

Informal Participation in Science in the UK: Identification, Location and Mobility with iSpot

Eileen Scanlon*, Will Woods and Doug Clow

Institute of Educational Technology, The Open University, UK // Eileen.Scanlon@open.ac.uk // Will.Woods@open.ac.uk // Doug.Clow@open.ac.uk

* Corresponding author

ABSTRACT

Informal participation in science is being recognized as an important way of developing science learning both for children and adults. Mobile learning has particular properties that have potential in informal science settings, particularly outside traditional educational settings. Mobile technologies provide new opportunities for learners to engage with science on the move. This paper reviews the impact of participation in informal science settings on some members of the public using the experiences of the iSpot project as a case study. iSpot aims to create and inspire a new generation of nature lovers by getting people to explore, study, enjoy, and protect their local environment. It facilitates an inquiry learning approach to identification of wildlife with support provided by a community developing round the resource. The iSpot project described here provides evidence of the ways in which informal participation in science can be enhanced by the use of technology. We draw on the findings of two case studies within the project - iSpot Mobile and iSpot Local. These demonstrate particular ways in which location-based activity and mobile learning can be developed and have an impact on the informal learning of science.

Keywords

Informal learning, Participation, Science learning, Mobile learning

Introduction

This paper discusses informal science learning in mobile contexts, and the theoretical framing and development processes used in the creation of iSpot (<http://www.ispot.org.uk>). It analyses two projects related to iSpot—iSpot Local, and iSpot Mobile— which have developed particular approaches to the support of informal participation in science.

Mobile learning

Informal participation in science is being recognized as an important way of developing science learning both for children and adults (see e.g., Bell et al., 2009). Informal learning (see Trinder et al., 2008) has become an important area of interest for education researchers in recent years. Livingstone (2001) has documented the informal learning opportunities used by adults and the issues which arise in studying such settings. Mobile learning has particular properties that have potential for productive activity in informal science settings, particularly outside traditional educational settings. Sharples et al. (2009) define mobile learning as “the processes (personal and public) of coming to know through exploration and conversation across multiple contexts, amongst people and interactive technologies” (p. 5). Sharples provides some examples of this process including MyArtspace where school pupils use mobile phones to support learning on fieldtrips to museums. In particular, mobile technologies provide new opportunities for learners to engage with science learning. Dierking et al. (2003) have a view of learning as a cumulative process involving connections and reinforcement among a variety of learning experiences and describe informal science education as “science learning which is strongly socioculturally mediated and occurs across a wide range of physical contexts” (p. 109).

Here we discuss the impact of participation in informal science settings where mobility is an asset. The National Science Foundation describe informal learning as follows:

“Informal learning happens throughout people's lives in a highly personalized manner based on their particular needs, interests, and past experiences. This type of multi-faceted learning is voluntary, self-directed, and often mediated within a social context...; it provides an experiential base and motivation for further activity and subsequent learning.” (NSF, 2006, Section I, Introduction.)

Increasingly it is recognised that mobile technology can play a part in Citizen Science activities (discussed further below). See e.g., Robson (2012) describing the use of mobile phones in CreekWatch.

It is important to emphasise with Sharples et al. (2009) that in mobile learning what is mobile is the learner. This is important for the topic of this paper: mobile learning of science in informal settings. In the iSpot case studies which follow, the learner is always mobile, sometimes accessing a website from a field location, sometimes using a mobile device but always engaged in location-based learning. Mobile learning in science settings has been studied both in formal and informal settings. There are a range of relevant studies in formal learning (e.g., Littleton, Scanlon, & Sharples, 2012; Chen, Kao, Yu, & Sheu, 2004) but fewer in informal settings. Early examples of studies which demonstrate the potential of mobile learning in informal science settings include that of Clough (2009). She describes developing mobile support for nature trails, and researching the use of mobile technology with GPS in the geocaching community. It is a challenge for learning scientists to develop and study learning in such completely informal settings.

