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Chapter 4 Mobile Usability and User Experience

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Introduction

We all know when a familiar object is not usable: a pen with no ink cannot be used for writing in a notebook, and a scratched photo lens will not produce a good picture. Objects can become unusable because of breakages, missing parts or flat batteries. Alternatively, an object may have been so badly designed that it was never of much use in the first place. In either case, this is 'usability' in its most basic definition: whether something can be used for its intended purpose. However, as this chapter will try to show, in mobile learning this basic level of usability (it works/it doesn't work) cannot be taken for granted. What is more, this basic level is often not enough for understanding complex devices, the demands of educational activities and the needs of hurried lifestyles.

Consequently, it can be helpful to think in terms of levels or degrees of usability. To take an example from common experience, nowadays many people carry with them a card that allows them to enter designated buildings. If it is a swipe card, you may have to pull it through a device to make the doors open. This can be a bit cumbersome, especially when several attempts are needed. An improvement to this is a system that allows one simply to hold the card next to the device that activates the opening of the door, making it easier for authorized people to open it. Sometimes the system can recognize your card while it is still in a bag or pocket, so that you do not even have to take it out in order to enter the building. This adds a welcome degree of ease or comfort for most people. With these improvements, the system becomes more and more usable.

In the human-computer interaction (HCI) literature, *usable* systems and devices are generally regarded as being easy to learn, effective to use, efficient, and enjoyable from the user's perspective. To achieve this degree of usability, a broad set of concerns have to be taken into account. Over a decade ago, Preece *et al*. (1994) already discussed usability in the context of 'user experience': it meant creating systems that were helpful, fun, entertaining, aesthetically pleasing, supportive of creativity, satisfying, rewarding or emotionally fulfilling. As can be seen from these descriptors, user experience is highly subjective and dependent on a user's expectations, which in turn are shaped by the user's age, education, cultural background, gender and many other factors. Although in the 1990s there was no literature on user experience in mobile learning, the point is that even then, human-computer interaction researchers recognized that to produce systems with good usability, it was important to understand the psychological, ergonomic, organizational and social factors that determine how people operate. Nielsen (1993) explained usability in terms of a system's overall acceptability, which included its social acceptability and all practical aspects such as reliability, cost, compatibility and usefulness.

Preece (2000) then moved on to analyze on-line communities, concluding that software with good usability supports rapid learning, high skill retention, low error rates and high productivity; it is consistent and predictable, which makes it both pleasant and effective to use. In a subsequent book, Preece, Rogers & Sharp (2002) explained the related concept of 'interaction design', an area of activity that focuses on how to support people in their everyday and working lives and is concerned with an even broader range of issues than has traditionally been the scope of human-computer interaction. Interaction design entails 'creating user experiences that enhance and extend the way people work, communicate, and interact' (Preece *et al*. 2002: v). We have to realize, however, that on the whole, this is still something of an ideal to aspire to rather than a description of current user experience.

Usability is often perceived by educators and trainers to be a technical topic but from a pedagogical perspective, it is about ensuring good educational experiences and enabling

successful interactions. It is essential that those who teach have a good grasp of the issues and actively draw attention to usability in discussions with technical experts and others who advise them on the choice of mobile devices, software, applications and services. Usability influences whether learning is an engaging experience and will have an impact on learning effectiveness and efficiency. Put more starkly, potential learners will reject technologies and learning materials that are unusable, drop out of courses, and find alternative education and training providers.

Usability of Mobile Devices

Current mobile devices are designed for specific uses that typically focus on allowing users to enter and access fairly structured data like contacts, lists, dates, financial information and memos, to send and receive messages, to view documents and pictures, or to access the Web. Although they can work well for these purposes, mobile devices and services have inherited some of the ongoing problems of usability that most people will recognize from their experience as computer users, and they have introduced a number of new issues. In his book on handheld usability, Weiss (2002) remarks on the 'general lack of usability on most handheld devices' (p. xiii). He attributes this largely to inconsistencies in design; for example, the lack of a 'back' button on many Internet-enabled handsets makes it difficult to browse the Web in ways that people are accustomed to on their desktop or laptop computer. Each manufacturer develops a unique user interface, so there is also little consistency between devices.

