iSpot Mobile – A Natural History Participatory Science Application

Will Woods
Open University
Walton Hall
Milton Keynes
will.woods@open.ac.uk

Eileen Scanlon
Open University
Walton Hall
Milton Keynes
e.scanlon@open.ac.uk

ABSTRACT

This paper reports the progress that has been made towards the development of a mobile application to enable people to learn more about natural history by helping them to identify observations of nature as part of the iSpot project (www.ispot.org.uk). The paper identifies relevant research in mobile learning within the field of science and the challenges faced when designing and developing a mobile application for participatory science including the user-centred design approach and evaluation process that were adopted for the development. The paper includes lessons learned when adopting an agile and iterative approach to mobile application development.

Author Keywords
ambient technology; mobile learning; participatory science

INTRODUCTION - MOBILE LEARNING IN SCIENCE

Advances in technology make the current generation of mobile devices more educationally-appropriate through improvements in aggregation and use of services coupled with increasing multimedia capabilities; for example, the powerful combination of picture capture, geo-location and 'network awareness' makes the current generation of smart phone technologies potentially beneficial for rich exploratory and discovery application.

The iSpot Natural History project is one of many such projects which rely on user-generated content and related activities; such activities encourage a transition from consumption of academic content to greater learner collaboration, which are increasingly mobile. There is a wealth of research into mobile learning in science and the prospects of mobile learning to support learning, for example;

Sharples at al. (2007) have characterised mobile learning as 'the processes (both personal and public) of coming to know through exploration and conversation across multiple contexts amongst people and interactive technologies.' p 5. Mobile technologies provide new opportunities for learners to engage with science learning. Informal learning is an important part of this discussion as mobile learning often offers the opportunity of extending learning outside traditional educational settings. Scanlon et al. (2005) describe three factors of mobile learning which outline the ways in which learning is affected, 'First, that learners are on the move, moving around physically but in other ways too, for example between devices and over time. Secondly, a vast amount of learning takes place outside formal learning situations and thirdly the ubiquitous nature of learning' (p4).

New models of inquiry learning have made use of the affordances of mobile technology and these may impact on the experience of the learner (Scanlon et al., 2005). For example, the Personal Inquiry project (Collins et al., 2008; Mulholland et al, in press; Scanlon and Gaved, 2011) investigated scripted inquiry learning and mobile technologies in formal and informal science learning settings. Other theoretical approaches have also been applied to the consideration of mobile learning e.g. self-regulation, as described in Sha et al. (in press). See Vavoula et al. (2005) for a review of mobile learning in formal and informal settings.

Research had indicated that participatory science was a field which suits the development of mobile applications, for example a number of researchers have studied mobile learning in science. Hoppe at al. (2003) had predicted the importance of 'handheld computing devices allow for exploratory activities not bound to a special location, for example field trips, without losing the potential of taking electronic notes and retrieving information of various types.' P256; Chen et al. (2003, 2004) designed mobile learning bird-watching and butterfly-watching systems for supporting learners. Clough (2009) researched a Geo-caching community using social networking tools and community resources to learn about the geology, geography and history of particular areas. Also, researchers have considered the potential of mobile learning for extending access to the outdoors. Davies at al. in the Enabling Remote Access project studied the way in which mobile technology enhanced field learning experiences. Adams et al (2001) describe how 'live' distributed collaboration through field based mobile technology (e.g. smartphones, tablets, laptops) and laboratory static technologies (e.g. multi-touch surfaces, large screen displays, PCs) can support geology learning.

‘Outdoor learning in areas such as natural science has high potential to enhance learning by giving students a real experience of what they shall learn’ Huang,K. et al (2008). The project team therefore decided that iSpot would be a prime candidate for a mobile phone app.