Approach to development, theoretical framing of the design and methodological challenges

In this section we set out the development of the design of the iSpot project. A core group (Jonathan Silvertown, Martin Harvey, Richard Greenwood and Doug Clow) led the creation of iSpot, the iSpot website, and generated its initial design by informal discussion, based on the expertise they brought to the project, which included field biology, citizen science, online learning, and software development. Some iSpot team members were driven by theories of participatory design. An initial motivation was the exploration of applications of geographically referenced teaching and learning. Next we compare the features and intentions of the work with theoretical perspectives from research on learning.

iSpot supports a community of practice (Lave & Wenger, 1991) where members learn from legitimate peripheral participation (Wenger, 1998) and develop their expertise through a process close to apprenticeship. A central theoretical design principle for work on communities of practice is the support of different modes of participation. Preece and Shneiderman (2009) set out a 'Reader to Leader' framework, categorising successive levels of social participation in online communities as reading, contributing, collaborating and leading. Other work suggests that a developmental model is not a good fit with observed activity in online learning sites: rather, different users participate in different ways at different times (as described in the 'Fairy Rings' model see Clow and Makriyannis, 2011).

One way to consider a contribution on the iSpot website is as a shared social object (see e.g., Knorr-Cetina, 2001) which can structure this participation, and scaffold participation in the community of practice. iSpot also reflects the constructivist notion of authentic learning activities (Jonassen, 1999) together with what Scardamalia and Berier (2006) describe as knowledge building: The learning activity is not only akin to scientific activity, it initiates learners into the knowledge-creating culture and enables them to actively contribute to scientific knowledge.

The development of a system such as iSpot needs to combine, in a cyclic approach, research, pedagogical design, and technology development. Accounts of socio-cognitive software design (Sharples, Taylor & Vavoula, 2007; McAndrew, Taylor and Clow, 2010) are influential in developing such processes, as are principles of Agile software development (<http://agilemanifesto.org>). Substantial engagement and envisioning activities with stakeholders were conducted, followed by deployment of the system to gather feedback from users.

There are a number of definitions of design-based research: our approach was in line with Barab and Squires's description: "Design-based research [...] was introduced with the expectation that researchers would systemically adjust various aspects of the designed context so that each adjustment served as a type of experimentation that allowed the researchers to test and generate theory in naturalistic contexts" (Barab & Squire, 2004, p. 3). In some aspects of our project, particularly the development of the mobile app this included iterative cycles of designing (both pedagogy and technology), running an inquiry, and then evaluation and analysis that fed into the next cycle. Thus some of the key findings of the research become embedded within the system: not just in the design of the software, but in how it is used by the growing and developing community of practice.

So the approach taken in the design of iSpot was the co-design of technology and pedagogy i.e. to design the educational activities and technology together, drawing on a participatory design approach (see e.g., Penuel, Roschelle & Schetman, 2007).

There are methodological and practical challenges associated with developing an understanding of how learning takes place in the communities which use iSpot. The learning episodes which involve a user can be relatively short and informal. An important perspective on learning that comes from the public understanding of science movement is to think more broadly about the impact of engagement. Relatively simple models of learning, such as the deficit model used at first in work on the public understanding of science, were replaced by an investigation of the potential outcomes, including increased awareness and impact on attitudes, as well as engagement and participation. Groups enabled by technology will form round particular interests and issues suggesting a need to assess how expertise can develop in these groups. There is a complexity to examining such learning settings as iSpot. We need to look more broadly at them, in terms of new data and analysis methods (Scanlon, 2012, July).

Citizen science

In considering the learning which takes place through participatory science enabled by the use of mobile technology in field settings, it is necessary to look for some different ways of examining those learning settings and the use of mobile technology. Dron and Anderson (2007) describe how online communities enable different types of participation in the form of groups, networks and collectives.

iSpot may be described in Dron and Anderson's terms as a network. It also can be seen as an example of citizen science. Wiggins and Crowston (2011) provide a typology of citizen science projects where members of the public work in combination with researchers. Hand (2010) and Newman et al. (2010) caution that additional verification may be necessary on projects which involve citizen scientists. Rotman et al. (2012) surveyed volunteers on ecological science projects to find out their motivations for participation, and many cited their desire to increase their scientific knowledge.

iSpot

This section describes iSpot, the project at the heart of this paper. This paper uses the iSpot project to examine the ways in which informal participation in science can be enhanced by the use of technology, and in particular ways in which location based activity and mobile learning are developed in the project. iSpot allows an inquiry learning approach to the identification of wildlife with support provided as part of a community of practice. It is important to note however that in what follows we are drawing examples from approaches taken in the particular case studies, rather than describing the whole cycle of development in the iSpot project or all the particular design decisions taken to develop its website.