Nielsen's verdict on mobile usability in 2003 was that 'The latest mobile devices are agonizingly close to being practical, but still lack key usability features required for mainstream use' (Nielsen 2003:1). According to Nielsen, in some parts of the world there are persistent problems with service provision, constraining the ability to use a connected mobile device anywhere, anytime. He goes on to say that on-line services such as e-mail should be 'reconceptualized' for mobile devices through better filtering of messages and summarization services that highlight urgent messages needing to be read while away from one's desktop computer. Physical aspects of a device, such as a wheel for scrolling, also need to be refined to take account of common user actions such as wanting to 'flick' through pages of text.

These are all very pertinent remarks, showing that now, and over the next few years, users may be faced with some difficulties surrounding the use of a mobile device. Any problems encountered will depend on the device itself, users' familiarity with it, and its suitability for particular activities or tasks.

How Is Mobile Usability Different?

Usability issues in computer systems generally have been researched over several decades now and there are many good practice guidelines, but these relate to desktop systems and they have mostly been developed within the human-computer interaction research community or by practitioner designers. It is not simply a case of taking such guidelines and applying them to mobile devices. The following are some of the new factors that have to be taken into consideration:

- The considerable variety of devices and types of connectivity
- The nature of fragmented, context-dependent use on the move
- Small screens with poor readability, especially in monochrome
- Short battery life and dependency on re-charging
- The new concept of synchronization between PC and mobile device
- The paradox that a 'personal' device may not be owned by its users
- Few educational applications and learning-specific software
- Relatively slow transfer speeds, such as slow access to web sites
- Inconvenient means of input to some devices, for some tasks
- A new way of communicating, e.g. Short Message Service (SMS), and endless new acronyms
- Mobile devices form part of a way of working that involves other devices
- Bystanders can feel annoyed when mobile phones are used in public

To get an idea of what issues might arise when learners are using mobile and wireless devices or services, it is vital for educators and trainers to be able to describe how, where and when learners will be undertaking learning activities. This can be done by

thinking in terms of scenarios of use (Evans and Taylor 2004). In turn, Weiss (2002) suggests that mobile device developers should ask themselves questions such as: Why would someone use the application? Under what circumstances would they use it? What are the various things they would want to do? He offers some guidelines for the designers of handheld devices, the top one being: 'Design for users on the go':

> Whether in the back of a taxi or walking down the street, people are likely to need their handhelds to perform in distracting situations. … designs must include context and forgiveness. While desktops accommodate 'surfing'… wireless devices are more about instantaneous search and retrieval…. Wireless users may be using their leisure time to gather information, but they typically have immediate goals.
>
> (Weiss 2002: 66)

The authors mentioned above were not writing specifically about the use of mobile technologies in the context of teaching and learning. It is possible for a mobile device, such as a phone or Personal Digital Assistant (PDA), to be perfectly usable in one context but not usable, or less usable, in another. For example, it may be easy to access a list of contacts, but difficult to read and study a lengthy text. It may be easy to send a simple message, but hard to use the same device to communicate with a tutor about one's understanding of a difficult concept. Educational contexts tend to impose new sets of requirements that may not always be met by existing devices and services.

The first step in any product or application design project is to define the target audience, just as the first step in designing a learning or teaching activity is to understand the participants and their characteristics. A good example of the two going hand-in-hand is provided by the development of the Interactive Logbook on Tablet PCs at the University of Birmingham: target users were consulted and when interface designs were drafted, these were shown to groups of students for them to select and modify (Kiddie *et al.* 2004). Another fine example is a hospital information system

developed at the Campus Bio-Medico University of Rome, for students to access on PDAs. The initial interface design was enriched through student feedback that included requests to avoid long web pages, provide drop down lists and check lists of options, and to vary text box sizes for inserting additional information such as observations (Cacace *et al.* 2004).

O'Malley *et al.* (2003) remind us in their guidelines that usability should account for two sets of users: those who create mobile content (in many instances these will be teachers), and those who access the mobile content, namely learners and teachers. Elaborating on this, we can say that it is essential to get to know users' requirements and interface preferences, their new work or study environments and patterns of use, along with new demands placed on them by mobile technologies. Pehkonen and Turunen (2003) endorse the view that in the case of mobile learning, user-centred design means not only planning learning goals and actions but also specifying different contexts of use and the requirements of different 'actors' – which might include teachers, students and even parents. Syvänen & Nokelainen (2004) have identified some special features of mobile learning materials and environments: pedagogical concerns include how personal the learning materials are, the extent of flexibility in collaboration, support for contextual use, and the added-value of mobility.