BACKGROUND TO THE PROJECT

In 2007 the Faculty of Science and the Institute of Educational Technology at the Open University set out on an ambitious project to create a service funded by the National Lottery through the Big Lottery Fund which enabled people to learn more about natural history by helping them to identify observations of nature. In 2008 the iSpot site (www.ispot.org.uk) went live. The project has already identified two species previously unrecorded in the UK: a bee-fly (*Systoechus ctenopterus*) and euonymus leaf notcher moth (*Pryeria sinica*). The site is now well-established and very popular with over 18,000 registered users and over 100,000 observations. An iSpot user can post observations of animals and plants on the site and the iSpot community will help to identify them reliably. The service has an ‘expert panel’ that ensure that observations are identified quickly and accurately. The experts are a mixture of amateur and professional naturalists who volunteer their help. The project team at the Open University, led by Jonathan Silvertown (Professor of Ecology), has developed the iSpot community which now includes more than 80 natural history organizations. A sister iSpot site has been created for Southern Africa, whose content and experts are managed by staff at the South African National Biodiversity Institute. iSpot uses a unique reputation system that motivates and rewards learning. Participants gain reputation through correctly identifying observations that have been verified by others. Figure 1 indicates core elements of the iSpot model (the iSpot ecosystem).

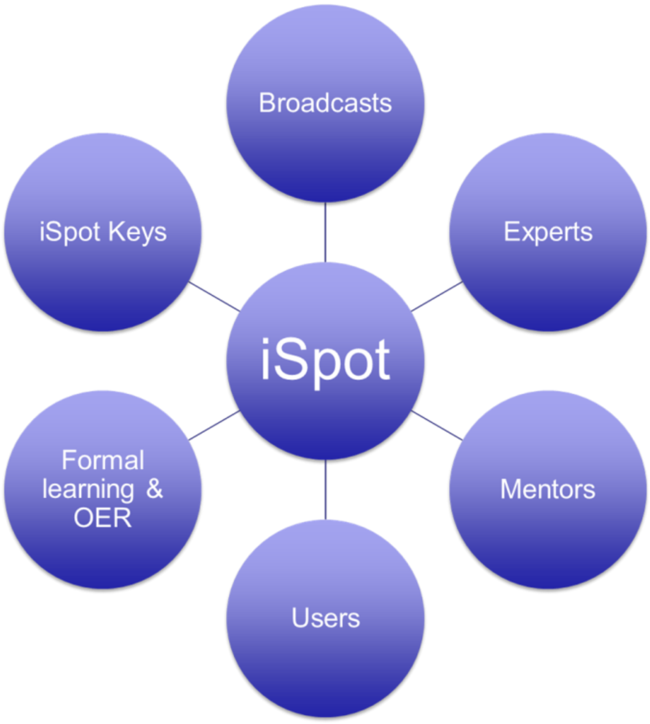

Figure 1- iSpot conceptual model (courtesy Doug Clow iSpot LAK11 presentation - available from slideshare)

The service not only provides information about the observations but also about their geographic locations. It allows people to use geo-tagged images (images with GPS data included in them about their location) or provides people with the ability to add information about where an observation was discovered. The site then uses Google mapping technology to allow people to search and filter using various tags and identifiers to see where observations were discovered throughout the UK.

The website itself is available to be viewed on mobile phones, however because the site focuses on observations, and is more about images rather than text, and because people will naturally be outdoors making observations, there is a need and opportunity to use mobile phones and digital cameras to make observations.

The team took a lightweight contextual design approach to establishing the requirements for the mobile app based on the user-centred design process developed by Hugh Beyer and Karen Holtzblatt (Beyer H et al., 1998), exploring the types of users, the scientific context of nature study, the environment which they would be exploring and the learning outcomes to be achieved. There is a wealth of research pointing to the effectiveness of taking a user-centred approach and the issues facing those designing effective learning environments using current technologies, in particular Bill Buxton says ‘..the nature of software applications is being transformed by virtue of their being embedded into devices that have broken away from the anchor of the stationary PC' Buxton, W. (2007) and Yvonne Rogers describes the challenges of working within these new interfaces in her paper on The Changing Face of Human-Computer Interaction in the Age of Ubiquitous Computing (from HCI and Usability for e-Inclusion (Holzinger, A. et al 2009)). Through this and related research we concluded the main purpose of developing the mobile app would be to allow users to upload observations (a combination of photo, identification, and location) to iSpot using their mobile device. i.e. providing them with a pedagogically grounded instructional design. The secondary purpose would be to enable iSpot website functionality on a mobile device in a native format and using the enhanced capabilities of a multi-touch mobile phone, for example the ability to pinch to zoom on images to see greater detail and the ability to use the devices to interact with the iSpot community whilst on the move and to enhance their experience from that of the website through utilising the geo-location services available within mobile devices.

