ABSTRACT
The purpose of this paper is to explore components that influence the Mobile User Experience (MEX) in a mlearning interaction through a review of relevant literature. The application of mobile cellular technology in education has been the focus of the emerging domain of mlearning, and has, through numerous pilots and initiatives, been shown as having the potential to overcome several barriers experienced in education. This potential is, however, counterbalanced by studies that show the relative high dropout rate and non-use for learners using a diverse array of electronic learning systems when compared to the traditional face-to-face classroom interactions. The learners as end-users often indicate a frustration with the technology as a major obstacle for the use and participation in technology enhanced learning systems. Moreover, organizations are increasingly requiring evidence that technology enhanced learning systems and programs will be widely accepted and utilized before implementing them. This paper explores and documents the components that would impact on the phenomena within a discourse between the technology affordances and domain requirements as revealed by the literature in the domains of mlearning and Mobile Human Computer Interaction (MHCI).

Categories and Subject Descriptors
H.1.2 [User/Machine Systems]: Human Factors and J.1 [Administrative data processing]: Education

General Terms
Human Factors, Theory.

Keywords
Mobile Learning, Mobile User Experience, Mobile Human-Computer Interaction.

1. INTRODUCTION
Mobile technology’s application in education has been the focus of the emerging domain of mlearning that, through numerous pilots and initiatives, has shown as having the potential to overcome several barriers experienced in education and to enhance the learning environment. This potential is, however, contrasted in studies that show the relative high dropout rate and non-use for learners using a diverse array of electronic learning systems when compared to the traditional face-to-face classroom interactions. Learners, as end users, have indicated that they experience frustration with the technology interactions and consider this as a barrier to their ability to effectively use and participate in virtual learning activities[30; 44]. This is reiterated in studies reporting that negative educational user experiences lead to limited participation and engagement, resulting in the ineffective utilization of the expected pedagogical gains and organizational benefits. Furthermore, a comprehensive survey of 1000 users found that poor user experience translated to the abandonment of data services [56].

As such, education and training organizations are increasingly requiring evidence that the technology based learning systems and programs they invest in will have a significant uptake, before putting them into operation. As a result, it is imperative to acknowledge the educational user experience in order to provide an optimal learning environment in order for learners to become active participants in technology enhanced learning environments [8].

Bearing this in mind it becomes desirable to identify components that influence the Mobile User Experience (MEX) of a mobile user when engaging in learning environments facilitated by mobile cellular technology.

The MEX of an mlearning interaction is an under researched concept in the literature. As such, this review, although residing in the field of Human-Computer Interaction’s (HCI) focus on MHCI, is founded on the considerations of Mobile User Experience as a specific focus of User Experience (UX) and Human Experience in general.

Figure 1: MEX of a mlearning interaction

The review is informed by a reflection on Mobile Human Computer Interaction (MHCI) and the educational perspective as revealed in the literature on mobile learning as illustrated by Figure 1.
The study, although acknowledging the complexity of the phenomenon, does not focus on learning or learning gains or the measurement of these in the mlearning interaction, but considers contextualized use of mobile phones to facilitate curriculum driven task completion as part of a mobile enhanced learning environment. As such, the following were not dealt with as primary concerns in this study:

- While acknowledging the role of instructional design and learning interaction design in the technology-enhanced environment, this study’s primary focus is on the experiences of the learner as end user of mobile cellular technology in a curriculum driven mlearning interaction.
- Technology adoption, and factors affecting technology adoption and integration, is an ongoing discussion in Education [55]. This study, however, selected to focus on the mobile technology in use as mobile human-computer interaction.

The findings in this study therefore represent a single perspective of MEX in an mlearning context.

2. MLEARNING INTERACTION

The mobile user experience of a mlearning interaction is underpinned by the requirements of pedagogy and the attributes and affordances of the technology to realize and support the aims of the user. This acknowledged inter-relationships and dependency of mlearning on the technology that supports it, is well documented and accepted [25; 42; 48]. Traxler, however, while recognizing this interdependency, discounts technology as a defining characteristic stating that “different hardware and software platforms support rather different interpretations of mlearning [52].”

Mlearning can be viewed as facilitated on the considerations of MHCI as a supporting discipline; however, MHCI is not the focus of the learning interaction. Mlearning is primarily about the mobility of the learner and the quality learning that it enables anywhere or anytime [1; 25].

