MILK: THE MOBILE INFORMAL LEARNING KIT. COLLABORATING TO DESIGN SUCCESSFUL MOBILE LEARNING APPLICATIONS.

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ABSTRACT

This paper suggests ways for educators and designers to understand and merge priorities in order to inform the development of mobile learning (m-learning) applications that maximise user experiences and hence learning opportunities. It outlines a User Experience Design (UXD) theory and development process that requires designers to conduct a thorough initial contextual inquiry into a particular domain in order to set project priorities and development guidelines. A matrix that identifies the key contextual considerations namely the social, cultural, spatial, technical and temporal constructs of any domain is presented as a vital tool for achieving successful UXD. The frame of reference provided by this matrix ensures that decisions made throughout the design process are attributable to a desired user experience. To illustrate how the proposed UXD theory and development process supports the creation of effective m-learning applications, this paper documents the development process of *MILK* (Mobile Informal Learning Kit). *MILK* is a support tool that allows teachers and students to develop event paths that consist of a series SMS question and answer messages that lead players through a series of checkpoints between point A and point B. These event paths can be designed to suit desired learning scenarios and can be used to explore a particular place or subject. They can also be designed to facilitate formal or informal learning experiences.

KEYWORDS

Mobile learning, user experience design, interaction design, informal learning, game design

1. INTRODUCTION

While the possibility for new information and communication technologies to augment learning experiences is not a new topic for discussion, it has not been until recently that we have begun to edge closer to an established design theory for developing and deploying successful m-learning applications. In the past e-learning and m-learning applications have tended to be designed with either an inherent technological or pedagogical bias, leading to largely unsuccessful implementations. Richard Van Eck notes; "the answer is not to privilege one arena over the other but to find the synergy between pedagogy and engagement" (Van Eck, 2006: 18). From an interaction design perspective, what is needed is a rigorous discussion about orientating design processes around user experiences so that we can move towards a validated theory of design that facilitates creating applications that are designed explicitly for a particular context, such as in this particular case pedagogy. This paper enters into this discussion, along with the developers of 'serious games' and other m-learning researchers, and is an attempt by interaction designers to formalise a process where by we can identify and prioritise user needs and desires over technologies in order to develop successful learning tools. The user experience design theory presented in this paper outlines a process in which designers can consider, broadly and in detail, the contextual framework around the use of learning applications. This requires interaction designers to include factors that are often viewed as 'outside' the realm of interface design considerations to include broader social, cultural, spatial, temporal, and technical influences. The theory also emphasises the need for educators and designers to understand and merge priorities in order to inform the development of m-learning applications that maximise user experiences and hence learning opportunities.

Image 1. Location-based game *SCOOT*. Child - "I Found Myself Learning"

2. PROJECT HISTORY

The development of *MILK* has been significantly informed by an independent project called *SCOOT* (Polson and Caceres 2005) previously designed by some of the ACID researchers, featured in the images above. *SCOOT* is an SMS treasure hunt that employs web, mobile devices and public displays as tools of play to guide groups through unique public places. Simply, players must seek out mystery objects that are hidden in a public place. Along the way they participate in activities and solve clues by seeking out facts about the sites. The game intentionally requires experience in game play as well as the ability to identify and interpret cultural information. As *SCOOT* has been played in nine locations on four separate occasions, its iterations have given us knowledge of designing for engagement in place and for social interaction. Following our experiences with *SCOOT* the design team and museum curators soon realised that the learning potential provided by the game was more significant than we initially realised. This team has since joined forces with a group of educators at the Queensland University of Technology (QUT) to consider how mobile devices and game dynamics can be further exploited for and in learning environments. The potential for m-learning activities to maximise learning opportunities, lies in the links between formal and informal learning activities and settings. Informal learning is "the sort of learning that goes on as part of out normal day-to-day activities" (Sefton-Green et. al., 2006: 26). There are two key methods through which informal learning can occur. Firstly through activities designed specifically for formal learning outcomes that are completed in informal contexts and secondly through activities that occur outside the traditional educational realm, often viewed as leisure activities or part of children's social lives. Before we can design effective m-learning applications the first challenge is to find more effective ways to combine the different processes, tools and languages of educators and interaction designers to maximise possible learning outcomes.