How Usability Affects Teaching and Learning

If we look through the case study accounts in this book from a usability perspective, they reveal both positive and negative aspects. When a device has good usability, learning can proceed without obstacles and can be enhanced by the availability of certain device features. For example, the Trinder, Magill & Roy case study shows the advantage of the immediate readiness of PDAs – they can be switched on and used straight away with no 'boot up' time. This makes them ideal to grab a few moments' useful working time at times and in locations where even a laptop would not be useful. They also claim that among their learners, the ability to beam items between PDAs encouraged collaboration and communication, illustrating how, at best, a usable facility can support educational goals. The Levy & Kennedy case study shows how mobile phones worked successfully alongside conventional paper tools: language students

copied into their personal dictionaries foreign language words that they had received in SMS messages while commuting.

Several authors of our case studies have made suggestions about what they see as potential usability improvements or ways in which they are planning to use mobile technologies in the future. Table 4.1 gives some examples.

Insert Table 4.1: Possible improvements suggested by case study authors

On the negative side, the Smørdal & Gregory case study identifies problems in cutting and pasting material from one application to another, which limited the usefulness of the PDA as a communication device; for Global System for Mobile Communication (GSM) connected PDAs in their study, the slow transmission of web pages also resulted in a negative experience. The Luckin *et al.* case study describes the substantial overhead of staff time in terms of technical support, account administration and finding workarounds for features that did not work as required. The Sharples *et al.* case study reports that students expressed discontent about the size and weight of their mobile devices, their inadequate memory and short battery life; the memory was considered too small to hold the course resources, additional PDF and media files, added software, games and music files. An additional factor was the lack of device ownership: as the students were required to return their handhelds at the end of the year, they did not want to invest in additional memory modules. The Hackemer & Peterson case study notes that whilst students were comfortable with their handheld's built-in functions, additional applications proved problematic, as most of the available software for handheld devices lacks formal usability assessment and documentation; this resulted in very few students being willing to explore applications in order to understand how they could be used. The Polishook case study shows that for some individuals, the small, poorly lit low-resolution screens, tiny dialogue boxes, and the need to connect extra wires, stood in the way of productive use for music composition. The Weber *et al.* case study indicates that peer-to-peer interaction on mobile devices could become a distraction in class – perhaps this is a case of good usability facilitating communication to the extent that it becomes 'second nature', but may then be used inappropriately with regard to educational goals.

Elsewhere in published literature and project reports, the ICT Team at Aberdeen City Council (2003) in Scotland describe both positive and negative experiences of schoolchildren and adults using early models of Tablet PCs: one of the most powerful features was the ability to import files into the Windows Journal application and use the digital pen (stylus) to annotate document images. The children experienced no difficulty using the stylus and those children who did not have keyboard skills found that this no longer created a barrier to producing work electronically. There were, however, some issues with the weight of the device and short battery life. In a higher education context, Corlett and Sharples (2004) report that pen input on a Tablet PC was useful but unreliable. Taylor (2004) explains that from an evaluator's point of view, what is important is the effectiveness with which learners are able to achieve their goals and complete learning activities, irrespective of the specific devices they are using. De Freitas & Levene (2003) remark that greater interactivity will be based upon the usability and adaptability of mobile devices. These approaches put the emphasis on successful learning activities and interactions, with the technology playing a supporting or mediating role so that ideally its usability becomes transparent.

