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Learning Bridges: a role for mobile technologies in education

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In 1963 the science fiction writer Brian Aldiss wrote a short story for a children's science annual[1] about a world, thirty years in the future, where children learn through guided project work rather than formal schooling. The fictional London Educational Authority funds a trip for Jed, a 13 year old boy, and his father to Antarctica to survey the melting glaciers: "The sad masses of rock were heavily scarred where the ice flow had once rubbed them, for in this year of 1994, the glacier was smaller than it had been even a century ago."

Looking out over the ice floes, Jed adjusts a little apparatus behind his right ear that offers him immediately-relevant information about the world as he explores:

> "It was a simple thing to do. Many of the parts of the miniputer were synthetic bio-chemical units, their 'controls' built into Jed's aural cavity; he 'switched on' by simple neural impulse. At once the mighty resources of the machine, equal to the libraries of the world, billowed like a curtain on the fringes of his brain…Its 'voice' came into his mind, filling it with relevant words, figures, and pictures.
> … 'Of all continents, the Antarctic has been hardest hit by ice.' As it spoke, it flashed one of its staggeringly vivid pictures into Jed's mind. Howling through great forests, slicing through grasslands, came cold winds. The landscape grew darker, more barren; snow fell."

Although the story is fanciful, its basic premise is sound. Children learn more effectively when they are in a more challenging environment than a school classroom, when they are investigating an open question of real interest (for Jed, the consequences of global warming[2]), when they are accompanied by an adult guide, where mobile technology gives them rich and relevant information in context, and where they can make connections between formal knowledge and personal experience.

Mobile computers are not yet controlled by neural impulse (though labs are working on it[3]) and the funds of UK education authorities can only stretch to school trips to the local museum, not Antarctica. But a project called MyArtSpace, funded by the UK Department for Culture Media and Sport, is today exploring how children can engage in similar enquiry-led learning supported by mobile technology and how this can link to school and home learning. Using MyArtSpace as an example, we discuss the possibilities for mobile technology to form bridges between formal and informal learning. We also offer guidelines, drawn from our experience with MyArtSpace, for designing such bridges.

MyArtSpace

MyArtSpace is a service for children to spread their learning between schools and museums using mobile phones linked to a personal web space. It currently runs in three UK museums: the Urbis museum of urban life in Manchester, the D-Day museum in Portsmouth, and the Study Gallery in Poole. It can be used for informal learning, but is best suited to school field trips. The aim is to make a day out at the museum part of a sequence that includes setting a big question in the classroom, exploring it through a museum visit, reflecting on the visit back in the classroom or at home, and lastly presenting the results. The technology provides the essential link across the different settings.

The teacher starts by planning a class visit to the museum, consulting the MyArtSpace Teacher's Pack to prepare the trip. Typically, the teacher sets an open-ended question that the students can answer by gathering and selecting evidence during the museum visit. For example, Key Stage 3 (US Grade 6-8) students from a history class visited the D-Day Museum which interprets the Allied landings during World War II. Their task was to collect evidence on whether D-Day was a triumph or a disaster for Britain.

At the museum, the students are given multimedia mobile phones and each student keys in a personal identifier. Then they can explore the museum in any way they choose. They can 'collect' an exhibit by typing a two-letter code (shown on a printed label beside it) into the handset. This then shows a multimedia presentation on the phone and also automatically sends an image and description of that exhibit back to the online store on their personal web space (see Figure 1a and 1b). The students are prompted to type in their reasons for collecting, encouraging them to reflect on what they see in the museum in relation to the big question they are trying to answer. After collecting an object, the students are shown a list of who else has collected it and prompted to find and talk with them face-to-face. In addition, they can use the mobile phones to create their own interpretation of the visit, by taking photos, recording sounds, or writing text comments (see Figure 1c and 1d). After each action the phone sends the picture, sound or note to their online store.



(a) (b) (c) (d)

Figure 1. *MyArtSpace mobile phone interface: (a) collecting an object, (b) multimedia presentation about a collected object, (c) main menu options, (d) taking photos*

Back at school, or at home, the students can view their personal collections. Each student's web space shows a record of the visit: the exhibits they collected, the

pictures they took, sounds they recorded, notes they wrote. They can also see the collections of other students in the class, and can add items from them to their collection as well as items from an online store provided by the museum.