3. USER EXPERIENCE DESIGN

In order to marry existing pedagogical theories and the practice of interaction design to create effective m-learning applications, we sought to adopt an experience design process whereby development is dictated by a thorough consideration of the contextual elements of user experience. Social researchers and interaction designers at the Australasian CRC for Interaction Design, a highly distributed and multidisciplinary research and development organisation, have collaborated to develop a theory and development process for supporting effective User Experience Design (UXD) across multiple domains and contexts. Designing for the mobile learning domain, in addition to being a natural flow-on from the learning potential identified in the playing of *SCOOT*, was seen is an opportunity to apply and evaluate this theory to a new context, particularly one that demands a focus on user needs rather than a techno-centric design approach. UXD is a newish and emerging design theory in the field of human computer interaction (HCI). It is an approach to design that encompasses many facets of a users experience (Garrett, 2002; Knemeyer, D. & Svoboda, E., 2005). Rather than sitting apart from user interface design, usability engineering or information architecture; there is a consensus in the field that UXD must aim to encompass each of these design methods (http://www.paradymesolutions.com/articles/what-is-user-experience-design/, accessed May 18 2007). While all of these design methods are usually employed to varied extents during the process of developing software or an application, UXD requires that each step in the development phases be framed by objectives for user experience. As such UXD places a strong emphasis upon conducting a sound initial inquiry into the context of a user in order to identify user needs and set project priorities. So while a project must be born out of initial assumptions about user needs, UXD focuses upon testing these assumptions and making all design decisions attributable to known user needs and desires.

As such our design team has developed a matrix that helps us to conduct domain analyses and identify development guidelines for a project in collaboration with other domain experts. This matrix is a non-prescriptive guide that ensures that the designers and developers become familiar with the key contextual aspects that frame user needs for a particular project. Through numerous iterative cycles across several projects we have

identified these key contextual aspects as the social, cultural, spatial, technical and temporal relationships of the context. These contextual aspects allow us to build a broad understanding of any context that not only acknowledges users technical needs but also the social and cultural constructs that frame their use. The following is a sample only of the questions raised and discussed for a pedagogical context.

Table 1. Contextual Considerations

Relationships	Dimensions	Questions
Social	student/student student/school student/teacher student/parent parent/teacher	Who are the students of the sites? What cultures, practices and dispositions do they share? What relationships develop with each other and the supporting faculty? How do these relationships develop?
Cultural	Student/student Students/student work Student/others work	What kinds of expectations do the students have relating to the cultural artefacts in the site (access, understanding, interaction)? How might they want to contribute culturally?
Spatial	student/site family/site school/other sites	How to integrate everyday sites into the learning activities? What role can other locations play? How do they currently relate to the site? Can other sites be linked to the school/classroom?
Technical	student/ICT teacher/ICT	What relationships do they currently and potentially have to the technology and the interaction it can provide? What support do the teachers require? What may impede access or use of the technologies?
Temporal	Mobility, Duration, Rhythm of Stay	How long do students stay and why? Do they return and why? How do they fit the various locations into their daily lives?

This matrix not only acts as a support tool for designers to identify key contextual considerations for projects, it is also a useful tool to facilitate collaboration between designers and context specific experts. In an m-learning context, this matrix allows educators and designers to understand and merge priorities in order to inform the development of m-learning applications that maximise user experiences and hence learning opportunities. This matrix not only supports an initial inquiry to set project priorities, but it also supports domain translation of project aims from context specific information into visual and functional design. Furthermore, the questions raised with this matrix can be used to articulate such priorities to the entire team from ethnographers to programmers and support ongoing evaluation of design outcomes. It ensures that decisions made throughout the development process are attributable to user needs and provides a conceptual framework for user trials. User trials are another key aspect to successful UXD. They provide opportunities for thorough reflection upon user needs and build upon or dismiss assumptions developed with an initial contextual inquiry and inform implementation impacts for the next phase of development.