To highlight the requirements of teaching and learning, it is in fact insufficient to refer to usability as though it were the same notion irrespective of the context in which technology is used. Muir, Shield & Kukulska-Hulme (2003) have addressed this issue with respect to educational web sites, describing usability in terms of four levels: technical, general, academic and context-specific. At the *technical* and *general* levels, one is mainly concerned with reliable functioning of software and hardware and with design that is based on good practice. *Academic* usability foregrounds one's pedagogical approach, the place of the web site within a course and in relation to other media, and expected study behaviour. *Context-specific* usability stresses the needs and intended outcomes of a specific course of study and its subject matter. Kukulska-Hulme & Shield (2004) subsequently proposed 'pedagogical usability' as a way of describing the interplay of technical and pedagogical issues, and concluded that technical usability is the basis for other aspects, whilst not being sufficient in itself. Also, some disciplines have quite definite requirements, e.g. multimedia in music education and in language

learning, or the availability of symbols for mathematics. Syvänen & Nokelainen (2004) express similar concerns when they distinguish between technical and pedagogical mobile usability: aspects such as accessibility, reliability and consistency come under the *technical* heading, whereas *pedagogical* usability criteria focus on aspects such as learner activity and cooperation, added value for learning (e.g. better adaptation to individual needs) and feedback. This is an area of active research, but the key point to note is that educators and trainers have a crucial role in asking the following question: If a mobile device has been tested for usability, what contexts of use were taken into account?

Human Needs and Contexts of Use

Mobile and wireless technologies require users to develop new habits both in relation to the upkeep of the device, e.g. having to recharge a battery on a regular basis, and in relation to new patterns of work or study. In the Smørdal & Gregory case study in this book, there is emphasis on acquiring new habits of caring for and interacting with a new technology, and the realization that use of existing PCs, phones and paging systems may work against adoption of PDAs. In the Ramsden case study, the author remarks that two learners displayed behaviour that was different to that of others in the group - they constantly transferred information between their Palm Pilot (handheld) and computer – thereby reminding us that emerging patterns of use are likely to be quite diverse and may digress from what was envisaged.

An investigation by Kukulska-Hulme (2002) pointed to a range of cognitive, ergonomic and affective issues associated with the introduction of PDAs for reading course materials in higher education. Table 4.2 shows a range of cognitive and ergonomic issues. Affective issues included the fear of overwriting diary or personal information by mistake, some reluctance to switch over to a new PDA (offered by the institution) from one's own familiar handheld, and an emotional attachment to one's device which made it impossible to lend it to someone else. It was also noted that some learners naturally look for fun and games on a PDA – just as they do on desktop computers. Waycott (2004), who undertook several case studies of mobile technologies in learning

and workplace contexts, used the concept of 'appropriation' to describe how people adopt a device over time as a useful aspect emerges.

Insert Table 4.2: Examples of cognitive and ergonomic challenges in using PDAs (adapted from Kukulska-Hulme 2002)

Environmental factors also have an impact on usability, when one considers the range of settings in which mobile devices could be deployed. Outdoor use often brings problems of screen readability, and the case studies in this book provide further examples, e.g. hospital regulations prohibiting use of PDAs for Internet access or mobile communication within the local hospital, or the difficulties of writing and selecting information while travelling on a bus.

Role and Extent of Technical Support

In the case studies reported in this book, training and technical support for users is frequently mentioned. The Luckin *et al.* case study reports that students were given a training session and technical support was freely available throughout the period of use. The Smørdal & Gregory case study confides that there were about as many technical support personnel as medical students in their project; a team of 'super user' medical students in fact provided the IT support to other students. In the Trinder, Magill & Roy case study, students were given basic training in the use of the PDA and its applications, and the authors note that if PDAs were to be deployed in larger numbers, training could be a significant overhead. In the distance education context described in the Kukulska-Hulme case study, students were not given training, though a set of instructions was made available for downloading from their course web site.

The Ramsden case study also makes several points about training and support. It describes how groups of two or three students underwent initial training on Palm hardware and software, but states that improved training and advice was needed, in particular on the use of preference settings and assistive technologies; the case study recommends a shift towards more self-help documentation and a culture of student peer support. In addition, students required training on the most efficient use of the PDA e-

mail client in conjunction with their PC e-mail clients. Students could share memo documents, however for this more sophisticated use of the technology, it is estimated that significant support would be needed. The Hackemer & Peterson case study warns that although students suggest that additional training is necessary, there is an initial steep learning curve and few of them attend enough sessions to get to the point where they would understand the use and usefulness of handhelds.