The app would exchange data securely with the iSpot site, via an appropriate process to manage this handshaking, through the creation of an API within the iSpot Drupal service. The Lead Developer of iSpot, Richard Greenwood, says "Producing a coherent and extensible API was important because it allowed iSpot to be consumed and updated via new channels such as mobile applications and third party websites, this opened up new avenues to reach existing and new users but also offered the ability to start exploring exciting new ways for the website to be utilised, these are the subject of on-going research." The RESTful API includes oAuth authentication layer (www.oauth.net) and uses the HMAC-SHA1 signature method.

The iSpot development team investigated HTML5 rather than native app development but at the time support for HTML5 on mobile was not considered mature enough to allow the team to develop a suitably sophisticated application. Recently PhoneGap (using Apache Cordova) and other similar HTML5 wrapper technologies have made this a much more appealing prospect for app developers, and the long term strategy is to eventually move to HTML5 to avoid the complexities of having to develop bespoke applications for the different platforms.

To reduce complexity the team therefore decided to focus initially on a single mobile platform and the decision was made to develop for Google Android platform for the first iteration of development with a view to porting to other platforms at a later stage. Android was chosen because of (a) Increasing market share - at the time of development sales of Android devices were outstripping sales of any other mobile platform (b) The open nature of the Google technology suite and app store (c) The Open University had an existing partnership with Google over use of the Google Apps for Education to facilitate Open University student interaction. The team were however aware of issues with this platform choice, specifically (a) The number of variants of the operating system that needed to be catered for and (b) The variety of device types and screen sizes. For example Figure 2 shows the current distribution of operating systems and screen sizes over a seven day period ending on 1 August 2012 accessing the Google store.

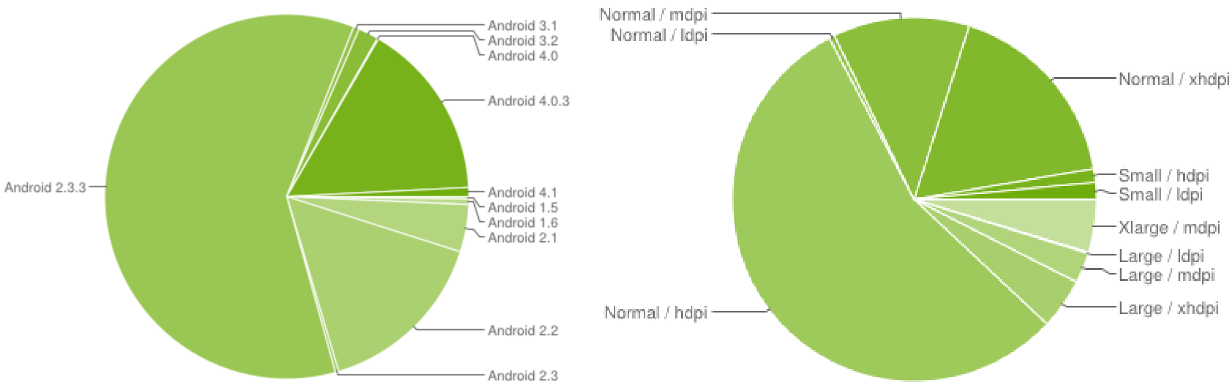

Figure 2 - Data on Android platform versions and screen sizes and densities is based on the number of Android devices that have accessed Google Play within a 7-day period ending on the 1st August 2012 (data and images courtesy of Google).

FIRST ITERATION

As explained previously a light-touch user-centred design approach was used for app development, beginning with a storyboarding process using experiences from users of the current iSpot website, specifically we collected data from a selected group of experienced iSpot website 'volunteer' users then applied interviews and data capture techniques to analyse their practice alongside usage data from the website to establish common patterns of use. We then turned these into stories which became a coherent functional specification. The first iteration of the app started in October 2011 and took eight weeks of development and then a further two weeks were spent bug fixing and adding additional checks. One of the initial issues, as explained previously, was that Android devices have all manner of shapes and sizes of screen and this made the display of the images a challenge. We initially went for a 'clean and corporate' interface design for the app, for example Figure 3 shows a screenshot of the observation list.