The relationship between MHCI and mlearning can be visualized as in Figure 2 below. MHCI as a domain that is concerned with the reasons and ways in which people act and interact with data that is accessed through the mobile device [5; 29] as acknowledged by literature underpins the mlearning interaction by providing affordances to the mlearning interaction, that is primarily concerned with supporting learning [1].

![Figure 2: MHCI as support for mlearning](image)

The affordances and technology as presented by MHCI, does not define mlearning. These affordances and technologies, however, supports the curriculum guided learning endeavor by offering needed attributes to fulfill the technology requirements for a mlearning interaction.

This distinction, although slightly diffused, provides layers that present a direct or indirect impact on the mlearning interaction of the user, while providing a useful schema in that a clear statement of design concern is represented.

MHCI provides a broad enabling platform and interactions while mlearning uses the platform and interactions for educational endeavors in the mobile learning interaction.

Traxler concurs stating “…hardware devices and technical systems are all without exception designed, manufactured and marketed for corporate, retail or recreational users. Any educational uses of the devices and the systems are necessarily parasitic and secondary [52]”.

3. USER EXPERIENCE

3.1 Focusing the User Experience

UX, as a trans-discipline and emerging concept, has a multitude of definitions that are sympathetic to its origins, indicating the complexity and richness of the UX.

Pine and Gillmore [40] position experience as a unique offering of the emerging experience economy. They argue that an experience occurs when an organization intentionally uses services and goods to engage individuals in such a way that creates a memorable event. Dix [10] observes that with the growth of the web, much software that traditionally sold as products have become services and where products allowed for one infrequent choice point, services allow near continuous choice. As such, user-experience becomes imperative to success.

Forlizzi and Ford [14] distinguish between experience, an experience and experience as a story. They interpret experience as the constant stream that happens during moments of consciousness, an experience as a finite happening and experience as story as a remembered finite happening. They posit that a single experience consist of numerous smaller experiences which, each in turn relate to the context, people and products.

They conclude that that “user-product interactions take place in a context of use, shaped by social, cultural and organizational behavior patterns [14].”

Further to this discussion, Forlizzi and Battarbee [13], however do not distinguish between experience and user experience. Both the users’ interaction with a system and events in a context are lumped under experience. Roto [46] argues this, positing that the term ‘experience’ encompasses too many variables and that a focus on the interaction and experiences of the user with an interactive system is desirable. She states that “[m]aking this distinction would help us to understand what is meant by experience or user experience, to identify the factors affecting user experience, and also to evaluate user experience in a systematic way [46]”.

She views user experience as a special case of experience that involves a service or product, relating to an interaction with the system, where the system does not need to be interactive. This review will build on this understanding, with the improviso that the system is interactive, and focus on a User Experience as opposed to an Experience.

3.2 User Experience

Although there is no consensus in literature as to either the definition or characteristics of a ‘user experience’, it is...
generally agreed that it would include subjective attributes and social aspects to a space that has previously concerned itself mainly with ease-of-use and is beyond the task related [2; 10; 17; 27].

Preece et al. shape the HCI concern and state that “[t]he dominant framework that has characterized HCI has been cognitive. In general, cognition refers to the processes by which we become acquainted with things or, in other words, how we gain knowledge. These include understanding, remembering, reasoning, attending, being aware, acquiring skills and creating new ideas [41]”. Hassenzal and Tractinsky reiterate this stating that “[s]ince its early days, HCI research focused almost exclusively on the achievement of behavioral goals in work settings. The task became the pivotal point of user-centered analysis and evaluation techniques (e.g. usability testing). To ensure the interactive product’s instrumental value became the major endeavor of the field [17]”.

Hassenzal and Tractinsky [17] further identify three perspectives that each contributes a facet to the understanding of the users’ interactions with technology in that the interaction is additionally beyond the instrumental, emotional and affective and in the domain of the experiential.

User experience research’s relationship with HCI, can accordingly, be described as taking the traditional space of HCI beyond the instrumental to the holistic, aesthetic and hedonic. This would include the emotional and the affect by considering the subjective, antecedents and consequences of interactions, and incorporating the experiential, that which is dynamic, complex, unique, situated and temporally bounded [17].

There are several reasons for the illusiveness of a universal definition of UX. The first can be ascribed to the broad range of vague and dynamic concepts of which there is little consensus as to the inclusion or exclusion of attributes. The second reason concerns the unit of analysis for UX, which range from a single aspect of an individual user with a standalone application, to all aspects of multiple users with many and diverse services and applications across multiple domains. The third has to do with the fragmented research focus [26].

