A Method for Creating Collaborative Mobile Learning Trails

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Abstract

In this paper I report results from recent trials in which students used mobile devices to collaboratively create, edit and share trails. These included 9- to 10-year-olds as well as adult diploma students, in the subject of horticulture in botanic gardens. Findings indicate that a narrow subject focus and a manageable amount of data capture are appropriate in most cases; trails are most effective when framed with structured tasks and a narrow focus. Structure can be introduced through the use of collaboration scripts that specify tasks, roles and groups.

Findings also show that audio is an important mode for communication and interpretation, particularly when paired with photos; audio alone is effective when location data is known; but photos alone are much less effective. Audio is especially effective when used collaboratively – for example when two people have a conversation or share their impressions while in front of the object or exhibit of interest.

Introduction

This research explores the use of mobile technology to create personalised learning trails, through the capture, editing and sharing of audio, photos and text during visits to museums, botanic gardens and other cultural heritage sites. This area of research was started by Peterson and Levene (2003) and developed in the Kaleidoscope project 'Personal and collaborative trails of digital and non-digital learning objects.' (http://www.dcs.bbk.ac.uk/trails/)

The core idea is that meaning is in the linkages between objects, not the individual objects themselves. Within the trails model, as it is developed so far, there are many possible variations – for example trails can be explicitly created about particular topics, or generated after the fact from data captured from random points of interest. Each point of interest in the real world is regarded as an 'analog learning object,' which, when captured, can be augmented with 'value added' information into a digital learning object. Learning objects are defined not according to a formal specification (such as IMS-LD) but very broadly to include almost anything; standardized data could be added automatically, but that is not within the scope of the present research. In the trails model, meaning is made and knowledge is constructed by connecting these individual learning objects into a coherent – usually narrative – representation. This includes the steps of trail 'enactment' or capture, editing, reflection, and sharing – creating a circular process.

However, the theoretical trails work so far has focused on trails as the passive result of a learner moving through a knowledge space. My research seeks to add an explicitly constructionist element, so that learners actively create trails for other people; thus the trail serves not only as a process but as a learning product made comprehensible by the trail

creator, and also as a 'tool for thinking' which prompts the creator to reflect on the task and the content to be collected.

This research is also informed by other research conducted in the Kaleidoscope network, specifically in the following activities:
• the Mobile Support for Integrated Learning project;
• the Mobile Learning in Informal Science Settings project;
• the Philosophy of Technology Enhanced Learning SIG (which has focused on mobile learning);
• The Kaleidoscope mobile learning initiative; and
• the Narrative and Learning Environments SIG.

My research is focused broadly in the area of science, with the following general research questions:
• Are digital learning trails effective for recording, analysing, interpreting and sharing data?
• Are digital learning trails an effective means for recording and testing hypotheses?
• How does the use of web-linked mobile technology change the process of the above activities?

While this is focused on a particular technological intervention, the focus is on the structure the entire activity system, which includes but is not limited to, the technology. That said however, the technology, in use, can change the activity, and even the nature of knowledge itself.

Methodology

In the trials described here, pictures, audio recordings and text are captured during a visit using a mobile phone. Using special software described below, the data are automatically uploaded to a web site where the captured trail can be edited, added to, and re-ordered in a way meaningful to the visitor. The trail can then be shared with others, as either an online or classroom presentation.

The captured data is analysed in relation to the task, and its relative quality in relation to the task. In addition, the trials were recorded with video, audio and photos, and this is treated as data - specifically footage and photos of students using conducting activities and using the system, and more importantly, students' conversations as they conducted the activities and used the system. This is augmented with interviews with the teachers, venue staff (in this case, educational coordinators at the botanic garden), other participating researchers, and the developers of the system, in order to attempt a comprehensive picture of the trials.

I have been collecting informal data from adult visits to museums since January 2006. An initial assumption was that automatic capture of location information would be important; in practice this appears to be irrelevant in many cases. For example in museums a thematic trail is more useful. In sites such as botanic gardens however, the location of particular plants, for example, can be important.

Focused trials began in June 2006. Four classes of school children aged nine to 10 visited Kew Gardens, a large botanic garden in London. Each class visit occurred on a different day. Each class was put into groups of four to five students, and each group given one mobile

phone containing software enabling them to easily capture photos, audio and text, all of which was automatically sent to a web site.