The students can organise their collections into personal galleries (like simple web-based presentations), to present in the classroom or to share with their family (see Figure 2). Access to the web space is password protected, and the content published by the students is moderated to ensure privacy protection and appropriate use.



Figure 2. *An example student gallery*

MyArtSpace is now a fully working service that has been used by over 1500 students on visits to the three museums. It is also being trialled in other museums and outdoor sites. Our early evaluations of the service have collected positive feedback from students, teachers, Local Education Authority representatives and museum educators. This indicates the value of the service as a way to provide children with meaningful, engaging and enjoyable experiences of museum visits, complete with tangible outcomes that they can take away with them and work with after the visit:

> "The day was of tremendous benefit to the pupils and their history studies. The mobile phones were easy to use and the children were quickly off exploring the museum and making their own collections. I have not seen pupils so engaged or enthusiastic on a museum visit before." (teacher, D-Day museum)

The way the 'collection' of museum items takes place encourages students to stop and think about each exhibit: what is the exhibit about, and how does it relate to their learning task?

> "Made me look at artwork more ... Most people think going to galleries is boring, but when you put ideas on a web site and use the phones it's much more fun." (student, The Study Gallery)

By following up the visit online, the students' interest in the museum topic is increased as is their motivation for related learning. This is what makes MyArtSpace different from other multimedia museum guides: that it connects the museum visit to

the classroom and to the children's home, so that the visit becomes part of a sequence of planning, engagement and reflection, rather than just a fun day out.

In this way, the mobile technology of MyArtSpace is used to bridge the children's experiences of different contexts, media and content, leading to an integrated learning experience across formal and informal settings. The various bridging roles of mobile learning – at least as important as the delivery of teaching content onto small screens – will be examined in the following paragraphs along with suggestions about how to design for them.

Designing technology bridges: divide and conquer

A successful learning activity should be integrated with other learning events, building on them and contributing to their outcomes. Likewise, successful mobile learning activities should be seamlessly integrated with other types of learning activity. Systems like MyArtSpace do not confine the learning experience just to interactions with a mobile device. Rather, they make use of highly mobile devices for the part of the experience where they bring the most value (e.g. for data collection in the museum, where the use of fixed technologies is impracticable and the use of traditional media such as pen and paper is cumbersome). The mobile device is then used as a bridge to technologies used in other parts of the learning experience (e.g. the exhibits, installations and printed media available in the museum that trigger reflection and inform data collection, or the Web-enabled ICT suite at school used for data analysis).

This is a wiser use of mobile technology than an indiscriminate digitisation and 'mobilisation' of all learning activities. For example, it would in principle be possible for students to use a web browser on a mobile phone to organize their personal MyArtSpace collections. However, a desktop PC is a better medium for students to manage their large collections of multimedia objects, collected through the mobile phone in the museum. Moreover, most schools in the UK are already equipped with desktop PCs in ICT suites, so taking advantage of existing technology and infrastructure is more cost-effective.

Deciding which type of technology to use should be done by 'divide and conquer'. The learning experience needs to be broken down into a sequence of activities and the following questions answered for each activity:

1. *What will be the location of the activity?* Will it be taking place in the field, in the classroom, or in the lab? Will it be indoors or outdoors?
2. *What are the human factors of the learning activity?* Does it involve physical movement and interaction? Will the learner's hands be otherwise occupied? Will the learner be standing, sitting, moving?
3. *What technology is already available?* Are there PCs, laptops, PDAs or tablet PCs, available? Do the learners bring their own devices that they are willing to use? Is there a network infrastructure already in place?
4. *What are the technical requirements for the user interface?* Will the user need to manage complex collections of data that require a large amount of display estate to be represented properly? Are there specific requirements for input/output form?

5. *What is the cost of transition from this activity to the next one?* Will the learner do another activity immediately after that will require them to switch to another device? How smooth can the switch between the two be?

Designing technology-activity bridges: put mobility in the learning experience, not only the technology

The design of educational technology of any kind needs a good balance between the technology and the education, and the same is true for the design of mobile learning systems. Although it is relatively straightforward to design a piece of technology that is usable, robust and delivers impressive functionality, the experience should go beyond the technology, with clear purpose for the teaching and learning.

In the case of MyArtSpace, the design of the mobile phone service and the web portal that hosts the students' collections went hand in hand with the design of the three-stage learning experience (in the classroom, in the museum, and back in the classroom). Teachers, educational consultants, museum educators and Local Education Authority representatives were involved throughout the design of the system, providing expert advice on the kind of functionality that would be useful and shaping the template for the learning experience that would make use of that functionality.