Consensus is however that User Experience proposes a more holistic view of the user’s engagement with interactive computing devices than what is usually taken in the evaluation of usability. Usability evaluations, as practiced in the domain of Human Computer Interactions have primarily focused on task related issues such as efficiency and effectiveness. User Experience studies goes beyond the usability to include both the pragmatic or usability issues and hedonic or experience attributes[6; 31].

The literature review done by Hassenzahl and Tractinsky of user experience research identify three high level components that affect user experience that is [17]:

- The user,
- The system, and
- The context.

These high-level components are incorporated in various ways, directly or indirectly, in most relevant UX definitions in literature and form the basis of further discussion. For the purpose of this review, UX will be defined as the consequence of the end user’s interaction with an interactive technology system in context.

3.3 Mobile User Experience (MEX)

In order to identify the components of a MEX in a mlearning interaction the MEX was explored. Research findings were limited to expert opinions and anecdotal conclusions related to other fields of study. A few of the most relevant are outlined below.

Subramanya and Byung [50] focus their study of mobile user experience on three dimensions namely device-related issues, communication-related issues and application related issues. Device-related issues deal with hardware features that would facilitate ease of use of the device and accessories. Communication-related issues focus on efforts to enrich interpersonal communication and application-related issues deal with mobile application interactions. The latter they identify as the most important layer and contributing directly to the user experience by compensating for underlying device and user constrains due to the mobility.

Oinas-Kukkonen and Kurkela [35], although not giving a definition of mobile user experience, argue towards a positive mobile user experience. They recognize the device itself, the network, the user, mobile services and the usage context as elements that contribute to the mobile user experience. The device limitations are recognized and the network limitations are identified as the limited bandwidth and data transfer rate, the high latency and the cost of the use. The user is again acknowledged as distracted, in context and impatient as the browse behavior witnessed on desktop PC’s is often substituted with search behavior [31]. The mobile user is also identified as more discerning and critical due to the cost implication and thus more susceptible to value implications. Mobile services are by and large accessed while mobile and in context resulting in interactions characterized by distractions and noise. These interactions tend to be task-orientated and should allow for easy and quick completion.

Palen and Salzman [38], although not directly investigating Mobile UX, observe that the customer experience reaches beyond usability of the hardware and software artifact in use to include network concerns and business concerns. Network concerns include the connectivity, the services provided, while business concerns include the cost of connectivity, customer support, billing, sales and marketing.

Jones and Marsden [21] acknowledges the difference in mobile context. Working from a design perspective they infer that designers should, in addition to hardware and software concerns, also be cognizant of the whole package presented to the user, including the marketing, the customer care and billing packages. The “aim is to present the user with an experience that is solid, distinct, understandable, trustworthy and satisfying [21].”

Hiltunen et al. [18] provides a guide through the process of designing a mobile user experience. They consider the limitations and unique affordances of mobile media and present pragmatic solutions to improve the usability of mobile applications. They identify the following elements that influence the mobile user experience:

- User: related to the goals and unique attributes of mobile users, cultural context, personal characteristics, skills and interaction techniques
- Task context: multitasking, interruptible and mobile
- Physical context
- Social context
- Technological context
- Privacy and security
• Device: Processing power, memory, power consumption, user interface
• Connection: Network and bandwidth concerns.

With due acknowledgement to the contributions of the above cited authors, this review further embarks on an exploration of the attributes and affordances of the mobile technology.

4. Mobile Human-Computer Interaction
This engaging with the emerging field of MHCI is premised on the centrality of the mobile user’s interaction with mobile information and communication devices facilitated by network and service providers in everyday socio-economic life.

4.1 Defining MHCI
MHCI, as an emerging discipline with strong roots in Computer Science (CS) and HCI, has, as is often the case in similar young research fields, had a tendency to be highly opportunity and technically driven with a “focus primarily on producing solutions” [16]. The following definitions for MHCI reflect this origin and technology driven emphasis. It is debatable whether one definition of MHCI would eventually suffice as domain experts would integrate and apply innovations and learning to their own areas of expertise. It would be expected that the definition of MHCI would also be tailored to the emphasis of the field and the appropriation of the technology in that field

Oulasvirta and Brewster [37] describe MHCI as a sub-area of HCI focusing on one type of interactive computing systems, specifically the mobile and handheld computer.