iSpot (McAndrew et al., 2010; Woods & Scanlon, 2012) aims to create and inspire a new generation of nature lovers by getting people to explore, study, enjoy, and protect their local environment. The iSpot web site (home page shown in Figure 1), launched in June 2009, allows users to post observations of animals and plants on the site, and the iSpot community helps to identify them reliably. As a web-based system was used, this allows users to access and learn 24/7 and at anyplace with Internet access. These observations constitute the 'shared social object'. Support is provided for identification partly by online resources but more fundamentally by the community of practice active on the site. The site connects together informal novice learners with experts in a wide range of natural history fields, including over 100 who are representatives of natural history organisations. Learning the name of an organism you have observed is the first step in learning more about it. Furthermore, the process of recording observations of species - including the name of the species, the location and the time of the observation - is the fundamental unit of activity in biodiversity monitoring and research. Indeed, selected observations from iSpot users are now used as part of formal biodiversity monitoring. Thus iSpot enables learners to engage in Scardamalia and Berieter (2006)'s knowledge building: they contribute to new knowledge, as a community activity.

A key feature of iSpot is its sophisticated but easy-to-use reputation system, which provides an indication of each user's expertise on the site (see Clow and Makriyannis, 2011). Unusually among online reputation systems, as well as providing an indication of "social" reputation on the site, the iSpot reputation system includes elements designed to provide sound indicators of the expertise – or learning – displayed through activity on the site. The reputation system structures and makes manifest expertise, facilitating learners' development within the community of practice.

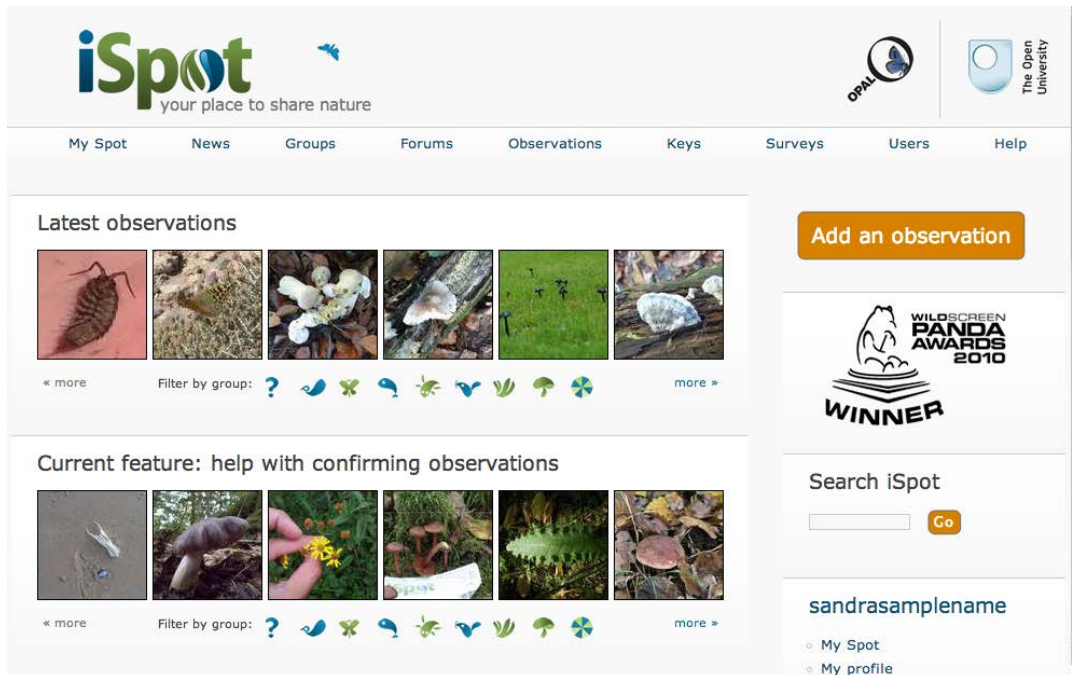


Figure 1. iSpot home page

iSpot findings on participation and learning

The impact of iSpot can be seen through its wide reach. Currently it has over 31,000 registered users who have added more than 200,000 observations with over 340,000 images, identifying more than 6,900 different species. The project has identified two species previously unrecorded in the UK: a bee-fly (*Systoechus ctenopterus*) and euonymus leaf notcher moth (*Pryeria sinica*). Further empirical analysis of learning activity on iSpot is underway, but some initial findings are presented here.

