sources of ideas (e.g. music, popular culture, folkways) that are available through the Internet are brought together to express meaning in new ways. This reflects the broader, socially-located role of a writer in the creation of a product. If this is the case, then the idea of ‘modal strands’ may better fit the nature of the preliminary product, as it posits an active relationship between the Composition (bringing together and balancing) and the choices and influences of the Producer.

When the Composition of the modal strands has occurred, producers may then expose their preliminary work to an outside observer. Rather than viewing it as an ‘evaluative’ action, this part of the process may serve as an opportunity for collaboration with an Interpreter. The Interpreter may or may not come from the Producer’s affinity group, and thus may see different possibilities in the modal strands, or may not have an existing knowledge of the community’s communications syntax. The differences between the Producer and the Interpreter may then affect the Selection of Media and the form of the final Artifact in ways that dramatically change the nature of the product. This interplay between the Composer and the outside Interpreter may ideally set up the conditions consistent with Vygotsky’s idea of the ‘more knowledgeable other,’ where teaching and learning become co-constructively embedded in social relationships. If mobile learning activities are designed with teaching and learning in mind, the presence of learners of different levels of knowledge may foster the exchange of skills and information in the course of the pursuits of the

creation of meaningful artifacts. In refocusing the ‘evaluation’ phase of Hayes and Flowers’ cognitive model of literacy to examine the engagement of students in teaching and learning, researchers may find opportunities for creating more effective and creative learning opportunities for mobile learning.

Interpreters may also form communities of practice around technology-supported artifact production or dissemination, as are often found in fan fiction (Thomas, in Knobel & Lankshear, 2007) and role playing texts (Hammer, in Knobel & Lankshear, 2007). These communities, generated along a number of lines, exist outside of Chenoweth and Hayes’ cognitive paradigm, but display a real and direct effect on the nature of the Artifact. For example, an online community of writers may emerge out of a shared interest in a card game such as Yu-Gi Oh (Gee, 2010). The community’s collective intrinsic interest in this topic may lead the participant Producers to explore other encoded modal strands (such as illustrations, music, or the remixing of video) that allows the community to develop new, original artifacts. It is the examination of this interplay between Producer and Interpreter communities that defines post-Structuralist paradigms in literature, anthropology, and the New Literacies, but cannot be understood directly through the cognitive paradigm.

This socio-culturally situated approach to artifact creation provides us with a way to understand the learning processes associated with Traxler’s ‘learning in the mobile age.’ As the New Literacies model illustrates, a literacy approach to mobile learning provides not just a new approach to how people learn to read text, but how they learn to make meaning with and from multimedia artifacts on mobile platforms in the virtual and physical communities that they interact with online.

## **FUTURE RESEARCH DIRECTIONS**

The final section of this chapter will turn from issues of theory and practice to questions of design. Based on the New Literacies model of ‘learning

in the mobile age' that we have examined so far, how might instructional designers and researchers use this model to create situations where mobile technologies are not merely a convenient feature, but a crucial part of the process of learning in authentic contexts. In order to achieve the specific outcomes for their mobile literacy projects, designers of learning materials for mobile devices will need to adapt and adopt new approaches to the creation of learning materials that are not grounded in classroom metaphors. To propose a model for designing learning in the mobile age, this chapter will use a modified version of the TPACK framework (Technological, Pedagogical, and Content Knowledge, defined by Doering et al., 2009; Mishra & Koehler, 2006) to identify key message design principles for this new medium that are grounded in research from the fields of Instructional Design and Learning Sciences.

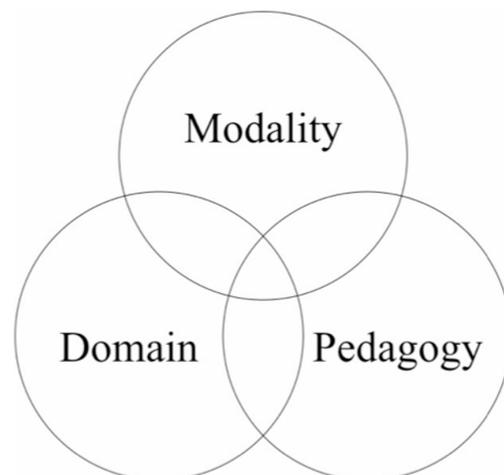
The TPACK framework was originally created to describe the interactions of teachers' various kinds of practices as an integrated set of skills and knowledge. However, this theoretical model makes a set of assumptions about the relationships of teachers and learners that cannot be generalized about all mobile learning initiatives. In places that are far from centers of knowledge, teachers may never interact with their learners in real time and learners may not have local access to knowledge and expertise. To address this challenge and use mobile tools to their full potential, designers who work on mobile learning initiatives will need to think about the same set of interrelated knowledge from a broader perspective, and require a model of learning that focuses on the needs of learners and deemphasizes the role of the teacher as researchers traditionally define it in the field of Education. Thus, teachers and instructional designers must embed their Technological, Pedagogical, and Content Knowledge into the technology in ways that make it possible for learners to make use of these resources without the local presence of the expert teacher.

To serve students across cultures and geographic locations via mobile learning, researchers and designers will need to conceptualize a

new role for the technology that is more akin to Vygotsky's 'more knowledgeable other' (1980). For this reason, this paper will adapt the TPACK framework to emphasize the role of technology in prompting learners to think about moments where mobile technology may advance their goals and interactions with their affinity groups. The Modality-Pedagogy-Domain (MPD) framework is a tool that allows designers to systematically identify the features of learning experiences that play into the mobile literacies paradigm described earlier, and their mutually-reinforcing effects on learners. Figure 3 illustrates the Boolean model of the MPD framework, and this paper will conclude with a discussion of how designers might look to the intersections of these components to promote learning in the mobile age.