4. KEY DESIGN AND DEVELOPMENT CONSIDERATIONS:

Apart from understanding the user needs, a process is still required to translate the design priorities into actual user interfaces and experiences. This is to be done without diluting the initial design priorities along the way, considering the development process is complex and often undertaken by many different collaborators. At ACID the team of interaction designers normally act as domain translators, translating values of one or more expert domains, in this case pedagogy and game design, into a series of interfaces and activities. This process is not simply concerned with sharing a glossary of terms; rather it is about shifting the definition of domain terms for specific context of production and deployment with a commitment to successful user adoption. It is important to note that interaction designers are not able to act as domain translators without sufficient knowledge of the domain and this knowledge must be elicited with a contextual analysis tool such as the matrix presented above. To be able to act as domain translators, interaction designers have a specific skill set that equips them with the ability to encode client values into an interface. This is a complex process whereby numerous design factors are implicated in communicating context specific information. While there is no one methodology informing the practice of interaction design, there are key design elements and systems (aesthetic and technical) that a multidisciplinary team can employ to translate a set of shared values and priorities into dynamic and functional interfaces. The following design considerations are in no particular order and should be viewed as inter-related and co-dependent.

Representation and simulation (of learning content)**:** Primarily this refers to the way learning content is selected, made and displayed, with particular attention to the aesthetic qualities, compositional elements and significance of the content. Also, considering how the modes and media determine how the concept and content is expressed and understood. In game design, and also applicable to interaction design, this particularly refers to

the audio and visual specifications with attention to how this determines the users' reception and response to the narrative, actions, behaviours and situations of the game existents and events.

Identity and relationships (representation of the user/s)**:** This is intended to refer to the complex and contextual inter-relationships between the stakeholders, participants, media and actual world in which it is situated. It may also refer to the broader contexts of the potential 'users' of interfaces in order to evaluate their impacts beyond the simplistic and immediate relationship the user may have with the interface. The context (immediate and historic) of the user and the interface is part of a complex network of social, spatial, cultural, historical and social factors.

Communication enablers (for the reception of content)**:** This category refers to the tools and modalities enabling the communication and reception of the interface content. This takes into account the technical and semantic processes and systems employed to deliver and communicate content. Decisions about which devices/formats/services to use to deliver content are done far too lightly and normally based on availability, cost, novelty and popularity. Expert knowledge is required to assist in identifying and evaluating tools and the possible levels of interference (technical, cultural, social) effecting the quantity and quality of data that is transmitted.

Logic Design (support for content)**:** This not only refers to the underlying system design, logic and rules that determine the parameters of interaction and user profiling but more importantly how the work and learning outcomes become part of the broader learning environments and social systems supporting the interaction.

Feedback qualities (interacting with content)**:** This area refers to explicit levels of control, feedback and most importantly the agency of the experience that determines "when [and how] the things we do bring tangible results... the satisfying power to take meaningful action and see the results of our decisions and choices" (Murray, 2001).

5. THE MILK PROJECT: KEY PEDAGOGICAL AND INTERFACE DESIGN VALUES:

Pedagogical Values:

In order to put the above matrix to the test the ACID design team set out to develop a valid set of pedagogical priorities in collaboration with pedagogical experts. We partnered with two particular organizations in two Australian capital cities, Brisbane and Adelaide; the School of Maths, Science, Technology (Queensland University of Technology) and The Technology School of the Future (TSOF). After a number of workshops, the key pedagogical values for the Mobile Informal Learning Kit (MiLK) were identified:

- To increase teachers' confidence in using ICTs in the classroom
- To give teachers' authority over learning scenario possibilities by supporting the utilisation of teachers' expertise in designing and distributing mobile content.
- To allow for the integration of everyday places into the learning experience of students and to facilitate knowledge transferral.
- To promote and sustain more social (informal) learning activities.
- To support assessment processes and student self-reflection.