Qualitative analysis shows clear examples of users who start as complete novices, but come to fairly sophisticated understanding of identification. There is also quantitative evidence of users learning. For instance, analysis of a sample of 407 users as they progressed through submitting and identifying their first fifty observations within iSpot is strongly suggestive of learning. As shown in Figure 2, users showed improvement in their ability to identify other people's observations over the period that they submitted observations: As users progress from their first to their 50th observation posted on iSpot, they have a bigger percentage of correct identifications that is they are more likely to identify what they have seen for themselves.

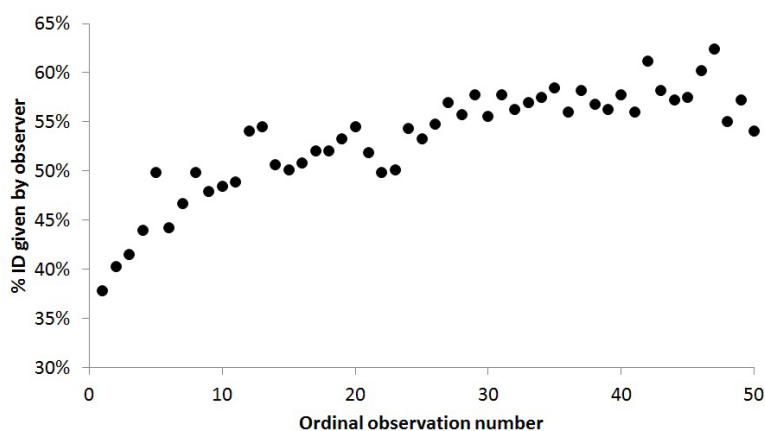


Figure 2. How people improve in identifications from repeated use of iSpot

The crowdsourced identification model within iSpot, rewarding improvement in ability to identify observations, provides some of evidence that people are learning and improving their understanding of nature through iSpot. However a person may gain reputation through identifying very common species and without expanding their knowledge of other species.

In order to get a better understanding of how and whether people learn from using iSpot we require empirical evidence of improvement in people’s ability to identify a greater variety of observations as their reputation improves. We designed the iSpot intelligent quiz to test this knowledge. The quiz was launched in July 2013, since then around 350 people per week have taken one or more quizzes, so an average of around 50 people per day. The quiz is tailored to the level and subject area that people request when they start a new quiz on iSpot. The reputation level that iSpot provides is a good indicator of the level that people should take but there is no restriction on the level so, for example, a level five expert could take a level 1 quiz and vice versa. The data from the weekly logs shows however the people are averaging about 7 out of ten for quizzes across the skills levels which suggests that people are naturally finding a level which challenges them.



Figure 3. Screenshot of the iSpot intelligent quiz

The quiz has a number of different types of question that test a range of knowledge within a specific domain, some questions are multiple choice and others are about entering the correct name or type of observation. The data collected so far indicates that people who use iSpot are gaining knowledge about nature.

Face-to-face outreach work has reached over 55,000 beneficiaries, over 10,000 from hard-to-reach groups, whilst over 800 participants have used iSpot at local “bioblitz” events, including schools, local government and voluntary sector organisations.

This account of iSpot provides the framing for the description of two specific projects linked to iSpot that particularly explore mobile and ubiquitous learning: iSpot Local and iSpot mobile.

iSpot mobile

The first case study linked to iSpot is iSpot Mobile. The iSpot website was already available to be viewed on mobile phones. However since people are outdoors making observations, there was both a need and an opportunity to use mobile phones with digital cameras to make observations and interact with the iSpot community.

The iSpot mobile design approach

A lightweight contextual design approach to establishing the requirements for the mobile app was taken based on the user-centred design process developed by Beyer 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. We defined the main purpose of developing the mobile app as allowing users to create and upload observations (a combination of photo, identification, and location) to iSpot using their mobile device and to become part of the iSpot community using tools for sharing information. The secondary purpose was 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 through utilising the geo-location services available within mobile devices.

A core group consisting of Jonathan Silvertown, Martin Harvey, Will Woods and Richard Greenwood produced the initial design. 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, data was collected from a small selected group of experienced iSpot website ‘volunteer’ users whose practice was monitored through interviews and forum discussion, taken alongside usage data from the website, and feedback from the core group to establish common patterns of use. These were converted into stories to build a coherent functional specification. For example, one user said “I am running an inquiry based learning project and I want to [use the iSpot mobile app to] develop scenarios around ecosystems that I’m observing, for example birds in my garden, population of bugs in my flower bed, fauna in my pond ...”

