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11. The Case for MobileHCI and Mobile Design Research Methods in Mobile and Informal Learning Contexts

MARK A.M. KRAMER

Overview

This chapter examines the applicability of MobileHCI and Mobile Design research methods in mobile and informal learning research. The purpose of the chapter is to summarize the most commonly used and emerging research methodologies deployed by MobileHCI and Mobile Design, and to suggest that these might be suited to help mobile learning researchers and practitioners to gather essential data to inform the design of learner-centred experiences.

1. Introduction

Understanding the human factors surrounding the use of mobile devices and applications is central to the design of usable mobile technology. The fields of Mobile Human Computer Interaction and Mobile Design research (hereafter collectively referred to as M-HCI/D) employ various research methodologies to gather and analyse quantitative and qualitative data on mobile usability. Ultimately, the research conducted enhances the users' experience by highlighting the aspects that could be improved upon with the technology and/or applications that are examined.

According to Jensen and Skov (2005) it is useful within a discipline to investigate research methods derived from different disciplines, as these

can help inform future directions and influences on the field. The flexibility and scalability of M-HCI/D methodologies posit them ideally to gathering large sets of quantitative and qualitative data within natural settings and contexts, like those encountered in mobile informal learning.

In fact, one of the greatest challenges facing mobile and informal learning research is gathering data about various observable and non-observable phenomena within contexts or settings in which Individuals and groups of learners engage in "real-world" learning. Examples of real-world learning contexts include daily commutes, individual or group journeys, family holidays and class field trips. The ubiquitous and pervasive nature of these contexts makes learning difficult to observe and document for evaluation or research purposes. Therefore, it is imperative to devise new, or enhance existing approaches and methods that will help researchers observe and gather data on informal and mobile, everyday learning.

An example of such a methodological "novelty" is to use the very mobile technologies that enable these modes of real world learning, to gather data on informal and mobile learning. M-HCI/D researchers already utilize methods that harness the technologies themselves and engage users as active assistants in the evaluation of mobile devices and services. Mobile learning research can do the same: make use of mobile technologies to help gather quantitative and qualitative data in real world mobile and informal learning contexts. Indeed, some chapters in this volume present examples of such use of the technology (see the chapters by Hooft; Trinder et al.; Pierroux; and Wali et al.)

In the following we will explore the potential for further methodological transfer between these fields. Ultimately, such exchange of methods will help to broaden the choices mobile learning researchers have, and will also enhance their current methodologies. With this objective in mind we will consider which M-HCI/D research methods and approaches might transfer fruitfully into mobile informal learning research. The methods cited within the chapter have been chosen on the basis that they will assist in collecting data, such as recordings that document the learning process or trace-logs of contextual information that can help to measure the effectiveness of mobile learning tools and technologies. Such data can inform

research decisions about current and future designs of learner-centred informal and mobile learning environments and scenarios.

The chapter is exploratory in nature, and thus, will not cover in depth the methodologies, concepts and topics surveyed. It is helpful to view this work as a means to encourage thoughtful discourse and to initiate an ongoing dialogue regarding how M-HCI/D research methodologies can be adopted by mobile learning research to help inform how individuals learn in mobile, informal learning contexts.

2. Harnessing MobileHCI/MD research methods

The research methods highlighted in this chapter are grounded within the methodological approaches of *Action Research*, *Ethno-methodology*, *Participatory Design* and *User Centred Design*. Research methods are always adapted by the research projects that deploy them. It is important to understand how research methods have been adapted by different disciplines; this potentially informs us on possibilities of adaptation in our discipline (Kjeldskov and Graham, 2003).

Wynekoop and Congor (1990) present a review of software engineering research methods in which they created a classification scheme to help in their analysis. The classification examines research methods in terms of the environment in which the research takes place and distinguishes between methods in natural settings, in artificial settings, and environment-independent. Kjedskov and Graham (2003) and Jensen and Skov (2005) have adapted this scheme to classify mobile HCI and children's technology design research methods respectively. Table 1 presents a further adaptation of the classification, to highlight the strengths and weaknesses of the methods for mobile learning research.

Table PL_Table_Ch11T1 presents existing methods that are commonly used within the M-HCI/D communities, where they are evaluated, reflected upon, and enhanced or augmented as needed in order to yield greater value and use. In this way, new methods emerge, adapted to changing conditions and situations.

ENVIRONMENT	METHOD	STRENGTHS	WEAKNESSES	USE
Natural Setting (*Real-world learning*)	Case Studies	◦ Natural setting ◦ Rich data	◦ Time consuming ◦ Cannot be generalized	◦ Descriptions ◦ Explanations ◦ Developing hypothesis
	Field Studies	◦ Natural Settings ◦ Replicable	◦ Difficult data collection ◦ Unknown sample bias	◦ Studying current practice ◦ Evaluating new practices
	Action Research	◦ First-hand experience ◦ Applying theory to practice	◦ Ethics ◦ Bias ◦ Time consuming ◦ Cannot be generalized	◦ Generation & testing of theories / hypotheses
Artificial Setting (*lab-based artificial learning task*)	Laboratory Experiments	◦ Control over variables ◦ Replicable	◦ Limited realism ◦ Cannot be generalized	◦ Controlled experiments ◦ Theory/ Scenario testing
Environment Independent	Survey research	◦ Easy ◦ Low cost ◦ Reduce sample bias	◦ Context insensitive ◦ No variable manipulation	◦ Descriptive data from large samples
	Applied Research	◦ Learning scenarios can be evaluated	◦ May need further design to make learning scenario applicable	◦ Scenario development, testing hypothesis and concepts
	Basic Research	◦ No restrictions on solutions ◦ Solve new problems	◦ Costly, time demanding, may produce no solution	◦ Theory building
	Normative writings	◦ Insight into first-hand experience	◦ Opinions may influence outcome	◦ Descriptions of practice ◦ Building frameworks

Table Ch11T1: Summary of existing MobileHCI / Mobile Design research methods. (Adapted from Kjeldskov and Graham, and Jensen and Skov).