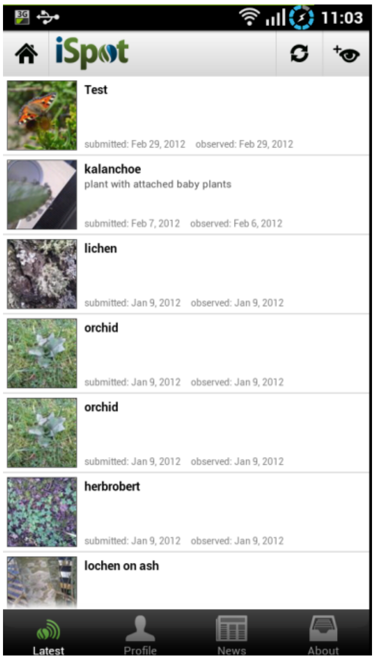

Figure 3 –screenshot of original app design

EVALUATION AND REFLECTION

After the first iteration we began a process of testing the application. A usability expert within IET conducted an expert evaluation. The application was also provided to a group of ten experienced mobile users who were new to iSpot and they were asked to evaluate the app ‘authentically’ using a scenarios gained from the stories we had established earlier in the contextual design process i.e. going out and taking observations in naturalistic settings and then providing feedback on their experience. This was challenging because we were testing both the application and the context of the mobile device stack. We also wanted to identify gaps between what people say they do and what they actually do (Smørdal and Gregory, (2003)), e.g. to validate information gained via follow up interviews.

From the feedback it was clear that people were generally enthusiastic about the functionality of the app but they were less positive about the interface design. For example here is a typical comment we received from one of the testers:-

“She thought she had to put something in the scientific name or the common name and did not realise that she could leave these blank (she knew it was a ladybird but there was not the option to say just ladybird so she selected one of the named ladybirds, a 10 spot one, even though she knew it was wrong just to get to the next screen and submit the observation)”

Desktop research was conducted during this reflection period into the best of breed competitor products in the natural science field, including WildKey and Project NOAH. We concluded that the iSpot app is distinctive from competitors as it references species dictionaries and because observations are identified by the iSpot community, often within a very short time of being observed and uploaded; half of all un-named observations are identified within an hour of appearing on the site.

Through these evaluation processes we realised that we had been creating a service that largely mimicked website navigation and we therefore had to completely redesign the navigation and layout for the mobile app.

SECOND ITERATION

In January 2012, as a result of the user feedback and desktop research, we made the decision to invest in further development and interface design and a further iteration of the application before releasing the beta to the public. We acquired the assistance of a mobile interface designer who worked alongside the developer to implement a set of improvements to the interface. In March 2012 we started a second phase of development.

Our first attempt at improving the interface involved providing a big button menu screen as the ‘home’ to get into the main app functionality (Figure 4). The designer created a stylised logo and incorporated design features of the iSpot website to improve the app and make it feel more nature related by using grass and wildlife within the layout.

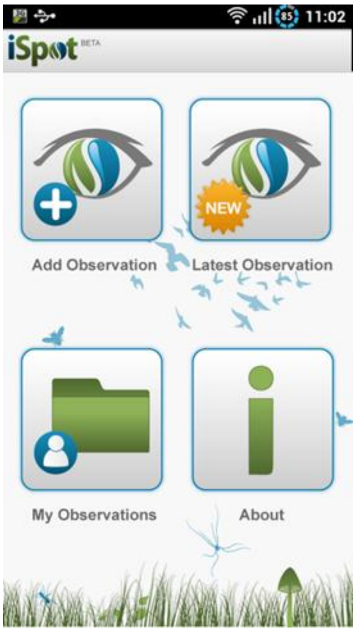

Figure 4 – second iteration theme with more 'nature' focused interface design

Testing was again conducted with another group of ten mobile proficient users as part of the development process and this interface received positive feedback from users, however although people liked the design there were still concerns that the navigation was not providing the rich interaction and direct engagement, focusing on the main things the user would like to do and drawing them directly to those. We were also concerned that this interface design was not scalable, i.e. as functions were added how would we incorporate them into the menu?

From data collected through the exercises in the first iteration we were aware that users primarily wanted to see the observations, we therefore decided to explore a design based on taking the users directly to the observations as this emerged as the predominant feature people would most regularly go to iSpot to explore. We made the observation thumbnail images larger to increase usability and aesthetic appeal (Figure 5). We didn't want to remove valuable screen 'real estate' on what is a small screen so we explored using a dynamic menu which users could click on or swipe to view and which provided all the functions within the application allowing extensibility using horizontal swipe to access menu choices.