Interface Values:

These pedagogical values were translated into a set of interface values:

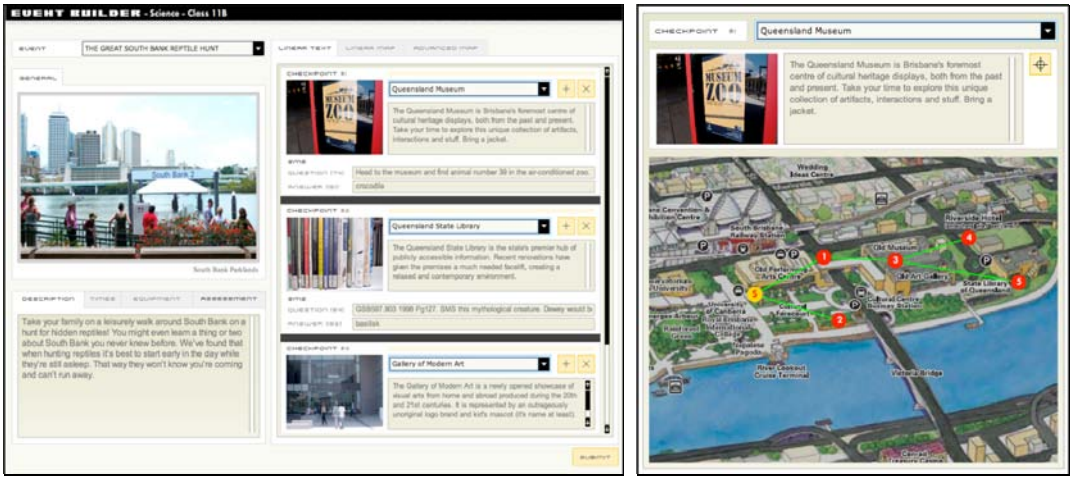
- Clean, clear and simple interfaces that support storyboarding techniques for developing learning scenarios
- Support the use of everyday tools in everyday places by designing for SMS on mobile phones combined with web services
- Provide a set of tools that are open to learning scenarios to be determined by teachers (rather than assuming motivations and mediating the use of the tool)
- Tools for student reflection and collaboration
- Tools for teacher assessment and student tracking
- Tools for moderation of use

From these interface values we developed a clear conceptual model of what *MILK* would be and began the development of a simple prototype with limited functionality for trial purposes so that we could test interface usability, gauge user interest, and the feasibility of adoption. The team working on *MILK* made an explicit decision to only develop the interface to a prototype stage so as to allow further opportunities for pedagogical

reflection. First and foremost the prototype is a demonstration tool used to present *MILK* to educators and students for essential feedback on the interface from a pedagogical perspective.

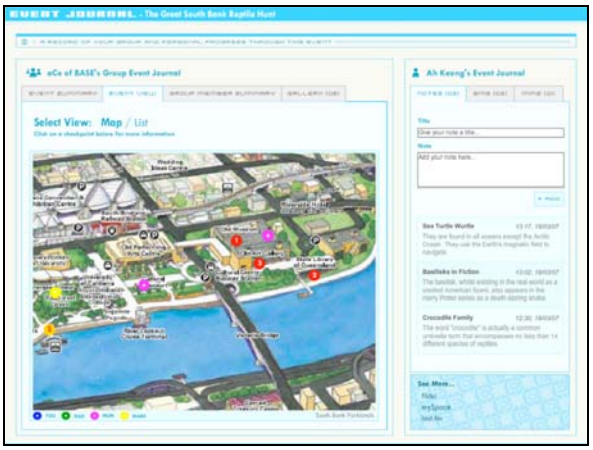
Users of the MiLK kit fall into one of two categories – teacher or student. Teachers have access to all of the MiLK interfaces, including the 'event builder. The 'event builder' allows them to create and edit their own series of SMS clues/challenges/questions, view events created by other teachers, assign students to events and track the students' progress throughout the event. Students have access to their Event Journal, which records relevant information about their progress throughout the event. Teacher SMS accounts are assigned upon registration. Student accounts are created by a teacher and bound to a sim card number for the duration of a student or student group's participation in an event (see image 4).

Image 3. Event Builder – Prototype 1



The event builder was designed with communication enablers that employ storyboarding techniques that allow teachers to design their own content in a clear and simple manner. This interface was also designed to emphasise the versatile nature of the kit in that it allows for the creation of content specific to the learning scenarios dictated by the pedagogical experts, the teachers. In designing this interface we also included feedback qualities through the each of the tabs that communicate the steps to be taken in the process of designing an event path.

