# Learning outside the Lecture Space

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**Statement**

Modern technology can enable enhancements with the learning journey of architects and architectural technologists.

**Context**

This paper is reporting on pedagogic development enabling students to take the virtual into the real world on their mobile devices. By the use of this development engage in the real world space to discover richer learning supplemented and enhanced by the learning outside the lecture space.

Schon's 'pedagogic space' was the design studio, the proposal is to use geotagging and QR coding of buildings to create a new pedagogic space. The 'pedagogic tool' Schon describes to simulate architectural design problems, is replaced by web based information for reflection. Finally where Schon utilised 'pedagogic method' of learning design artistry via coaching from tutors, the proposal allows for learning to occur whilst 'within the architectural capital' that is the built environment of the campus.

**A new currency in learning**

The study analyses the impact of a new method of architectural teaching and the medium of exchange to ensure what is learnt in the architectural lectures and nurtured in the design studio is linked with the 'actual and physical' architecture that surrounds these very students. The cohorts of today's architectural schools are far more technology savvy than any previous generation. What was once researched in University library's from large well bound tomes on architecture are now in many cases replaced with clicks on keyboards or swipes on a screen to access the same information. This speed and ease of accessibility has become the accepted norm. The pilot was based at Northumbria University and focused on assessing the pedagogy of architectural teaching and the increasingly needs to address the 'currency' of learning and teaching in terms of modes, moving towards the profound. The mode of learning within the pilot allowed for new meaning in changing situations and contexts; developing a holistic appreciation of the relationship between themes, subjects and principles. The assessment is through personal authenticity and integrity.

**Methodology and tools**

The mode of a shared knowledge resource with functionalities that allow for real time access and interaction was formed, as the primary stage of the study, by the development of a website ran from a collaborative server within the University. This allowed for the content to be amended, uploaded by staff and then accessed by the cohort at anytime on or off campus. This approach was tested and assessed for future curriculum development by various schools within the University on a roll out basis. This format allows the students to become reflective learners and for them to observe and realign their learning at any point during their day, including their journeys around or to and from campus. The structure of each webpage allowed for a mixture of pedagogic content on architecture and its associated technology from lectures.

QR codes or Quick Response / matrix barcodes (or two-dimensional bar codes) were first designed for the automotive industry in Japan by Toyota, a subsidiary of Denso Wave in 1994, and have been used in media subsequently. By locating a series of QR code tags on buildings around the campus the cohort the pilot allowed access to web pages on the physical buildings. It allowed experience in real time that which was to be discussed in the lecture for that week. Additional learning material was accessible on the lecture subject via the student using a freely available QR code reader app on their mobile devices. The QR could then be scanned and would then direct them to the webpage's relating to that building typology. This 'live learning' allowed for a direct correlation between what was learnt in lectures to be reflected upon as they walked around the campus and its buildings

This paper aims to:

- Create an understanding of the current context for mobile learning outside of the lecture room.

- Assess the pilot study completed in 2012 and the outcomes from the data collected.
- Review implementation issues of the study to assist others who may wish to create their own mobile learning methods.

**Mode of teaching to match mode of culture**

The term 'podcast' derives literally from a combination of Apple's iPod and broadcasting , but its accepted meaning is a radio show or any audio-based object such as narrative, lecture, individual or group presentation that is made available through the World Wide web (Morales & Moses, 2006). This pilot study was developed from the notion of gaining the most productivity and learning within a lecture. To get the most from the lecture the cohort were required to blend external enquiry with the traditional pedagogy of the lecture. The approach to support teaching using mix mode delivery was supported by Fernandez et al. (2009). Fenandez argued that podcasting could be used to complement and build upon existing teaching resources. Jarvis & Dickie (2010) argued that an enhancement such as podcasting would improve support of enquiry-based and independent learning. However it was also shown that shown that in order to be successful they must be flexible and adaptive to a variety of pedagogic contexts.

Annual surveys on mobile phones use are now common place, these show common trends in use and map the increases in potential new needs from the users of these devices. Mobile internet usage has increased considerably from 2009 and is predicted to overtake fixed internet access by 2014. In January 2013 the number of mobile devices moved through the 4 billion barrier, with a reported 1.08 billion of these devices being smartphones. When carrying out feedback sessions at the end of this pilot the cohort reported that 34% used QR tags regularly to download links or coupons from posters or magazines. Looking at the amount of time the cohort used their mobile devices during the learning day on campus they reported an average of 2.25hrs use. These results were then further queried by asking the cohort to compare their mobile use against use of a University PC on campus. The cohort reported that 62% would default to using their mobile devices to access the intranet or module information. The remaining 38% stating that PC access would be dependent on their location in relation to available PC's on campus.