Figure 5 – the image-centric design adopted for the beta release

The feedback from user testing this with ten participants was very positive about the new interface design, comments included:

Participant 3

"Pull down icon menu intuitive once you try it for the first time"

"Tried taking photo of pot plant and identifying it. Intuitive interface. Easy to add details. Recognised my location. Though somewhat cramped with keyboard. Pleased to see my first observation appear on iSpot."

Participant 7

"Overall I have found the app to be extremely stable, easy to navigate and fairly intuitive."

As a consequence of the positive feedback from both user testing and technical testing we felt in a position to move towards releasing the app to the public however we wanted to ensure that we mimicked our standard developmental quality assurance processes as closely as possible so we therefore asked for accessibility testing of the application. This proved challenging since standards are still being established in this area and within the organisation we found that there was no benchmark against which to test the application. We therefore asked our accessibility expert to conduct a review of standards and guidance in this area in order to create a benchmark with which to test future iterations of the application. The results of that research are a list of references provided below (accessed 31st August 2012)

(i) Google Android accessibility guidelines for developers: http://developer.android.com/guide/topics/ui/accessibility/index.html

(ii) Apple iOS accessibility guidelines: http://developer.apple.com/library/ios/#documentation/UserExperience/Conceptual/iPhoneAccessibility/Accessibility_on_iPhone/Accessibility_on_iPhone.html

(iii) Henny Swan from the BBC blog on 'Getting to grips with a mobile accessibility strategy': http://www.iheni.com/getting-to-grips-with-a-mobile-accessibility-strategy/ and lists some 'Resources for Mobile Accessibility Guidelines': http://www.iheni.com/mobile-accessibility-guidelines/

(iv) OneVoice report and 7 principles: http://www.onevoiceict.org/news/moving-together-mobile-apps-inclusion-and-assistance

The evolving benchmark incorporates elements of the WCAG 2.0 (http://www.w3.org/WAI/intro/wcag) website guidelines which also apply for mobile applications; therefore the evolving mobile benchmark follows the guidelines provided by the platform manufacturer (points (i) and (ii) above) where they do not conflict directly with the WCAG 2.0 website guidance. The accessibility testing therefore includes, for example, testing audible feedback using a service such as Talkback (Android) or VoiceOver (iOS).

LESSONS LEARNED AND RECOMMENDATIONS

An important aspect of the project was the creation, at project conception, of a clear vision of how the app will benefit the iSpot user community. This is particularly important when employing contract staff as they can quickly 'buy-in' to the concept. The project team had differing ideas of how the app should look and therefore employing the services of a graphic designer early, from the second iteration onwards (Figure 4), was very important as the designer interpreted the different design aspirations and weaved them into a coherent user experience (UX). The choice of Android as the development platform provided some interesting technical challenges due to the many different versions of Android operating system, for example two new versions were released during the development phases, and the complexities of designing for the wide variety of screen layouts. Another lesson learned from the project is to ensure that there are adequate gaps between the different development iterations to allow time for testing and assessment. We allowed a minimum of six weeks between phases. There is a risk that you may lose staff to other projects during the 'gap period' between iterations but the main benefit is that you can improve the quality through comprehensive assessment of the app, interviewing users and gathering feedback to improve the next iteration.

When developing an app consider the following:

(i) Follow an agile approach using short windows of development
(ii) Ensure adequate graphic design input throughout the project
(iii) Establish features and priorities most suitable to app development (e.g. features which appeal to people whilst on the move)
(iv) When appropriate, ensure that there is a suitable, and extensible, API against which to build the app.
(v) Consider designing for a single platform initially and ensure that you consider specific interface issues and standards.

CURRENT AND FUTURE PLANS

The Android iSpot application 'stable beta' was released to the public via the Google Android app store (Google Play) https://play.google.com/store/apps on 8th June 2012. The iSpot app can be accessed on the Google Play store directly by visiting http://goo.gl/BWoM2 .

The iSpot project team are currently working on a third iteration of the mobile application. This iteration incorporates improvements to the application through the feedback gained from the testing processes and through the knowledge of best practice through the feedback from the expert users within the Science Faculty along with enhanced reference material from Google on designing for the Android Platform http://developer.android.com/design/index.html.

Comprehensive testing is currently being conducted prior to release, facilitated by evaluation experts within IET, using the state-of-the-art mobile eye tracking and mobile data capture facilities available within the Open University Jennie Lee Research Labs http://jennielee.open.ac.uk (accessed 31st August 2012). Testing is currently underway and the full product release (version 1.0) of the mobile application is expected later in 2012.