The user-centred design approach that the team adopted involved gathering feedback about how people engaged with early prototypes of the environment to inform later iterations. Twenty people volunteered. A small number of volunteers from the existing iSpot community were also invited to participate, including iSpot “mentors” (associates who work with iSpot to assist others in identifying observations). A series of usability and accessibility testing cycles were conducted during the course of the app development. The feedback was gathered and interpreted by the project team to help improve the functionality and design of later iterations.

First iteration

The first iteration of the app started in October 2011 and took a total of ten weeks including development, bug fixing and testing. An initial issue was that Android devices have all manner of shapes and sizes of screen and this made the display of the images a challenge. Figure 4 shows a screenshot of the observation list.

Testing took place over a two-week period which included an evaluation conducted by a usability expert. The results indicated that the app was missing some critical functionality and had a number of bugs.

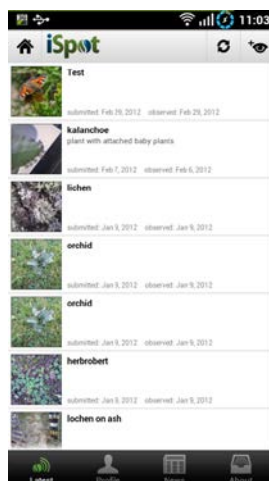


Figure 4. Screenshot of original iSpot app design

The application was also provided to a group of ten experienced mobile users. For example, one experienced iSpot user suggested a process of checking and validating an observation using the mobile app, producing the following scenario: “What iSpot offers is an authoritative resource for helping people learn identification. The new app could be like having an expert out in the field with you which is, I'm sure you'll agree, the best way to learn identification; in the field not through photographs.” To test these scenarios, users were asked to go out and take observations in naturalistic settings and then gain identifications from the iSpot community and then to provide feedback on this experience.

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 quote from notes taken during an interview with 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).”

The iSpot service 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 unnamed observations are identified within an hour of appearing on the site. The app therefore provides these unique services to mobile users, allowing them to have observations identified and potentially to identify and agree with the identification of other people’s observations.

The evaluation process established that the service created for iSpot Mobile largely mimicked the iSpot website navigation and the design felt quite sterile. The team concluded that the app should therefore be completely redesigned around a navigation and layout more suitable for a mobile app, increasing the interactivity and social elements.

Second iteration

In January 2012, a second iteration of application specification, design and development took place. A mobile interface designer worked alongside the developer to implement a set of improvements to the interface.

This design iteration involved providing a big button menu screen as the ‘home’ screen to get into the main app functionality (Figure 5). 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.

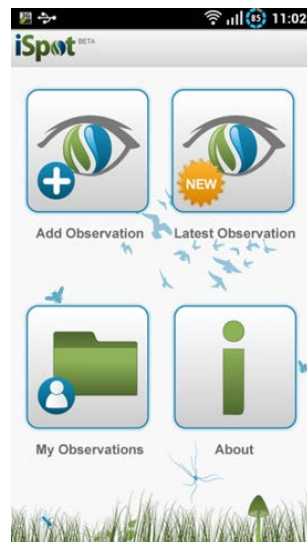


Figure 5. Second iteration of iSpot app

The redesigned tool the users directly to the observations. We made the observation thumbnail images larger to increase usability and aesthetic appeal (see Figure 6). To avoid removing valuable screen ‘real estate’ on what is a small screen 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.

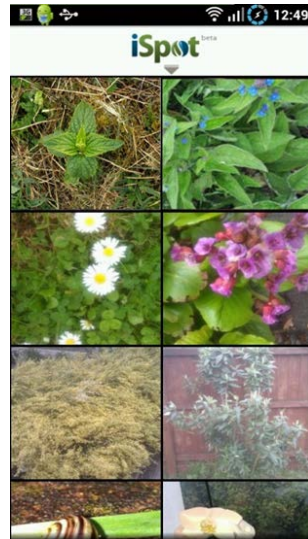


Figure 6. The image-centric design adopted for the beta release of the iSpot app

Further testing was conducted with another group of ten mobile proficient users. This interface received positive feedback from users, including the design, with comments such as:

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

However, there were still concerns that the navigation was not providing rich interaction and direct engagement, and that this interface design was not scalable, i.e., as functions were added how would they be incorporated into the fixed four button menu?