Moreover, it is important that teachers are given the chance not only to adopt the designed system, but also to customise it for their classrooms. MyArtSpace implemented this through Teacher's Packs, a set of materials that describe the potential of the technology and make suggestions for activities. The teacher can then use these as a starting point to plan in detail a learning experience for their class that matches its teaching style, objectives, and background.

Designing learning space bridges: acknowledge and respect all learning spaces

MyArtSpace allows visitors to interact in three spaces: the physical space of the museum which they explore; the personal space on the mobile technologies that they use to collect and create items of personal interest; and the virtual space provided by a web portal that stores their collected items and additional resources for them to organise, share and present.

In designing the system, debates over how much of the experience should take place in each of the spaces had to be resolved. For example, when collecting an item in the museum, the student receives a list of other students who have also collected that item. Although it would be possible for the system to also display the other students' reasons for collecting that item, it was decided instead that it would only display a suggestion that the user might want to talk to them face-to-face – the rationale being that if face-to-face interaction is possible, then encourage it rather than replace it.

Decisions need to be made about when and where to make interactions in each space possible. For example, should the students be able to access their online collections whilst in the museum? What would be the price for an additional interaction space? As trials of mobile museum guides often show, there is a danger that the visitor's attention is drawn to the mobile device completely, at the expense of the rich museum

environment. MyArtSpace therefore limits interactions in the virtual space outside the physical context of the museum.

Such design decisions discourage immersion in one learning space at the expense of the others. The technology that enables interactions in the personal and virtual spaces should be there to augment the experience in the physical space of the museum, not to 'swallow' or replace it without good reason. A good reason for technology to replace the physical experience might be when the student involved has particular special needs.

Designing context bridges: fill in the gaps between museum, classroom, and home

Many visits to museums and other similar school trips involve giving out numerous pieces of paper to children who will inevitably deface, tear, and possibly lose them before bringing the tattered remains into the classroom. MyArtSpace provides the means for children to end up with something less fragile and more engaging than a sheet of scribbled notes. Everything they collect in the museum automatically ends up being part of a meaningful artefact that they take away from the museum and then put to good use in later classroom sessions. The best thing is that neither the children nor the teachers need to put in any effort to make sure that this happens; the system just does it by default. One of the teachers at the D-Day museum in Portsmouth enthused about how MyArtSpace meant that the children's work wouldn't be lost on the bus on the way back to school – a real tangible benefit over visits without MyArtSpace. In this way, mobile learning technologies can help us build much needed bridges between different contexts and different learning spaces. It's hard to move museum experiences back into the classroom, but MyArtSpace shows us one way to do just that. The children ended up with something real to work with back at school. More than that, they then worked to produce something lasting that could be shown to their friends and family. The benefits go beyond simple mobility of artefacts - learners are able to continue their learning experiences across different locations and contexts.

Conclusions

In conclusion, the image of mobile learning in education is slowly crystallising into a picture of a learner enabled to not only use new technologies, but also to perform new activities with them; and of an educator who can not only put lots of learning 'stuff' in a mobile gadget and hand it to their students, but also to plan new learning experiences for them. Mobile devices can form steady bridges between technologies, contexts, experiences and learning spaces.

As Brian Aldiss might have written:

> "It took just a moment. The mobiphone seemed made for him. Jeff tapped in the two-letter code written beside the exhibit and waited just a moment. Somewhere, far away, a massive electric-library sprang into life, fetching just those pictures and words that would give meaning and context to the battered soldiers' boots in the museum display.
> ...The machine let him explore on his own, or with his friends. It never disapproved or got cross, but was always ready with the most helpful facts

and pictures at that moment for his age group. When he needed to ask questions, the teacher was there to help. Best of all, when he got home he could show everyone what he'd seen—he was curator for a day!"

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[1] Aldiss, B. (1963) The thing under the glacier. C. Pincher (ed.) Daily Express Science Annual No. 2, Norwich: Beaverbrook Newspapers Ltd.

[2] In this story, Aldiss not only predicts the concern about global warming, but also personal computing in the 1970s ("it wasn't until the great developments in microtechnology in the seventies that portable computers were made") and mobile computing in the 1990s.

[3] See e.g. http://en.wikipedia.org/wiki/Brain-computer_interface