The full release, as a consequence of the testing and evaluation, provides a richer and more interactive experience with an improved user interface, including a contextual "active menu" and larger images, as shown in the sample screenshots below (Figure 6).

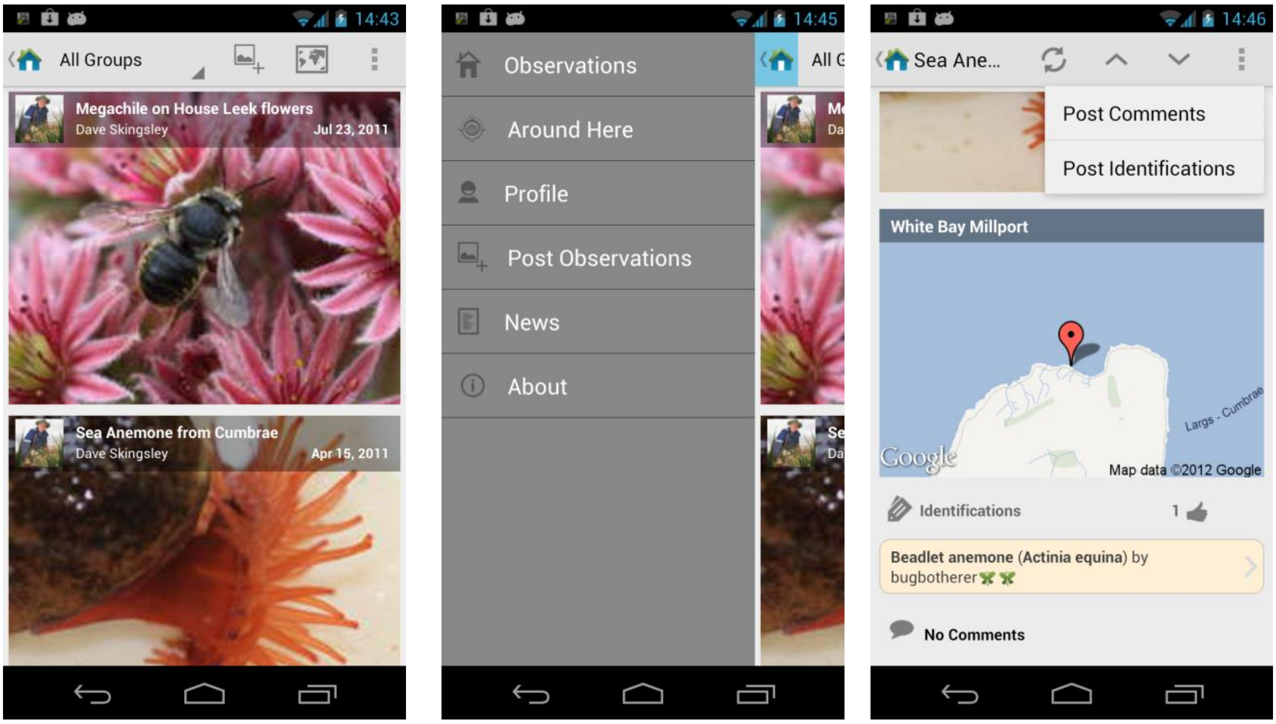

Figure 6 – Sample screens from current development showing (1) "active menu" and text overlays on images (2) the slide out navigation panel (3) The post comment and post ID capability.

There will be enhancements to the geo-location services to provide ‘around here’ information about observations within a specific locale. There will be enhancements to the social and community aspects of the application, in particular allowing users not only to comment on other peoples observations but also to identify them. Finally there will be improvements to the discovery and filtering services to allow users to quickly find out information related to a particular observation and to create their own individual journeys of self-discovery.

REFERENCES

Adams, Anne; Coughlan, Tim; Lea, John; Rogers, Yvonne; Davies, Sarah-Jane and Collins, Trevor (2011). Designing interconnected distributed resources for collaborative inquiry based science education. In: ACM/IEEE Joint Conference on Digital Libraries, 13-17 June 2011, Ottawa.

Buxton, W. (2007). Sketching user experiences : getting the design right and the right design. Amsterdam: Elsevier/Morgan Kaufmann.