Image 4. Event Journal – Prototype 1



6. USER TRIALS AND PROTOTYPE EVALUATION:

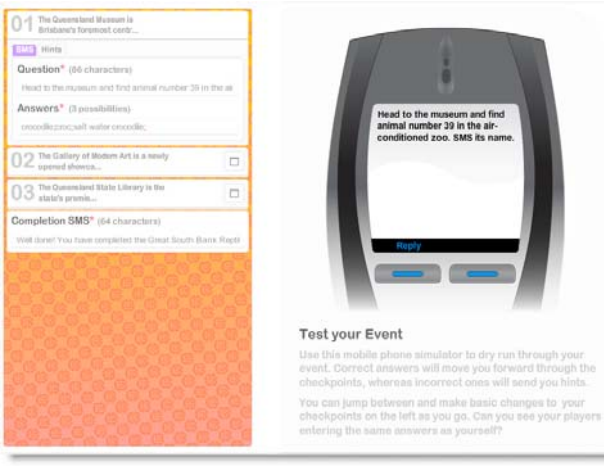
Trial 1:

As mentioned earlier, user testing is a key dimension of UXD and is conducted to ensure the various design elements and systems, communicates the project priorities and enables the desired user experience. So once we had developed this prototype, we sourced a user group with whom we could conduct a user trial. This user group consisted of teachers and students from both primary and secondary schools throughout South Australia

who attended a trial workshop at the Technology School of the Future (TSOF) in Adelaide. This trial was oriented towards gauging user group interest, usability, and identifying initial feasibility of adoption. The workshop entailed groups of three to four students with one teacher creating game events and SMS paths for the other groups to then play later. Participants were also asked to complete pre and post workshop questionnaires.

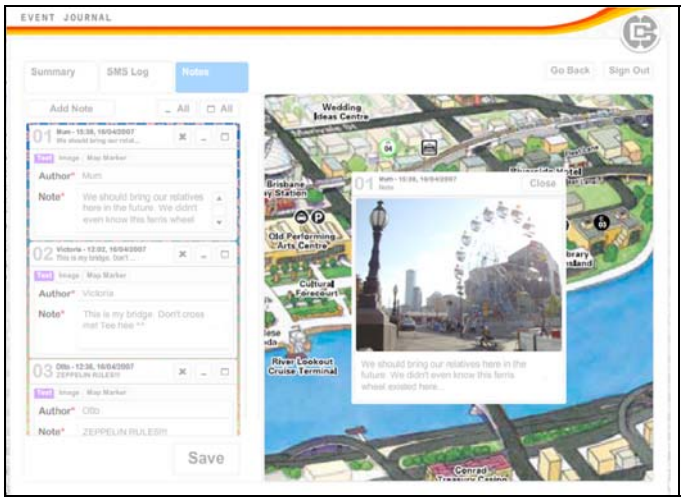
A group of vision-impaired students were also amongst the users. While we first saw this as an opportunity to test the access and processes involved in using the system, what resulted was much richer than that. The groups that were not vision impaired were asked to consider designing a mobile trail that would involve writing clues that used senses such as sound, touch and smell. This meant that the experience in making and playing the games was far more interesting and dynamic than we initially expected. Furthermore this experience with the vision-impaired user group emphasized the potential learning inherent in the act of building event paths as learning scenarios in themselves. This tested our assumption that the kit should be oriented towards teachers use and highlighted to us the need to reconsider a design that would allow for access to the 'event build' interfaces by both teachers and students alike. It also really emphasised the challenge for us to design what would essentially be an empty shell for use by anybody for any learning context whilst still directing an explicit and simple process for designing event paths and communicating imaginative possibilities for using the tool. We also learned that we needed clearer steps in the event builder to guide the design of event paths and a cleaner simpler interface overall. As such we developed an updated prototype with new interfaces to reflect the findings from this trial. In particular the 'event builder' was compressed into a more efficient single interface with a simple three-step process using multiple features including a new tool to test the mobile content with a mobile phone simulator (image 5).

Image 5. Event Builder – Prototype 2



The 'event journal' (image 6) now reflected the 'event build' interfaces making the transition from end user to event designer more seamless due to the familiar layout and use of terminology. We also experimented with an administration interface for teachers to more easily add users and their mobile numbers as well as assign groups to collaborate by sharing journals.