The speed of access to learning material and, how flexible its format is to allow varied consumption by the student, is the key to any proposed format. This was reflected in the format of the 'explore' pilot website. Allowing learning on the move or during the students commute is an increasing necessity and becoming a prerequisite of their learning.

**The pilot study**

The pilot was completed in 2012 using a Construction Technology module as the basis for assessing the impact of mix mode learning from lecture to mobile learning and overall enhancements in learning and understanding by the cohort. The study group consisted of students in their first year of their degree within the Department of Architecture and the Built Environment. The group comprised of 137 students (115 male, 22 female) 86% were white, of British or Irish origin. All of the students were aged between 19 and 26. The (LO's) learning outcomes related specifically to this exercise were that students upon completion would be able to:

1. Describe and analyse the functional and performance requirements of framed building elements.
2. Compare, contrast, specify and illustrate the technologies that are used to construct framed building elements.
3. Appraise, specify and illustrate the technologies that are used to repair and upgrade framed building elements.

The presentation materials, including power points, were amended to allow for inclusion of QR tags on selected slides. This addition allowed those in the cohort who did not own a smart mobile device, to access the web pages and the additional learning material.

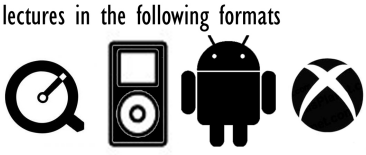


Fig.1. All lecture material via power point contained the logo above to indicate that the material was part of this pilot study.

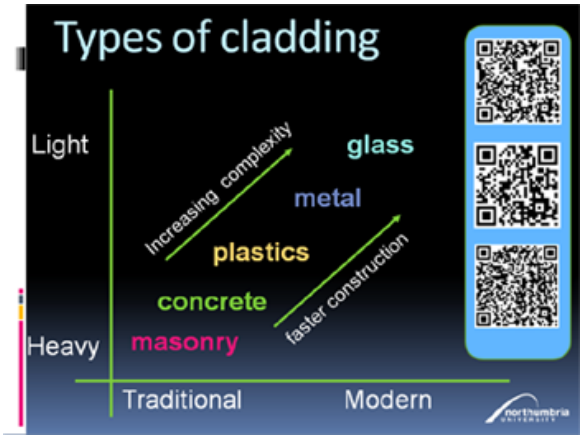


Fig.2. Example of power point containing QR tags to indicate to the cohort further learning material was available.

The pilot was conducted over ten weeks of a twelve week semester, with the questionnaire and feedback sessions held in the final two weeks. Each weekly lecture contained QR tags within the slides, with the presentation being uploaded onto the University e-learning portal (eLP). The additional learning material was held on web pages within the explore website. The campus and its buildings has evolved from the 1960s to present day and consists of various types of buildings from this period. These rich mixes of building typology were employed as examples of construction, materials and detailing to aid the lecture series. Ten buildings were chosen to reflect the lecture topics. All ten locations were explained to the cohort at the beginning of the pilot. The additional learning material was accessed in two ways: 1. the student could use their smart phone to scan the QR code located on the building; 2. Students without smart phones could access the additional learning material by using a static PC from a number of existing locations around the campus, including the library the hub and student's union building.

Accessibility to learning materials was a key aspect of this pilot study, this required consideration of the possible devices and operating systems. The scoping study of these devices from the cohort is outlined below.

Mobile devices as follows: iPhone ; Galaxy, Blackberry, Jelly Bean, HTC, Sony Ericsson, Nokia, Motorola, Samsung

Operating Systems: Apple IOS, Andriod, Bada, Mobile Linux, Windows Mobile, Symbian OS.

The variety of mobile devices and potential of formatting and accessibility problems required a design for the learning material that could be accessed from all of these devices. It was this fundamental requirement that culminated in the use of web pages and a website. The 'explore' website was run from one of the collaborative servers within campus. This allowed easy access to upload and amend pages as the pilot study evolved.


Fig.3. Webpage of expLORE allowing access to mobile learning pages, for cohort with no access to mobile devices.

When scoping the general requirements prior to roll out of the pilot it was understood that the use of mobile phones and their development occurs at a rapid rate. An example of this rapid rate of change is the fact that during the ten weeks the pilot was underway two new 'apps' were launched that allowed more immersive interaction with learning material using augmented reality. The use of QR codes as a medium for directing the cohort to the learning material was chosen for this study due to their fast scanning ability, ease of readability and greater capacity over the Universal Product Code (UPC) barcode. Using the QR codes had the additional benefit to users, allowing for scanning to be achieved using freely available software or apps for all of the current smart phone and mobile devices.