In contrast Love defines MHCI as “the study of the relationship (interaction) between people and mobile computing systems and applications that they use on a daily basis […] concerned with investigating the relationship between people and computer systems and applications [29].” Referring to mobile computing Love states that the concern is in “understanding the users, their capabilities and expectations and how these can be taken into consideration in the mobile systems or application design [29].” With reference to the mobile systems design he places the emphasis on the users, their intended activities, their distinguishing characteristics and their context, before the design of applications and services.

Kjeldskov and Graham [22] in reviewing MHCI Research methods selected papers if they were related to mobile devices and HCI. They, by implication, define MHCI as HCI through mobile devices and position MHCI as a specific focus of HCI.

Hagen, Robinson, Kan and Sadler [16] state that mobile devices have enabled the emergence of a variety of new interactions. Understanding the way in which users act and interact should not be reduced to events of physical relocation or information access. They argue that “our conceptualization of mobile computing needs to be more sophisticated than ‘using a computer while moving’” [16]."

4.2 Components of MHCI
Mobile interactions represent a “bewildering diversity of devices and services [21].” The mobile user “interacts in chaos [36]” as individual devices, networks, technology and applications have limited ability to communicate with each other and often have widely different formats of data, processing abilities and interaction capabilities. The proliferation of devices, services and software further increase the problems of diversity, inconsistency, accessibility, inaccessibility, replication and integration. The complexity of the mobile device interactions becomes immense because of the multiple of assorted relations that come into play at the same time, at different layers or dimensions [20]. Mobile interactions are further subject to mobile industry standards, device manufacturers and platform providers that affect both the input and output modalities, and network carriers that determine services available through the mobile device [4].

The MHCI consists of a cohesively integrated system of social and technological components that have been demarcated in various ways as briefly discussed below:

Palen and Salzman [38] suggest and Jones and Marsden [21] concur that the interaction is affected by four factors:
• Hardware: The physical device.
• Software: System and application programs.
• Netware: Network operator supplied services.
• Bizware: Services agreement and business practices of service providers.

Ballard [4] propose that the following should be considered in a MHCI:
• Network and wireless carrier (operator): Enables some of the technologies, connects user to internet and other users, sells applications and services, and regulates connection.
• Application platform: The application platform includes web browsers, the application environments, messaging technologies and media environments
• Output interface: Output from device.
• Input interface: Input to device.
• Server infrastructure: Complements the mobile application and adds functionality.
• Interface: Linking the application’s servers and other information sources.
• User: User accessing the technology while mobile.

Bauer and Patrick [5] advise the addition of thee levels to the OSI model. The OSI model emerged from the efforts of the International Organization for Standardization (ISO) to provide a guideline for developing standards to enable the interconnection of dissimilar computing devices, which are also applicable to mobile devices [9; 32]. The related elements of the OSI model and their added layers are:
• Physical devices and networks: Device hardware and networks
• Application Platforms: Device software
• Front end applications: these include onboard software, application environments and mobile services
• Display: This includes keyboard, vocal, Graphic User Interface (GUI) and other user related interfaces.
• User performance: Information processing features and limitations of users.
• User needs: Essence of interaction

B’Tar [3] submit the following four dimensions:
• Mobile user
• Mobile device
• Mobile application
• Mobile network
From these views of literature, MHCI can be synthesized to comprise of five interlinked focus areas: mobile users, mobile devices, mobile networks, mobile business processes and mobile use. These focus areas are depicted in Figure 3 above and further deconstructed in Table 1 below to incorporate specifics.

Table 1: MHCI components expanded

<table>
<thead>
<tr>
<th>Components</th>
<th>Mobile Device</th>
<th>Mobile Networks</th>
<th>Mobile Business Practices</th>
<th>Mobile User</th>
<th>Mobile Use</th>
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<tbody>
<tr>
<td></td>
<td>Hardware</td>
<td>Mobile Cellular Networks</td>
<td>Mobile Value Chain</td>
<td>Mobile user Characteristics</td>
<td>Penetration and Impact</td>
</tr>
<tr>
<td></td>
<td>Devices</td>
<td>Wireless Networks</td>
<td></td>
<td>Spatial Ability</td>
<td>Adoption factors</td>
</tr>
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<td></td>
<td>Classification of devices</td>
<td></td>
<td></td>
<td>Personality</td>
<td>Mobile Device Interactions</td>
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<td></td>
<td>Design areas of devices</td>
<td></td>
<td></td>
<td>Memory</td>
<td>Context</td>
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<tr>
<td></td>
<td>Application Technology</td>
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<td>Age</td>
<td>Mobility</td>
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<td></td>
<td>Input</td>
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<td></td>
<td>User types</td>
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<td></td>
<td>Output</td>
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<td></td>
<td>Software</td>
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<tr>
<td></td>
<td>Application Platforms</td>
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<td></td>
<td>Application Software</td>
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<td></td>
<td>Application Environment</td>
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</tbody>
</table>