Hagen, Robertson, Kan and Sadler (2005) demonstrate how this emergence of new research methods has taken place within M-HCI/D through extending and/or combining existing methods. They identify three categories of emergent data collection techniques, which "represent various approaches to accessing and making available data about different aspects of mobile technology use, [and] entail different roles and responsibilities for both researchers and participants" (Hagen et al., 2005). The three categories are:

1. Mediated Data Collection: In which participants [learners] and mobile technologies mediate data collection about use in natural settings [of situated learning].
2. Simulations and enactments: simulations and enactments are used to make available experiential information sensitized to real contexts of use.
3. Combinations: existing methods, and/or mediated data collection and/or simulations and enactments are combined to allow access to complementary data. (Hagen et al., 2005: 4)

Hagen et al. (2005) further present general descriptions of these emerging techniques and the three categories, and identify their origins in existing, well-established techniques. Table PL_Table_Ch11T2 is an adaptation of those descriptions for mobile learning research contexts.

3. Future work

One of the primary goals of mobile learning research is to evaluate the learning and developmental outcomes of individuals and groups of learners. M-HCI/D methods may be more suited to informing and evaluating aspects of usability and accessibility, which have an impact on the effectiveness of the embedded pedagogy of mobile learning scenarios (Squires and Preece, 1999). Furthermore, M-HCI/D methods can be used to capture

TECHNIQUE	DESCRIPTION	DERIVED FROM
Mediated Data Collection	Where access to data about actual use practices is mediated by both learner & technology	
Learner-captured	Learners actively conduct the data collection using mobile devices.	Self-reporting, Diaries, Probes
Technology-captured	Learners engage in mobile learning while data about technology use, content and metadata is logged automatically	Use/Data logs
Learner-Technology-captured	Learners go about their everyday learning while wearing sensors or cameras	Video-observation, Use/Data logs
Simulations & Enactments	Methods for allowing immersive scenarios in which data about existing or potential use is accessed through some form of pretending.	
Simulations	Physical, ergonomic or environmental props are used within a controlled environment in order to simulate mobile learning scenarios.	Lab tests, Scenarios, Heuristics, Prototypes, Emulators, Simulators
Enactments	Mobile learning scenarios are played out through visual imagery or storytelling in order to observe potential outcomes.	Prototyping Scenarios, Role-playing, Work shopping, Storyboarding
Combinations	Various established and/or new methods are combined to enable access to complementary data.	

Table Ch11T2: Mapping Hagen et.al.'s (2005) emerging MobileHCI data collection techniques onto mobile learning research

the learning experience and the learner's interactions over long periods of time, reflecting different stages of the learning process.

The chapter has presented a broad pallet of methods and techniques that allow for customisable and flexible research designs. In order to determine if they could effectively be transferred to mobile learning research, it is important to examine the specific context and settings of the studies that have employed them. Each study will have its own unique circumstances, which would directly affect the methods chosen and how they are employed. Transferability, then, is directly linked to the study variables, including environment, context, approach, and research questions. Of course methods and techniques are available for evaluation and customisation according to the circumstances of an individual study. Further work in this direction could aim to develop a framework that guides such transference and customization of methods and techniques from other disciplines

Hopefully this chapter will inspire such further research and will encourage thoughtful discourse on how M-HCI/D research methods can help mobile learning researchers to gather the data they need in order to understand how individuals learn in mobile and informal learning contexts.

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12. In-Sights into Mobile Learning: An Exploration of Mobile Eye Tracking Methodology for Learning in Museums

EVA MAYR, KRISTIN KNIPFER, DANIEL WESSEL

Overview

Mobile eye tracking provides insights into cognitive processing of visual information while a learner moves around. This chapter presents a case study in a small museum exhibition that was conducted to explore the suitability of mobile eye tracking for researching mobile learning. The study showed both potentials and limitations of mobile eye tracking methodology for research on mobile learning in general and in science exhibitions in particular: Mobile eye tracking provides rich, non-reactive data from the learner's perspective which can be further analysed qualitatively and quantitatively. Concerns were raised with respect to interrelations of object fixations and underlying cognitive processes. Limitations also include obtrusiveness, accuracy, selective sampling, ethical concerns, financial effort, and effort of data analysis. These limitations suggest that, to increase validity, eye tracking is best used in combination with other methods. Nonetheless, mobile eye tracking can be a powerful data collection method in research on mobile learning.

1. Mobile eye tracking

Why are eye movements interesting for mobile learning? Our eyesight is our most important sense: most daily tasks involve visual input, and people need to look at objects to acquire information about them. Eye