In this model, each of the primary zones provides an area of consideration for designers. First, modality is taken to mean the specific features of a medium. In the context of mobile learning, this refers to affordances such as portability, multimedia support, and pervasive Internet access as described in Wang and Shen (2012). As Traxler notes, much of the early research on mobile learning focused on this area of the model, and work by researchers such as Clark and Mayer (2011) has identified the specific capacities of online and mobile learning. At the intersections of Modality

Figure 3. The intersections of design considerations in the Modality-Pedagogy-Domain Model



and Domain, researchers and designers might consider the relationship between the kinds of knowledge that they will make available to their learners and how these might be presented to learners. For example, designers should consider the locations where this knowledge may be used (on a bus, in a classroom, or during the course of daily activity) and how the domain content should be portioned to best fit the demands of these environs.

Second, Pedagogy refers to the deliberate selection of a teaching and learning model that scaffolds the learning experience for learners as they engage with the content and modality via their mobile devices. In this case, the role of the instructional designer is to judiciously select a pedagogical model that prompts learners to use their mobile technology in educationally meaningful ways. For example, the selection of an Anchored Instruction approach (O'Mahoney et al., 2012; Schwartz, Lin, Brophy, & Bransford, 1999) or Gagne's Nine Events of Instruction (1981) should dovetail with both the modality and the domain content in ways that promote learner interaction with their affinity groups and with their environment. In selecting the pedagogical model to suit mobile learners, it is crucial that designers consider how the modality and pedagogy interact to provide learners with a satisfying and relevant learning experience. For example, the difficulty of text entry and the small size of text on mobile devices may preclude the use of writing-heavy pedagogical models and necessitate a different learning approach that emphasizes mobile photography, field notes, or multimedia input from the learner.

Finally, Domain refers to both domain content knowledge (as provided by experts through websites such as TED, or through more formal experiences such as MOOCs) and 'found content objects' from the physical and online world. This definition includes both formal and informal content knowledge, and would ideally promote the 'remixing' of this content by the learner to fit their interests and contexts. Further, the Domain area of the model emphasizes the idea that

learning occurs in the context of specific content knowledge systems. As has been found in research on formal education in US K-12 systems, the structure of a Domain can require learners to engage with new knowledge in ways that make sense to others who engage with these knowledge systems (for example, learning to think and write as a historian in order to critically engage with a knowledge of history). In considering the intersection of Domain content creation and Pedagogy in the mobile age, researchers may find that many existing models of instructional design are hostile to the new definition of creation and composition presented in the New Literacies approach to mobile learning. These existing models of pedagogy place an inordinate focus on the role of instruction, whereas the Domain-Pedagogy boundary of the MPD model opens opportunities for people to engage in learning within the context of their own lives and activities.

The MPD heuristic presented here is meant to provoke researchers and designers to more carefully consider how they might tightly integrate these qualities into their mobile learning initiatives. Further, it is a potential pathway for designers to more carefully consider the ways that learning will occur in the mobile age: spontaneously, in alignment with learners' own goals, and as part of a lifelong process. It is a simple model that designers may use to scaffold their thinking and planning as the field continues to grow and change. Learning in the mobile age has arrived, and instructional designers may find this model a starting place for charting their learners' journeys.

## **CONCLUSION**

In summary, mobile learning is currently undergoing a period of maturation that reflects changes in the broader field of education. As researchers shift from cognitive approaches to teaching and learning towards socio-culturally situated approaches, a number of new opportunities have appeared. We hope that instructional designers and Learning

Sciences researchers will take up the challenge to continue to define new approaches to ‘learning in the mobile age’ through design projects and initiatives. In continuing this agenda, these new projects may bring researchers, practitioners, policy makers, and educators closer to the realization of John Dewey’s idea that “Education is not preparation for life; education is life itself.”

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## KEY TERMS AND DEFINITIONS

**Affinity Groups:** Social knowledge sharing communities that arise around specific topics, genres, and modalities that support learners' goals, and often lead to creative new approaches to learning.

**Discourse:** Procedural and structural ways of presenting knowledge to others that invites understandings of shared meanings.

**Domain:** An area of content knowledge that is relevant to a learner's goals, and is scaffolded by

the mobile technology system. Domains (such as history, chemistry, literature, etc.) structure their discourse and knowledge in unique ways that require consideration during design.

**Literacy:** A system for encoding and decoding symbols, text, images, video, or other modalities for the purposes of expressing meaning to other people.

**Mobile Learning Message Design:** The manipulation and planning of signs and symbols that can be produced for the purpose of modifying the cognitive, affective or psychomotor behaviour of one or more persons.

**Mobile Literacy:** A system of meaning-making that uses mobile technologies to help

learners achieve their goals and communicate with their affinity groups.

**Modality:** The specific features of a medium. In the context of mobile learning, this refers to affordances such as portability, multimedia support, and pervasive Internet access.

**New Literacies:** A broad area of new research in the field of literacy, the New Literacies focus on the role of digital technologies in the process of communication, learning, and meaning-making in formal and informal contexts.

**Pedagogy:** Models of teaching and learning model that scaffolds the learning experience for learners as they engage with the content and modality via their mobile devices.