As a consequence of the positive feedback from both user testing and technical testing the team felt in a position to move towards releasing the beta version of the app to the public. The Android iSpot application “stable beta” was released to the public via the Google Android app store (Google Play) on 8th June 2012.

Third iteration

The third iteration of development began in August 2012. This iteration incorporated improvements to the application through the feedback gained from the testing processes, through user feedback from the beta release, and through use of enhanced reference material from Google on designing for the Android Platform (<http://developer.android.com/design/index.html>). The beta app on the Google Play store received positive feedback from the public.

The third iteration included enhancements to the geo-location services to provide “around here” information about observations within a specific locale, i.e., within a 1 kilometre radius of the current location using the GPS capability of the device. Users can also scroll to move the map location and receive information about observations within a 1 kilometre radius of any location. There are enhancements to the social and community aspects of the application, in particular allowing users to identify other people’s observations as well as comment on them. Finally, there are improvements to the discovery and filtering services, to filter on species type, to allow users to quickly find out information related to a particular observation, and to create their own individual journeys of self-discovery.

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 7).

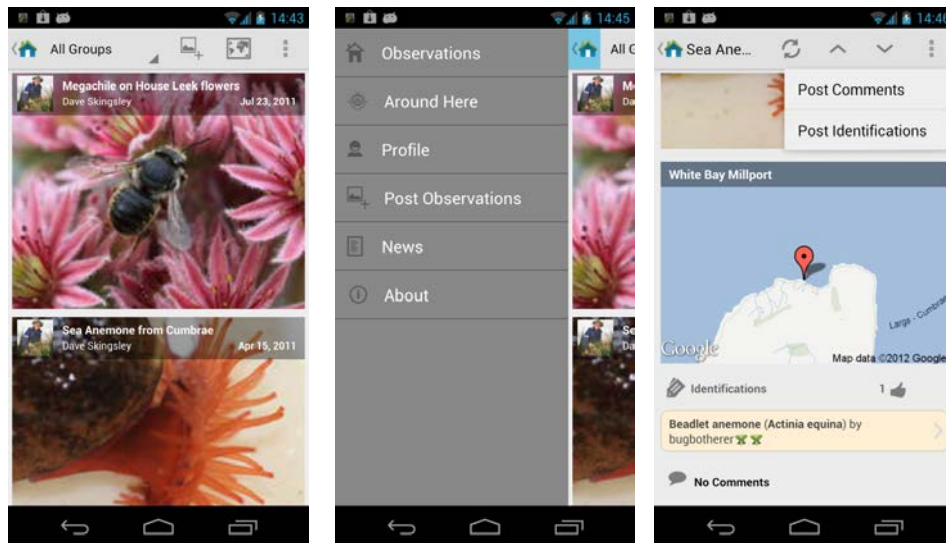


Figure 7. Sample screens from current iSpot app development showing (1) “active menu” and text overlays on images (2) The slide out navigation panel (3) The post comment and post ID capability

iSpot mobile testing and evaluation

A further round of comprehensive testing was conducted prior to release 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>). The app was judged to be more robust, fully featured and a better user experience. For example comments included:

“[The] ‘Around here’ map showing locations of observations in my immediate vicinity seems clear ...and easy to use”

After the testing and feedback, the version 1.0 product was released to the Google app store (Google Play) in December 2012. It is achieving over 1000 installations per month and currently has a user rating of 3.8 out of 5 (27 September 2013).

As learners become more mobile, the mobile apps may become the default way of engaging with iSpot and establishing participatory science learning journeys. The app may prove particularly suitable for individuals or groups engaging in local community bioblitzes. The iSpot team expect to use the app to support local group learning activities of this type in the future.

iSpot local

The iSpot Local project extended the iSpot approach to investigate the potential of using hyper-local events to frame the learning activity, moving it from a largely virtualised activity (on the iSpot website) to a grounded, community, mobile setting – including beyond the reach of electronic networks. This built on and extended the existing community of practice and knowledge building approach.

Bioblitzes

The key mediating event in iSpot Local was the bioblitz, a survey of the wildlife at a particular site at a particular point in time - say an afternoon, or a day. The general public, supported by a team of experts, try to identify and

record as many different organisms as they can within the time. This can generate real scientific data (knowledge building) as well as engaging the public in the scientific process - and the site itself - through active participation and learning within a community of practice. However, in traditional bioblitzes, it can be difficult to manage the data generated by the public, and identifying the species observed is problematic.

iSpot Local addressed these challenges by coupling the wider perspective and observational recording abilities of iSpot with hyper-local engagement with community stakeholders and effective practical management of the bioblitz events. The basic activity of iSpot Local is set out in Figure 8, a cartoon developed to explain the bioblitz to participants.