An in depth overview of each of these components identified in the Table above are beyond the scope of this review.

The components of a user experience identified in Section 3.2 as the user, the system and the context can now be expanded on to include additional considerations for the Mobile User Experience as:

User:
- The mobile user
- Mobile use

System:
- Mobile device
- Mobile business practices
- Network affordances
- Mobile Applications
- Mobile Interaction

Context:
- Mobile Context

The next section investigates the requirements of the educational domain, focusing on goal driven mlearning interactions.

5. MLEARNING

Planning for a mobile user experience in a mlearning interaction entails the consideration of contributing components. While an argument has been made for the MEX of a mlearning interaction as dictated by the requirements of pedagogy and the attributes and affordances of the technology (cf. Section 2), no comprehensive literature discussion on contributing components could be found. In order to explore the phenomena, the investigation on user experience done in Section 3.2 has identified three components of a user experience as the user, the system and the context and hinted at additional components for a mobile user interaction. The attributes and affordances of technology were investigated through a review of MHCI, in Section 4, and have expanded the understanding to include additional components to incorporate the mobile aspect.

The mobile user experience in mlearning interaction is further subject to the requirements of pedagogy. These requirements form the focus of the investigation in the rest of this section. The requirements that would affect a MEX in the mlearning interaction are investigated through the domain of mobile learning as a specific focus of technology in education.

5.1 Defining Mlearning

Experience and expertise in the development and delivery of mlearning has resulted in a discrete community of practice evolving separate from the e-Learning community. As with MHCI as an emerging disciplines, Mlearning has had a propensity to focus primarily on producing solutions and has tentatively developed distinctive theoretical conceptualizations [16; 52]. The term Mlearning is currently applied to learning exploits with handheld computers and mobile phones as well as other mobile devices. This study will draw on all the literature related to the use of mobile devices in teaching and learning interactions.

A definition of what mlearning is, has been much debated, and appears to reflect the focus areas of the community that has put it forward. Solution based technology research have a propensity to define mlearning in terms of learning through mobile devices [7; 19; 28; 42; 54]. Learners are described as accessing mobile devices to “acquire and learn through a wireless transmission tool anytime and anywhere [7].” Reflecting the early solution based technology focus, Traxler [51] initially suggested that Mlearning be regarded as “any educational provision where the sole or dominant technologies are handheld or palmtop devices.”

In contrast research which has been driven by concerns emanating from a pedagogical point of view, have defined mlearning in terms of the extent it has enriched a particular
learning environment and the learners’ experience of learning [12; 15; 43; 47; 57].

Another perspective has been in terms of the mobility affordance, framing mlearning as “the study of how the mobility of learners augmented by personal and public technologies can contribute to the process of gaining new knowledge, skills and experience [48].” Mobility is further deconstructed by Sharples et al. [48] as the mobility:

- experienced by the user due to the change in physical space,
- as being able to interface between different technologies,
- in conceptual space as users move between topics,
- in social spaces, and
- over time, extending the formal learning situations as a cumulative experience.

Consensus, however, is that mlearning, as a phenomenon needs to be considered in the context of the emergence of mobile phone [25]. Traxler suggests mobile technology be recognized as fundamentally transforming societal notions of communication and understanding. Nyiri [33-34] articulates this, stating that the “mobile phone is evolving towards the dominant medium. It is becoming the natural interface through which people conduct their shopping, banking, booking of flights, etc. Moreover, it is turning into the single unique instrument of mediating communication not just between people, but also between people and institutions or more generally between people and the world of inanimate objects.”

Traxler proposes that “mlearning is not about ‘mobile’ as previously understood, or about ‘learning’ as previously understood, but part of a new mobile conception of society [52].”