Collins, Trevor; Gaved, Mark; Mulholland, Paul; Kerawalla, Cindy; Twiner, Alison; Scanlon, Eileen; Jones, Ann; Littleton, Karen; Conole, Grainne and Blake, Canan (2008). Supporting location-based inquiry learning across school, field and home contexts. In: Proceedings of the MLearn 2008 Conference, 7 - 10 Oct 2008, Ironbridge Gorge, Shropshire, UK.

Chen, Y., Kao, T., Sheu, J., and Chiang, C. (2003). A mobile learning system for scaffolding bird watching learning. Journal of Computer Assisted Learning, 19(3): 347-359

Chen, Y. S., Kao, T. C., Yu, G. J., & Sheu, J. P. (2004, March). A mobile butterfly-watchinglearning system for supporting independent learning. In Proceedings of the 2nd IEEE international workshop on wireless and mobile technologies in education. March 23–25, JungLi, Taiwan.

Clough, G. (2009). Geolearners: Location-Based Informal Learning with Mobile and Social Technologies, IEEE Transactions on Learning Technologies, 11 Sept. 2009. IEEE computer Society Digital Library. IEEE Computer Society, <http://doi.ieeecomputersociety.org/10.1109/TLT.2009.39>

Davies, Sarah-Jane; Collins, Trevor; Gaved, Mark; Bartlett, Jessica; Valentine, Chris and McCann, Lewis (2010). Enabling remote activity: using mobile technology for remote participation in geoscience fieldwork. In: Proc. European Geosciences Union General Assembly 2010 (EGU 2010), 02-07 May 2010, Vienna, Austria.

Gaved, Mark; Collins, Trevor; Mulholland, Paul; Kerawalla, Lucinda; Jones, Ann; Scanlon, Eileen; Littleton, Karen; Blake, Canan; Petrou, Marilena; Clough, Gill and Twiner, Alison (2010). Using netbooks to support mobile learners' investigations across activities and places. Open Learning: The Journal of Open and Distance Learning, 25(3), pp. 187–200

Hoppe, H. U., Joiner, R., Milrad, M., & Sharples, M. (2003). Guest editorial: Wireless and mobile technologies in education. Journal of Computer Assisted Learning, 19(3), 255-259.

Mulholland, Paul; Anastopoulou, Stamatina; Collins, Trevor; Feisst, Markus; Gaved, Mark; Kerawalla, Lucinda; Paxton, Mark; Scanlon, Eileen; Sharples, Mike and Wright, Michael (2011). nQuire: technological support for personal inquiry learning. IEEE Transactions on Learning Technologies

Rogers, Y. (2009). The changing face of human-computer interaction in the age of ubiquitous computing. (A. Holzinger & K. Miesenberger, Eds.) HCI and Usability for e-Inclusion, 5889, 1–19. Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-10308-7

Scanlon, Eileen; Jones, Ann and Waycott, Jenny (2005). Mobile technologies: prospects for their use in learning in informal science settings. Journal of Interactive Media in Education, 21(5), 1-17

Scanlon, Eileen and Gaved, Mark (2011). Personal Inquiry Project: Progress with Open University Trials, Escalate Newsletter

Sha, L., Looi, C-K., Chen, W. and Zhang, B.H. (in press) Understanding mobile learning from the perspective of self-regulated learning, Journal of Computers Associated Learning

Sharples, M., Milrad, M., Sanchez, I. A., & Vavoula, G. (2007). Mobile learning: Small devices, big issues. In N. Balacheff, S. Ludvigsen, T. de Jong, A. Lazonder,S. Barnes, & L. Montandon (Eds.), Technology enhanced learning: Principles and products (pp. 20). Retrieved from http://telearn.noe-kaleidoscope.org/openarchive/browse?browse=collection/30/publication&index=0&filter=all&param=30

Vavoula, G. et al. (2005).Report on literature on mobile learning, science and collaborative activity, Kaleidoscope Project

Smørdal, O. and Gregory, J. (2003). Personal Digital Assistants in medical education and practice. Journal of Computer Assisted Learning, 19, 320-329.

Huang, K., Liu T., Graf S., & Lin Y. (2008). Embedding mobile technology to outdoor natural science learning based on the 7E learning cycle. 2082 – 2086

Beyer, H. & Holtzblatt, K. (1998). Contextual Design: Defining Customer-Centered Systems. San Francisco: Morgan Kaufmann. ISBN 1-55860-411-1