Fig.4. Differing format for data transfer - Barcode and QR Code

**Outcome of pilot**

Analysing the data it indicated in the initial weeks of the study the uptake was slow to occur with 32% of the cohort downloading the required scanning apps to their mobile devices to access the learning material. However, the benefits of the learning resource on this small percentage of the group began to bear fruit, with marked improvement within seminar groups (3 out of 6 weekly seminars by week 3) in understanding the material with evident external learning taking place. This view is supported by Prensky (2009) who proposed that a student preference for experiential and technology-led learning can due to motivation that occurs when a different mode of learning is used, in this case technology and QR tags. This increase in uptake and use of the QR codes increased steadily until it reached a plateau at week 7.

The cohort with mobile devices drove the increase in usage of the additional learning material. The cohort without smart phones were the most reluctant to access the learning material. During the feedback and assessment sessions in weeks 11 and 12 of the semester, this slower uptake was predominantly due to the lack of ease for accessing the material. When questioned, the smart phone owners of the cohort agreed that the 'point and click' process of the QR tag scanning from campus buildings was more preferable.

This response was further examined in terms of preference over PC access. The overwhelming opinion was that the building could be 'experienced' whilst accessing the learning material, with a ready connection made between the two (the building and the learning material). This finding directly correlates to the findings for distance or self directed learning in distance education. New models of teaching are making it possible to increase student engagement, productivity and motivation (Beldarrain, 2006). The act of listening to learning material whilst not necessarily being on campus also appealed to the majority of the cohort. It was agreed that 'making more of your commute' was recognised as a benefit and a view supported by Salmon & Nie (2008), who suggested that podcasts can offer flexibility in teaching and learning to support a diverse student population through their university experience.

**Results**

On completion of the pilot the cohort were asked to complete a questionnaire to assess the outcome of this mode of learning. The questionnaire was completed by 89 of the 137 students. The responses included 65 of the 83 students who owned smart phones. The group therefore comprised of 58% of smart phone users and 42% of non smart phone users.

Initial questions were aimed at assessing the types of learning the cohort used currently. A total of 71% of the cohort accessed online books and journals from the reading list for the module subject. However this was balanced with 81% of the cohort also using the library resources on campus. Northumbria University provide all students with access to the e-learning portal (eLP), this study indicated that 89% of the cohort use this resource on a weekly basis. As this pilot was a test bed for using QR tags and mobile learning there were a number of technical hurdles that required navigation, see lessons learnt below. The overall experience of using the learning materials via QR tags as a mode of learning was recorded as 'interesting' in the verbal feedback sessions and recorded an increase in student engagement with 67% of the cohort making a preference for future modules to have this teaching-learning format. To further explore the appeal of the pilot the cohort were as to indicate how the material on the explore website was used. A resulting 29% of the cohort stated that this learning has increased their understanding of the material in a more coherent manner. As a revision tool, 57% of the cohort responses agreed that this method of learning would be useful for revision of the module topics, with 28% responding to the material as a positive improvement to a overall understanding of the subject. However, 14% of the cohort did not feel that accessing the information helped them in any further understanding of the subject. The cohort were asked if they would want to have this format rolled out to other modules within the curriculum, of which 72% agreed that this would be preferable. The navigation of the web pages was also considered in terms of format and ease of use on mobile device screens (see consideration 7 below).

**Lessons learnt**

During this pilot study a number of useful findings were made in relation to the use of QR tags within power point presentations, using QR tags in location (on or within buildings) and using freely available 'apps' for mobile devices. Below

are a list of considerations that are valuable to those reading this paper and thinking of carrying out further use of this method of mobile learning.

**Consideration 1:**
Consider the printing of QR codes, the timescale they will be used and their location. During the study several instance of scanning QR tags were noted. Investigation of these during the study revealed that 'sealing' the QR tag in a shiny surface, such as laminating the tag for external use, rendered the tag unreadable on sunnier days. **Consideration 2:**
The lamination of QR tags rendered them unreadable on certain 'free' scanning apps on both IOS and Andriod devices.
**Consideration 3:**
The use of QR tags on power point presentations requires some consideration to size of tag within slide boundaries. This was noted early on in the study and adjustments made. It was found that the cohort nearest to the screen (A) could read the QR tag successfully, as could the cohort to the rear of the lecture room (C). However, the cohort sitting in the 'mid-range' (B) seats of the lecture room had considerable difficulty in successfully scanning the codes. This problem was not device specific as these students had a range of mobile devices. (Note: the most successful size for a QR tag would seem to be 150x150 pixels. This would read as an actual size of approx 220x220mm on the projected image, dependent on the location and distance of the projector from the screen).