5.2 Mlearning Interactions

Mlearning offers the opportunity to exploit the capabilities and characteristics of the mobile device to enable new as well as supporting established forms of learning. Klopfer et al. [23-24] identify five properties of mobile technology that enables unique educational affordances as:

- Portability: the user can take it to different locations;
- Social interactivity: information can be exchange and face to face collaboration is enabled;
- Context sensitivity: contextual data can be collected in real time;
- Connectivity: can connect to additional services, repositories and other computational devices or servers; and
- Individuality: can provide distinctive scaffolding that is adapted to individual investigations.

These affordances suggest methods of interacting that are unique to the technology such as distributed, collaborative investigations, peer-to-peer networking and augmented reality instruction [23].

Rochelle and Pea [45] in their analysis of Wireless Internet Learning Devices (WILD) used for educational purposes observe the following five ways in which effectively integrated technology could impact on the educational environment:

- Augmented physical space: the space includes the device but is not limited to the screen as it includes simulated data;
- Leveraging topological space: capturing and storing data for later reflection based on the spatial proximity of the learner;
- Aggregate information generated by all the individual students: each student contributes an answer, and all answers are rapidly aggregated into a single representation;
- Conducting classroom performances: situate the teacher as a coordinator of activity; and
- Act becomes artifact: the interaction of the learners becomes a captured artifact that can be analyzed and that gives additional data on the interactions as a whole.

Mobile technology can enable Mlearning interactions that are distinct from those provided by tethered e-learning or paper-based distance learning [39]. Sharples, Taylor and Vavoula [49] identify the new learning opportunities due to the integration of mobile technology. These are given in Table 2.

<table>
<thead>
<tr>
<th>New Learning</th>
<th>Mobile Technology</th>
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<tbody>
<tr>
<td>Personalized</td>
<td>Personal</td>
</tr>
<tr>
<td>Learner-centered</td>
<td>User-Centered</td>
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<tr>
<td>Situated</td>
<td>Mobile</td>
</tr>
<tr>
<td>Collaborative</td>
<td>Networked</td>
</tr>
<tr>
<td>Ubiquitous</td>
<td>Ubiquitous</td>
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<tr>
<td>Lifelong</td>
<td>Durable</td>
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</table>

Mobile technology is “more than just a phone [11]” and is not merely a medium that facilitates the Mlearning interaction. The device contributes to the nature of the interaction and ultimately determines the conditions in which the interaction will take place [53]. The following are characteristics of mlearning interactions in learning contexts. Mlearning interactions are:

- are personal and individual,
- mobile,
- available,
- spontaneous,
- authentic,
- situated,
- context- aware,
- support life-long learning,
- facilitates different pedagogies,
- disruptive,
- social,
- informal and formal,
- collaborative,
- creative,
- not always mobile,
- reflective,
- fractured,
- current and up-to-date,
- support blended learning,
- motivational

Full explorations of each of these characteristics are beyond the scope of this review. Consensus is however, that mlearning interactions have the potential to enhance educational environments by providing access to information and communication capacities in a personal and ubiquitous manner. Mlearning is perceived as successful when it appears a pedagogical need within the complex interactions that frame the
learning process, by either removing a barrier to the interaction or by augmenting an interaction. The versatility and ubiquitous nature of the technology allows Mlearning to potentially service both measures in a host of innovative ways while increasing learner motivation. Mlearning’s potential can be credited to the attributes of the technology that allow it to seamlessly integrate into pedagogical practices and assist interactions between the role-players in the teaching and learning interaction.

The educational perspectives on the user experience of a mlearning interaction further emphasize the task-oriented nature of the interactions and educational context bias that such an experience would be framed by.

Although the primary objective of the mlearning interaction is the facilitation of learning, the instructional designer cannot control learning but can only plan for learning. The Educational goal of the interaction would be determined by the educator and would form part of the learning process framed by the learning environment. The specifics of realizing the educational goal, the actual operationalisation and the evaluation of the educational goal are beyond the scope of this review. The review, however, is concerned with the technological enablement of the educational goal through the mlearning interaction as experienced by the learner as mobile user.

6. MEX OF A MLEARNING INTERACTION

Three high-level use experience components were identified from literature. The user, who interacts with a system, in context, frames the user experience. This can be illustrated as in Figure 4 below.