This service is called My Art Space (http://myartspace.org.uk). It has been used in other UK museums and schools, and has been evaluated by the University of Birmingham. It has been approved as a tool for use with the UK national curriculum; for younger learners this is related to the skills of collecting and noticing, and for older ones, investigating and collecting evidence. It is assumed that teachers will structure visits and in so doing influence what students create. Further evaluations are taking place in Portsmouth, UK, in which students are creating trails for younger students to follow.

Using museum metaphors, learners capture 'objects' (in the form of photos, audio or text) which are automatically placed in a linear 'gallery' which provides a minimal structure for linking them together thematically. New objects can also be created at the site, and photos and audio files can be uploaded or copied from teachers' or other students' galleries. Galleries can be further customised somewhat with regard to colours and fonts.

This service was created especially for museums, and its broader use in botanic gardens and school field trips may require different types of representations of user data. In fact the service is currently being re-branded as 'Ookl' (an anagram of 'look') to fit this broader focus. For non-museum uses, however, the museum metaphors have been sufficient; though it was not created specifically with trail theory in mind, the representation of learner-collected data in linear (though editable) galleries makes it appropriate for studying learner-constructed trails. The results from this research, in turn, are generating recommendations for further enhancements of the service. (I have no direct connection with the developers however, and the service is being used for research purposes only; the research is not restricted solely to this service.)

Learners can also 'collect' objects that the museum (or botanic garden in this case) has tagged with two-letter codes. When a learner selects 'Collect an object' on the phone and enters a code, the phone downloads information that the museum has entered for that object. This is meant to provide additional explanatory or contextualised information about museum objects one the phone.

Teachers can create their own galleries, and each class has its own 'store' containing all the objects created and collected by students, which they can all access. Students can copy teachers' or other students' objects to use in their own galleries; in such case this is made explicit and the student is asked to justify/explain why they are copying it.

Results: Initial data collection

Beginning in January 2006, adult visitors to museums were asked to record trails of objects or exhibits they visited, using text or audio recording. This proceeds from the hypothesis of Peterson and Levene (2003) that captured experience trails can support informal, lifelong learning. The data being collected is unstructured and informal, but indicates that unless framed with a specific focus and manageable scope, trails will not be used, much less used effectively, for learning. This finding concurs with Fritsch (2006) that museum visitors are more likely to create meaningful content when given discrete and focused tasks, not open-ended ones.

Another finding that emerged from this informal data was that location did not matter in many cases; what was important was the learning objects and the thematic links between them, not the geographic links. Related research by Nova et al (2005, 2006) shows that location was not important in other mobile contexts.

Results: School trials

In the trials with schools in June 2006 at Kew Gardens, the focus of the school visits was on food plants. Particular activities were devised before the technology was introduced – identifying the parts of a plant; sorting vegetables into plant parts; finding plants in the same family in the vegetable beds of the garden; and making up a drama, poem or riddle about a particular plant (without mentioning its name) for other groups to guess the plant. The first two activities were indoors, the others were in different parts of the garden.

The ability of My Art Space to add photos and text in addition to audio was thought to be important at a botanic garden – where images could help with plant identification for example. The 'collecting' capability of My Art Space would provide access to photos and data uploaded by the Gardens staff.

The four school classes collectively uploaded more than 700 individual objects. The collected objects for each group were plotted chronologically in a spreadsheet and classified by media type and whether task-related or not. [These spreadsheets can be included as an appendix if necessary; photos could also be included.] No attempt is made to quantitatively measure learning outcomes; the main goal has been to assess qualitatively how data was captured and used. Generally, students were able to easily use the technology in meaningful ways. There was concern by the Kew education staff that the technology might interfere with learning – a similar concern usually expressed by museums – but in fact, it was agreed afterward that this was not the case.

Overall the students loved using the phones as a tool for scientific investigation. There were a few cases in which boys tended to dominate the devices, but adults tried to ensure that everyone had a chance to use them. Each group of four to five students had one phone, and generally shared them around; in some cases a group delegated one student to record everything. One surprising finding was that the number of phones provided was deemed sufficient. If we had had enough phones we would have given one to every student, but the teachers said afterwards that such a 1:1 ratio of device to learner would have discouraged group work.