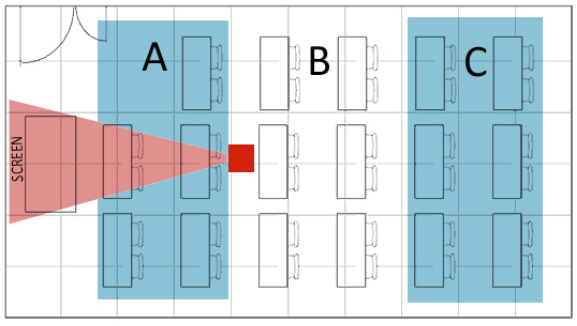


Fig.5. Zoning for Scanning of QR tags from power point slides.

**Consideration 4:**
There are many free apps for IOS that allow scanning of QR codes/tags. The most successful used in this pilot were: Semacode (Semacode Corporation), QR Scanner (Grip'd LLC), Scan (Scan Inc.) for Andriod devices, Optiscan (Airsource), Kaywa Reader (Kaywa), Blackberry Messenger (includes scanner for Blackberry Devices) and EsponceQR Reader (for Windows mobile devices).
**Consideration 5:**
The cost of downloading content from the explore website was also hi-lighted in early feedback sessions from the cohort during lectures. It was found that podcasts on the site over 8 minutes in length would create a increased cost to the student accessing this learning resource. This was resolved by creating hyperlinks to youtube clips. These created quick and free access dependent on whether wi-fi in campus was being used. Charges were incurred if downloading from a mobile device off campus. The majority of the cohort rapidly amended their access by scanning the QR tags at the locations around campus, then use the free wi-fi to download the podcasts and content prior to reading or listening to the content at a later time.
**Consideration 6:**
The most successful QR code creating software used within the pilot was Kaywa QR Creator. This was freely available to use directly from the Kaywa site. The QR code can be created by cut and pasting the hyperlink into the webpage, a QR tag will then be automatically generated. The website will offer 3 sizes of QR tag: Small; medium and large. After trialling all sizes, the most successful on power point slides was the medium sized QR tag. This size allows for a cut and paste directly into power point slides and will be readable by the majority of the cohort using various devices.
**Consideration 7:**
When designing and planning web pages for consumption by PC or mobile device it is very important to consider the proportion of the web page itself. During the pilot a number of web pages were tested for ease of use, with the portrait format being the most effective. This format allows consumption on most smart phones by the user scrolling up and down the information on the screen, this action requires the minimal adjustments when viewing from a mobile screen. The use of landscape formatted pages created the additional need for the user to wipe across the screen to zoom in and out of the text in order to read it clearly.
As a general rule of thumb, web pages with a frame width of 1000 pixels works effectively on the majority of mobile devices and smart phones. A small number of the cohort within the study used iPads. These devices were the only type used in the pilot study that allowed both reading of the web pages in both portrait and landscape formats.

## Conclusions

The results would seem to suggest that the mix mode approach to learning has responded best to those learners who are kinaesthetic or tactile learners. These members of the cohort are those who appear to learn best from the hands on approach that the pilot offered. The learning could be accessed whilst not within the confines of a lecture space, but outside of this space and at different locations around the campus. These learners are very active when exploring the real and physical world around them. The act of capturing data by merely pointing and clicking to download learning material onto the mobile devices appealed greatly when analysing the results of the pilot. The benefit of podcasting in meeting the needs of a range of learning styles was also supported by Dale (2007).

The feedback from the cohort showed that 62% of the students worked collaboratively in groups to find the locations of the QR tags and learnt together in study groups agreed amongst themselves. This result was supported in the finding that pod casting provides a forum for collaborative learning and student knowledge creation by Fisher & Baird (2006).

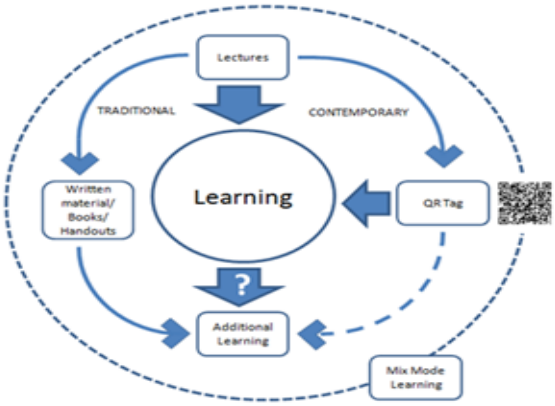


Fig.6. Mix mode learning diagram.

The mix mode of learning offered by the addition of e-learning or m-learning (mobile learning) is shown above. It affords the student the opportunity to amend his or her path to optimise their learning to create deeper and often clearer understanding of the subject being understood. This 'blender' approach is the optimum balance between what is understood as the traditional mode and mixed with one that is required by today's learner.

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