![Figure 4: Components of UX](image)

6.1 MEX

The added complexity that mobile cellular technology brings to the UX to frame the MEX is facilitated by incorporating the components of the MHCI as illustrated in Figure 5 below.

![Figure 5: Components of MEX](image)

The user of the system is a mobile user with the unique mobile user characteristics that are predicted from literature. These characteristics that are relevant to the MEX are briefly outlined below:

- The user is available or considered connected.
- The user is considered contextual and the environment affects the device use.
- The user personalizes the device.
- The user has previous experience with the technology and considers the device as familiar.
- The user’s skill level affects the use.
- Personal characteristics of the user impacts.

The use of the technology is affected by the ability to use it when mobile and in context. As such, the user appropriation of the technology in use is facilitated. This implies that:

- the technology is convenient to use (available),
- the user is in control of the technology,
- the user considers the device fashionable, and
- the user identifies with the technology as “my stuff”.

The MEX of the technology in use is further facilitated by the hedonic experience of the technology in use.

The MEX is further influenced by the dominant role of the device, underpinned by the device capabilities that support the technology in use interaction adequately, or related hardware and performance issues. The imbedded software supports the interaction adequately and is usable in-use.

The device component is facilitated by the Mobile Business Practices that are on available to the user as a commercial offering. The MEX is impacted on by:

- How well the pricing structure of the commercial offering is understood and appropriated in use.
- That the cost of interactions are disclosed ahead of the time for the user to make personal value decisions.
- The user perceives the interaction as ‘value for money’.

These mobile interactions are additionally underpinned by the network affordances. The MEX is impacted on by the stability, reliability and availability of the network.

Furthermore, mobile user engages in unique mobile use actions and activities with physical device limitations in a distinct mobile context. These relate to an additional emphasis on the application and the ensuing interaction.

The impact of the mobile interaction on the MEX can be perceived as usability factors such as:

- ease of use,
- fluency of navigation,
- learnability,
- the interaction is safe and secure, and
- additional elements that are specifically aimed at the usability of mobile cellular technology such as the ability to interact with one hand when needed and the complexity of the interaction is suited to the context.

The mobile application or service largely determines the interaction intention. These activities impact on the MEX through their ability to:

- access the interaction through navigation that are native to the phone and thus familiar to the user.
- provides services and content where the user needs it,
- is perceived to make the task at hand easier,
- provide only useful information,
- provides the appropriate functions for the interaction,
- is reliable and performs the service or actions consistently dependably, accurately and timely,
the application has the ability to support multiple users.

The mobile context changes as the user moves through his day and the MEX are centralizes around the concept of mobility and the ability to interact in-context with the technology in-use.

6.2 MEX in a mlearning interaction

Reflecting on the educational use of mobile devices, it can at best be considered a parasitic appropriation of existing development and infrastructure [52].

The mobile learner can exchange information remote through personal social interaction,

- The mobile learner can learn at different locations,
- The mobile learner can exchange information remote through personal social interaction,
- Contextual data can be selected in real time,
- The learner can access additional services and devices,
- Learning can be adapted to suit the learner,
- The mobile learner can record information in context to access later
- The mobile learner is able to personally interact with the technology
- The technology facilitates interaction

The removal of barriers to the mlearning interaction influences the MEX in that the following barriers are potentially removed as the interaction removes:

- Technology barriers,
- Time barriers,
- Skills barriers, and
- Access barriers.

The task-orientated nature of the interaction impacts the MEX by supporting both formal and informal learning interactions that enable goal achievement and supports different pedagogies.

Within the educational context, beyond issues of adoption and integration, the MEX is influenced by the perceived disruptive nature of the interactions, suitable managerial structures that would support such interactions and educational best practice models.

The MEX of the learner as mobile user within the educational context is thus subject to the institutional structures that would guide it and the ability of the educator to design and appropriate various available platforms, services and applications to achieve an educational goal in such a way that the learner as user has a positive experience.

7. Conclusion

Practitioners and interaction designers cannot design, and much less control, MEX to create an enhanced experience. They can, however, design for an enhanced MEX. As such, the components and their impact of the MEX becomes a 360° view of the learners as mobile user’s interaction with the technology.

The MEX is then not about the technology but about the experiences of the learner as user; the experience of the engagement with and through the technology, contextualized by the mobile and educational contexts. How the interaction can be shaped to enhance the experience of the learner’s educational endeavors and in turn how the learning gains, experienced through the interaction can shape the learner.

8. REFERENCES