Image 6. Event Journal – Prototype 2



Trial 2:

Once we had implemented the development recommendations and design improvements from the first user trials, we needed to conduct another user trial to gauge the success of these changes and to also address other questions that had been raised regarding user adoption. In addition to evaluating usability, the second user trial was conducted at the School of Maths, Science, Technology and Education at the Queensland University of Technology and consisted of a group of 12 Queensland teachers. The first trials indicated relative ease of use with groups creating events in up to an hour as opposed to up to four hours as we had experienced in previous trials of similar tools for creating Location Based Game events. The first trial also indicated strong student and teacher interest and high feasibility with many moments of delight being experienced by both user groups. However we were concerned that this trial did not address issues highlighted by our context analysis matrix concerning support for maximising teacher confidence and possible hindrances to adoption tied to educational institution culture and administration. Therefore the second user trial was oriented towards evaluating the kits role in increasing teachers' confidence in using ICTs for learning, identifying what additional support they may require from the *MILK team*, and what was required to deploy *MILK* in schools. Teachers were our target user group for this trial due to our focus on teacher confidence and institution adoption issues. As in the first trials, teachers in groups of four were asked to build an event path and then play each other's events and individual teachers filled out pre and post questionnaires tailored to our aims for the trial. This time however the workshop included and extensive open discussion about *MILK* framed by our objectives for the trial and teachers who all received a pilot version of *MILK* for actual use in their schools.

Results from the trial indicated that the teachers found the event builder easy to use with only minor recommendations for improvement and most of them reported an increase in confidence in using mobile phones for learning by the end of the workshop. The teachers also responded positively regarding the effects using *MILK* might have on student learning and offered ideas around potential subject matter, situated learning, knowledge transfer, higher order thinking and collaboration with other students. In terms of hindrances to adoption, the trial highlighted the need for improved administration interfaces within the kit for allocating groups to events and event journals and other support mechanisms to help overcome educational institution contextual issues such as school administration, costs, and parent attitudes. Currently in Australia mobile phones are banned in almost all schools. However every teacher that attended the second trial indicated they were there to expose themselves and their schools to ways of overcoming this ban, hoping to be motivated by access to tools that may offer interesting ways to integrate mobile phones into learning scenarios. Although the social, cultural and institutional issues surrounding mobile phone use in schools were highlighted as issues of concern through our contextual matrix, the trials both confirmed and alleviated most of these issues. However, to secure widespread adoption it is clearly not good enough to have a useful, versatile and operational learning tool, rather additional support tools must also be provided to encompass broader contextual issues in the user experience. These support tools may come in the form of informational packs for school leaders and administration staff or creative and innovative demonstrations of learning scenarios already built into the *MILK* interfaces to act as inspiration.

7. FUTURE RESEARCH:

Improving the administration interfaces of *MILK* and exploring what support tools will be required for successful adoption are the steps to be taken in the next phase of our iterative UXD process. We have created a *MILK* blog and discussion forum at http://www.milkit.com.au to track and document teachers' use of and experiences with *MILK*. This blog and discussion forum is also aimed to keep our communication lines open with teachers so we can provide additional support to existing participants and inspire new recruits so to broaden our evaluation.

8. CONCLUSION:

This paper strongly advocates the use of a UXD development process when designing m-learning tools. UXD requires that designers prioritise user needs and that they expand their considerations to the broad contextual aspects of user experience. The matrix presented identifies these broad contextual aspects as the social, cultural, spatial, technical and temporal characteristics of any context and we believe is a vital, yet non-

prescriptive support tool for successful UXD in any context. The development process of *MILK* illustrates how a UXD method allows designers to prioritise learning potential and maximise usability whilst also addressing adoption issues that often spring from the social, cultural, technical, and financial constructs of educational institutions. In addition to offering recommendations for employing a design method that is particularly pertinent to designing successful m-learning tools, this paper has presented a highly versatile and usable tool in *MILK* that supports the design of formal and informal mobile learning scenarios. Finally this paper acknowledges and wishes to emphasise that "the kinds of knowledge and the modes of learning exemplified in out-of-school informal learning is very relevant to learning how to become a modern kind of worker and that the formal education system needs to find ways to intersect with this kind of learning as a valid curriculum aim" (Sefton-Green et al., 2006: 30).

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