The audio recording facility proved – surprisingly – to be the most popular, and the most useful. Teachers praised the function because children could easily input information – especially those who might have difficulty in writing. Teachers and students also appreciated the fact this was a much quicker way of entering information than typing text – an important consideration in any mobile context.

Students used audio in different ways – sometimes individually recording their observations, sometimes conducting interviews with each other. Each audio clip could only be 15 seconds long, and students treated this limitation in one of two ways. Some students (especially girls) would carefully script and rehearse their recordings, while others (especially boys) would simply press record and if they didn't like the result, discard it and start again. Audio

recordings had to be played back before uploading, and students were thankful for and amused by this function.

Audio was particularly effective when used collaboratively – for example when two people had a conversation or shared their impressions about a particular plant. Some students (especially girls) also interviewed each other. This form of journalistic inquiry appears particularly effective in constructing trails for others to follow; preliminary data from another ongoing trial of My Art Space supports this.

Many pictures were taken – of other students, of vegetables, of other plants encountered and sometimes of information panels. Photos generally fall into four categories: those taken to record information for retrieval later; those taken merely to capture the experience of the day; those taken for use in constructing narratives; and miscellaneous – including tests of the camera and pure play. One teacher said she appreciated the ability to take photos because she would not have been able to provide enough digital cameras for the students.

The 'Collect an object' capability was used in the trials, with plants in each of the taxonomic families (carrots, tomatoes, mint, etc.) being tagged with information that could be downloaded. Both students and teachers particularly liked this function. The collected objects appeared in students' galleries.

Collecting is also a means of location tracking, since the location of tags is known. The tags were particularly useful in the outdoor activities; one activity had the students explicitly looking for individual plant traits among many unknown other plants, and the blue and white tags were much easier to look for than particular traits; most children are unused to identifying plants because plant science in schools can be very limited. Additionally, tags made it easier for children to share the location of plants.

Students learned very quickly how to use the mobile phones. There were some inevitable technical problems, with the software sometimes logging out unexpectedly for example. Generally the software is simple to use and there is no easy way for students to access the phone's other capabilities (the phones were restricted from making calls and sending text messages). At the start of one day, a student asked me how to take pictures; before I could answer, one of his classmates grabbed the phone and showed him.

Each time an object is captured it is uploaded, which can take up to 30 seconds; the developers have already planned to make the uploading occur in the background. A related issue is that everything captured cannot be accessed again on the phone, only on the web site. In the drama activity, students captured data as part of research to be used again later that day, but could not access it from the phones.

Both students and teachers wanted to record video, or at least audio together with photos (currently an 'object' is comprised of only a photo or audio clip). To my knowledge no one asked about the ability to communicate with other students over the phone or access others' data, but this capability has been suggested by the developers. It may be useful in collaboration scripts (discussed below).

Results: Adult trial

In September 2006 a trial was conducted at Kew Gardens with 13 adult students studying for a Diploma in Botanical Horticulture. These students were from a very diverse range of countries representing Africa, Asia and Europe.

I designed a task to exploit this broad cultural experience, and also to address the shortcomings of the previous trials and lessons learned. With the focus on food plants as before, students were asked to visit the vegetable beds, choose 6 to 8 plants, and for each, record one photo and one audio clip which was a conversation about how they used that plant in their home country. This did not proceed from an existing CSCL script, but falls into the general class of 'shared regulation scripts' identified by Stegmann et al (2004) in which learners plan, monitor and regulate their own cognition, motivation, behaviour and context.

Since the goal of the diploma course is to enable students to effectively deliver education programmes in their own countries, this trial was not designed to teach an aspect of botany but to act as a 'tool for thinking' to help them reflect on the process of creating their own educational materials for visitors. As such, the product they were asked to create was a multimedia tour for visitors, focusing on food plants.

The 'collecting' function was not used, but it was explained that at each stop, visitors would be able to download the content that the students were creating.

The students worked in pairs, with one phone per pair. This was intended to exploit the benefits of conversations observed in the previous trials. Since each diploma student was from a different country, this also provided each pair with two diverse sets of cultural knowledge.