Conclusions

Whilst envisaging a design ideal that is focused on human interactions, we have to recognize, as Schneiderman does (2003), that educators and trainers as consumers have to exert greater pressure on companies to produce more reliable, learnable and usable designs:

> There is no magic bullet that will bring widespread use of low-cost devices that are easy to learn, rapid in performing common tasks, and low in error rates. The main change that is needed is not a technology breakthrough. The most important breakthrough will be your change in expectations and willingness to ask for higher quality.
>
> (Schneiderman 2003: 26-27)

Unfortunately, educational users are often least able to afford the more expensive technologies that might offer them improved usability, e.g. a lighter device, a better screen, a multifunctional tool. So on a practical level – whilst expecting designs to improve in the longer term - it is also important to reflect on how learning activities can be planned for existing devices so that they take advantage of usable features and avoid, or provide alternatives for, those that are least usable. This should take place at the same time as consideration of accessibility for learners with disabilities and all those requiring special support.

Aspects of usability have surfaced in all the case studies presented in this book. From the perspective of further research into mobile usability, it will be important to work in multidisciplinary teams, since it is impossible for technical experts and software developers to be fully aware of educational possibilities and constraints, just as it is impossible for educators and trainers to have detailed knowledge of technical and design aspects of mobile devices. We need a better theoretical understanding of the mutual interaction of technical and pedagogical usability, and continued evaluation of user experiences in education and training.

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Tables

	When Internet access presents a problem:
Smørdal & Gregory case study:	The PDA did not have any direct connection to the Internet, but content from the Internet could be downloaded during synchronization with desktop PCs.
	Convergence:
Ramsden case study:	A Bluetooth or an all in one unit would be preferable to the infrared connection between the telephone and PDA.
	Integration:
Luckin et al. case study:	Provide learners with simple tools to help them link together the different elements of the course content.
Smørdal & Gregory case study:	Integrate parts of existing institutional, social and technical resources, and make them available on the PDAs.
	Ownership:
Trinder, Magill & Roy case study:	If students own the PDA then perhaps they are more likely to buy and install applications and tailor the device to their learning needs.
Kneebone & Brenton case study:	Unless participants feel a sense of ownership towards their PDA the technology may be regarded as an 'imposed gift'.
	Learning materials:
Ramsden case study:	Engage the academic in how best to author material to ensure its suitability for small screens and to make sure that they account for small screen devices when recommending web sites.
Koschembahr and Sargott case study:	Breaking an hour-long web lecture into six 10-minute segments for mobile devices; Providing lecturers with a 'preview mode' where they can see what their presentation would look like on a mobile device and make any necessary changes.

	Assessment:
Ramsden case study:	In survey/assessment questions, reduce the need for free text entry, since entering a large amount of text in the PDA without a keyboard would take significant time and have a large number of errors.
	User support:
Kneebone & Brenton case study:	Correct software functioning means nothing without a dedicated member of support staff who can talk about PDAs in plain English.
	Teacher mindset:
Weber et al. case study	The teaching pace in the classroom will no longer be driven solely by the instructor, who will have to be more adept at maximising interactivity while meeting more student demands and expectations.

Table 4.1: Possible improvements suggested by case study authors

Cognitive challenges:

- Using a new PDA invites comparisons with other devices, e.g. battery life or memory on one's PC, laptop, or other handheld device, compared with the PDA.
- Conceptions of paper-based study tools may need to be re-visited, e.g. is a PDA just like a paper organizer?
- What one notices in print can differ to what one notices on a screen.
- Skim-reading on a PDA may be slower than skim-reading print materials.
- Users may want to mark text, to underline, highlight, or circle words.
- Taking electronic notes can be difficult, as this disrupts reading.
- PDAs can open up new information gathering strategies that learners have to get used to.

Ergonomic challenges:

- Preference for a good quality colour screen, which may be more expensive.
- When font is enlarged, text can be difficult to scan.
- Possibility of eye ache and visual disturbance.
- Possible preference for a portable keyboard rather than an on-screen keyboard.
- Dislike of clicking noise when selecting a function on a PDA.
- Possible requirement for predictive text (automatic word completion).
- Problems caused by cleaning finger marks off the PDA screen while the device is switched on.
- Screen needing to be re-calibrated from time to time.
- Difficulties with gripping a very thin stylus.
- Leaning heavily on the PDA whilst writing, inadvertently pressing buttons at the bottom of the device.

Table 4.2: Examples of cognitive and ergonomic challenges in using PDAs (adapted from Kukulska-Hulme, 2002)