Six bioblitzes were organised across the South West of England, at a range of sites from schools to more public sites. The IT facilities available on site ranged from a high-speed wifi network and room full of dedicated computers (at a school) to a nature reserve with no power, no network, and negligible mobile phone voice signal. The team used a hybrid, flexible approach to technology to maximise the benefits given the nature of the site, typically using a set of laptops in a marquee to log photographs and observations, which were uploaded to iSpot later if connectivity was limited on site.

An important feature of iSpot Local was the way in which mobile access - mediated, supported and contextualised - enabled the hyper-local (the individual bioblitz) to connect to the worldwide (the international community network of experts and enthusiastic amateurs on iSpot).



Figure 8. Cartoon produced to help explain the iSpot Local approach

Development approach

Engagement with a wide range of stakeholders was critical to the success of the project. The funded project partners were the UK Open University, Ambios Ltd (a small not-for-profit company promoting environmental understanding) and Learning South West (a membership organisation coordinating learning and skills and youth work, with members including local authorities, colleges, private training providers and voluntary sector organisations). In line with the design approach, the project partners engaged extensively with many other stakeholder organisations including adult educators, family learning specialists, local government, volunteers, technical specialists and natural history experts.

The project developed and validated a three-phase model for ensuring effective participation including pre-bioblitz work, the bioblitz itself, and post-bioblitz activities. Thus the participation in the on-site activities was scaffolded and embedded through framing and linking activities, enabling the learner's participation in the community of practice.

In addition, as part of the iterative approach to development, some technical development was carried out to create a module to enable observations from a bioblitz to be embedded within a community website, part of which is shown in Figure 9 below.

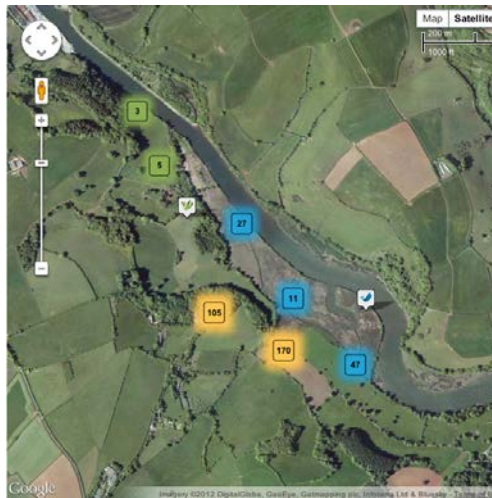


Figure 9. iSpot Local map showing observations at one of the bioblitz sites

iSpot local evaluation

Evaluation started at the beginning of the project, with the production of an initial Evaluation, Dissemination and Mainstreaming Action Plan. As described above, the design-based research approach meant that much of the outcomes are embedded within the practice developed as the project continued.

The bioblitz sites were generally open for participants to come and go as they pleased, and the participants were very diverse, from primary school-age children through to retired-age adults in to their 80s, and with previous experience of nature ranging from negligible to expert naturalists.

To engage with this diversity, a range of evaluation methods were employed to supplement analysis of the online activity, including observation, registration cards and evaluation cards during the bioblitz, and follow-up discussions with selected participants and stakeholders (e.g., school teachers).

Participation levels recorded through Registration Cards were high at the events, with significant data uploaded to iSpot. There was also a high level of activity by the wider iSpot community, with tentative identifications arising from an iSpot Local bioblitz rapidly translated into confirmed identifications on the website, and high numbers of others indicating agreement and posting further comments.

In total, 820 people participated directly in the six iSpot Local bioblitzes, making more than 1,800 observations in the course of the bioblitzes. On iSpot, these observations received over 2,000 identifications (some observations had more than one identification), from the bioblitz participants and the wider iSpot community. These identifications in turn received over 3,000 agreements. Most participants (74%) were children under 18 and the rest were adults. The gender ratio was roughly equal (53% female, 47% male). As a result of this engagement and participation, the iSpot reputation system was able to confirm over 1,250 observations as having a “Likely ID”—confirmed by sufficient expertise. This is clear evidence of the participants taking part in genuine “knowledge building”: despite the diversity of their initial expertise, they were able to jointly contribute to new knowledge.