The students spent one hour in the vegetable beds recording data, then one hour in the garden's computer lab editing their trails. The trails were then presented by each pair to the rest of the class. Trail editing and sharing steps were explicitly included to address a major shortcoming of the previous trials – that captured data was not revisited by the classes after their visit. Although the captured data in the previous trials was plentiful and substantive, it was not possible to plan for the successive editing and sharing steps. Thus in the adult trial the editing and sharing was to be done at Kew Gardens, directly following capture.

Collectively the students created a total of 101 objects. Though the focus of the task was quite narrow, the pairs were creative in constructing the resulting trails. For example, one group themed their trail as 'making a salad,' while another focused not on food-related uses of the plants but on medicinal uses in each country.

The structure of the task – specifying one photo and one audio clip for each plant –addressed the problem of decontextualised objects resulting from the previous trial. A trail which is merely captured but not revisited and edited simply does not make much sense without some additional interpretation. The My Art Space system allows learners to enter text when they capture a photo, but this facility was used for only a handful of the hundreds of photos uploaded in the school trials. Although the photos and audio recorded in the adult trial appeared as separate 'objects' (a shortcoming of the My Art Space system), the student pairs were able, in the editing process, to ensure that they were at least placed in the right sequence. More importantly, a great deal of text information was added to each photo during the editing process; some pairs augmented this information with internet searches, and one even added

Latin names of the plants. The resulting trails are generally coherent and stand alone as narrative threads.

Discussion and next steps

Research in cognitive psychology (Moreno and Valdez, 2005; Mayer and Moreno, 2000) shows that audio is a more effective mode than text for delivering information related to a visual object under study. Smith et al (2004) have shown the effectiveness of museum audio tours in this regard. The present research suggests its effectiveness not only for delivery but also as a constructive tool for learning – particularly in collaborative situations. The value of conversations is well known in museum learning (Allen 2002; Leinhardt et al, 2002; Hensel, 1987). In mobile learning specifically, learning is perceived as being as much about conversations as content (Sharples, 2005; Taylor, 2003). This could be seen directly in the Kew Gardens trials in the students' recorded conversations.

Gibbons (2006) says that the problem of learning objects is not a matter of finding and sequencing them, "but it is really a problem of *the instantaneous computational design of a conversation* intended to support learning through different types of events that accomplish story-telling in which the learner participates" (his emphasis). "Every bit of information in an instructional communication," he says, "is really just a new brush stroke on a larger painting of a system that is in progress." Just as a painting tells story, he says, so does a 'system', and the goal of education is to bring learners into the process of storytelling; learners' stories tell how much they know about the 'system' under study. By 'systems' Gibbons refers mainly to cause-effect systems – of which botany is a good example.

The trails created by the 9-year-olds were structured only by questions on printed worksheets prepared by teachers, which were not directly related to the mobile phone technology introduced. The most relevant data uploaded in those trials appears to have come from planned and self-structured collaboration within groups. Such collaboration could be further structured to stimulate productive interactions through the use of scripting. Kobbe et al (2003) have detailed the specification and standardization of such collaboration scripts, and they have been used in mobile contexts (see Stegmann, 2004).

Journalistic inquiry appears to be effective not only as a method but as a product of the trail capture, editing and sharing process. Future trials may frame tasks in terms of news stories or audio podcasts to be created and shared. A traditional journalistic approach utilises structured interviews to collect multiple viewpoints on a given topic, and frames a product as a structured narrative in an 'inverted pyramid' style in which the most important 'who, what, where, when, why, how' information is given at the start. A collaboration script may support this process by assigning roles to students (interviewer, interviewee, writer, researcher, fact-checker, editor); and by structuring tasks (interviewing, researching in a library or online, editing, etc.). This could be derived from a 'jigsaw' script in which different roles are assigned different parts of a larger 'picture' and must work together to put the pieces together. (Aronson et al, 1978)

The 'collecting' facility in My Art Space could be used not just for downloading relevant object data, but can pose questions, or specify scripted tasks or roles at each tagged location. The tagging ability also can also act as a form of location tracking, since the locations of tags is known; if 'collecting' is used at each step in the trail, this results in a trail of physical

locations as well as of subject-specific data. In sites where location is relevant for learning, this would conform more closely to Peterson and Levene's (2003) original trail theory.

Future work is expected to study the technology in relation to learners' formulation and testing of scientific hypotheses, specifically in the area of physics.

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