The feedback from the participants shows further evidence of the participants' engagement and learning—for example, the feedback from the evaluation cards included a parent reporting that the best bit was “Watching my children get so involved, questioning and learning about the world around us that we don’t always stop to appreciate.” Another participant reported that they gained “A better appreciation of just how much wildlife lives alongside us in the school field. Brilliant experts, really approachable.”

Engagement with iSpot Local motivated many participants to engage further with learning about nature—for instance “Examining and cataloguing and drawing the wild flowers in the lane to Granny's house’ and ‘Have looked at iSpot site and held our own mini bioblitz in the garden.” The diversity of the participants was reflected in the diversity of outcomes from the activities: at one site, the volunteers engaged in conservation work planned to run repeat events annually to track the effects of their work; at another (a school), follow-up learning events targeted to the children’s interests and the curriculum were developed.

The use of bioblitz events coupled with the iSpot website, in the context of a wider learning community, shows the potential for the iSpot website to support a vision of mobile, ubiquitous and lifelong learning at many levels, harnessing the power and range of a global, broad network of expertise with local concerns and knowledge.

The individual learner, located in a particular environment, was connected to multiple potential sources of learning, ranging from informal personal contact with experts through to technology-mediated access to explicit learning resources and relevant formal education opportunities. This rich environment structured their apprenticeship within a community of practice, and enabled them to engage in knowledge building.

Conclusions and lessons learned

The paper has drawn on an evaluation of the iSpot Local and iSpot Mobile projects to consider evidence on the impact of participation, and on which features can be identified as important in the design of such community projects. In particular, explicit attention was paid to how learners can be supported to be members of a community of practice, with participation structured around a shared social object, engaging in knowledge building as active contributors to knowledge, and the iterative, integrated approach to development have all proven valuable.

The overall experience of the iSpot project with its analysis of the improvement in identification as users become more experienced provides some evidence of knowledge development. However it is also possible that the users are becoming more proficient with the system so there is room for further investigation of how learning taking place with the system.

We know from the analytics of people’s progress through iSpot that they appear to be improving their identification knowledge as they become more experienced users of iSpot. The new quiz service within iSpot, also available on mobile, will provide further evidence to assess whether learning is taking place.

iSpot Local and iSpot Mobile are two elements within a comprehensive roadmap for iSpot development, with a full range of objectives to be achieved within the project through to the end of 2014. These include the internationalisation of the service, extensions to support integration with other systems and services (Facebook, mobile, species dictionaries), improvements to the service robustness, personalisation and the ability to support local and regional content to create an adaptive user-centred service and services to further test the learning that is taking place through analytical tools and intelligent quiz to track how users are increasing in their ability to identify and understand nature.

The iSpot Local project and the iSpot Mobile app are examples of mobile learning: the learners access iSpot in a range of contexts, settings and locations as appropriate to their individual situation. To a degree they are also an instantiation of the vision of context-aware ubiquitous learning (Hwang et al, 2008): the location of an observation is a crucial piece of information on iSpot, and it is possible to use location-aware sensors to capture this data automatically from the learner’s context.

Each case study illustrated a different facet of informal participation in science and contribution to knowledge in this area. The iSpot Mobile case study demonstrated the impact of a design based research approach to the development of such systems. The formative feedback also provided us with information on the processes by which the mobile app would facilitate learning. The iSpot Local case study showed how online communities of practice can be extended and connected to physical locations, providing more contextual opportunities for knowledge building, and co-creating new scientific data.

This experience and analysis demonstrates some of the potential for mobile and ubiquitous technologies to support learning in informal contexts but certain issues remain. These new developments include an iSpot site created for Southern Africa, managed the South African National Biodiversity Institute so is showing evidence of how the initiative can be translated into new settings. Also, iSpot has linked up with Treezilla an ambitious Citizen Science project to map all of Britain's trees and record vital data about tree disease and the environmental benefits that trees provide, developing a mobile app for use as part of the Open Science Laboratory initiative. The sustainability plan involves moving the infrastructure to managed cloud-hosting over the next twelve month period and for moving support for the application and services to the central IT department over the next two years, to be completed by July 2015. This underwriting of such a research system demonstrates the understanding of the importance of iSpot to the Open University and to the growing community that it supports. The iSpot team led by Jonathan Silvertown works in partnership with nature organisations (currently more than 100), the iSpot community, and other stakeholders, to enhance iSpot and to help further assure its longer-term future.

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