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# A NEW CURRENCY IN LEARNING

**Abstract**

The proposal analyses the impact of using QR codes as a route finder through architectural education and the medium of pedagogic 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 cohort of today's architectural schools is far more technology savvy than their previous generation. This generational change in understanding technology opportunities combines with the need for existing pedagogy in architectural teaching increasingly needs to address the 'currency' of design value.

**Keywords**

Pedagogy, mobile learning, QR Codes, Experiential learning, Technology based learning.

**Project**

**Statement**

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

**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 students. The cohorts of today's architectural schools are far more technology-savvy than any previous generation. The research that was once accomplished in University libraries from large bound tomes on architecture is 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 (to knowledge) has become the accepted norm. This pilot project 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 project 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.

**Mix mode learning – is the future blended learning?**

The study analyses the impact of a new method of exchange within the learning journey. It is interesting to note that the year this study was undertaken *Google* introduced *Google Glass* to the arena of mobile devices that allow for yet another iteration of increasingly mobile computer devices. Hardware and technology are becoming increasingly smaller and easier to carry or, in the case of *Google Glass*, the device can now be worn by its user. The graphical user interface (GUI) can, if designed correctly, minimise the cognitive overload from computer operations. As the current trend

for mobile devices and portable information increases towards 2020, it has been speculated that users will interact with these devices rather than interact directly with each other. However, studies by researchers such as Peter Hawkes, Pierre Wellner, Wendy Mackay, and Rich Gold have suggested that the WIMP (window, icon, mouse, and a pointing device) interface will emerge as an interactive and seamless way of accessing information, as the user fully integrates such devices into the daily lives.[1] Users will be able to complete tasks far more effectively with little computer manipulation.

It is now possible, and readily used by many phone applications (app), to relate objects or information in a database or phone application app to real world objects or locations, using geo-located data, using global positioning system(s). These augmented environments and the links with mobile communication have been explored by Wellner, Mackay, and Gold. [1] This team studied the recently emerging research field of computer-augmented environments. In this environment the portable device worn by the user recognises the real world situation(s) that surround it; allowing the user to see the world and have enhancements from the device on these real world occurrences; and enhancing the ability of the user in these situations. Such research opens up a new and exciting era of learning and pedagogic environments, where the pedagogy could exist outside the lecture space and become a richer experience that allows for real world interactions with the benefit of learning as these interactions occur. These experiences then have the potential to be far more deeply understood or remembered as they are part of the experiences of the user and enters the arena of tactic and explicit learning.

## 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 run 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.


**Figure.1. All lecture material via power point contained the logo above to indicate that the material was part of this pilot study. As the format allows for accessing the learning material by *Quicktime, iPod, Android and X Box devices.***

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 situated around the campus the cohort of the pilot project could gain access to web pages on the physical buildings. Allowing the cohort to experience in real time learning material be discussed in the lecture for that week.

1. Wellner, P, Mackay, W, and Gold, R. Computer augmented environments: Back to the real world. *Communication of the ACM*, Vol. 36, No. 7, August 1993

The learning material was accessible for the weekly lecture module via the student using a freely available QR code reader app on their mobile devices. The QR code could then be scanned, linking students directly to webpages relating to that building typology. This 'live learning' allowed for a direct correlation between what was learnt in lectures and the first-hand experience of buildings on campus.

This paper therefore 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 [2]. This pilot study was developed from the idea of increasing the 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 mixed-mode delivery was supported by Fernandez et al. [3]. They argued that podcasting could be used to complement and build upon existing teaching resources. Jarvis & Dickie [4] argued that an enhancement, such as podcasting, would improve support of enquiry-based and independent learning. However, it was also shown that in order to be successful they the cohort must be flexible and adaptive to a variety of pedagogic contexts.

Annual surveys on mobile phone use are now commonplace. They 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 globally 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 study the cohort reported that 34% used QR tags regularly to download links or coupons from posters or magazines. They also reported they used their mobile devices an average of 2¼ hrs during the learning day on campus. When further queried about their mobile use against use of a University PC on campus, the cohort reported that 62% defaulted to mobile devices for access to the intranet or module information. The remaining 38% stated that PC access would be dependent on their location in relation to available PCs 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. The format of the 'explore' pilot website reflected this approach to learning. This offered the students the ability to use various 'segments' of time during their day to access the material and learn. The daily of many students can now be a time for learning, using headphones and a mobile device.

2. Morales, C. & Moses, J. S, *Podcasting: Recording, managing, and delivering the classroom experience*. (Educause Evolving, 2006) Technologies Committee. Available at http://net.educause.edu/ir/library/pdf/DEC0604.pdf (accessed December 2012).
3. Fernandez, V., Simo, P., & Sallan, J. M., *Podcasting: a new technological tool to facilitate good practice in higher education. Computers & Education.* (Doi compedu.2009) 53(2), p.385–392.
4. Jarvis, C. & Dickie, J, *Podcasts in support of experiential field learning.* (Journal of Geography in Higher Education, 2010) 34(2), p.173 – 186.

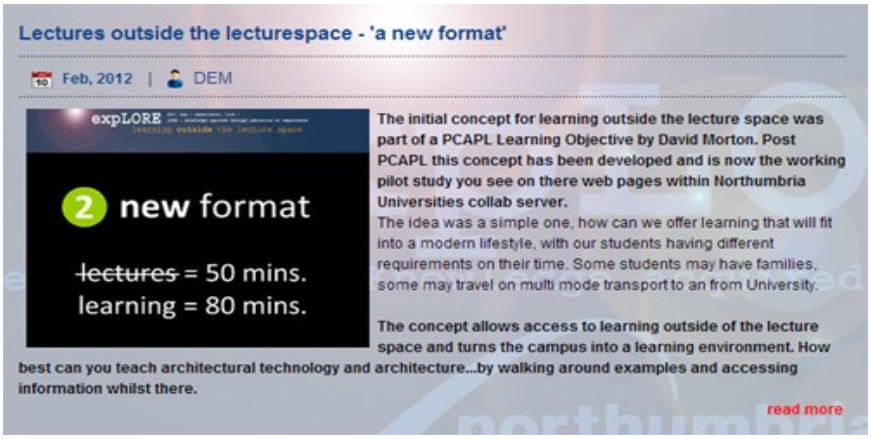


**Figure.2. All lecture material for pilot module (BE1046 Construction) was formatted to give the cohort an additional 30 minutes of learning via podcast(s).**

## The pilot study

The pilot was completed in early 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 the cohort's engagement and understanding. . The study group consisted of students in their first year of their undergraduate architectural technology 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 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 PowerPoints, 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 which included pdf's of PowerPoints, links to manufacturers websites for technical information


**Figure.3. The 'expLORE' website, updated regularly throughout the study.**
**The main home page is shown above.**

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. The additional learning material was held on web pages within the Explore website.

The Northumbria University City campus and its buildings have evolved from the 1960s to present day and consist 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 study/project. 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 Students' Union building.


**Figure.4. Example of web page accessed via scanning QR tags around campus. The links at the base of this page indicate to the cohort that further learning material is available.**

**Figure.5. Example of location for QR Codes sited around Northumbria University, City Campus (New Students' Union Building)**

**Figure.6. QR Code located at Ellison Building Entrance. Note, the study indicated that consideration of location for QR Codes was key to their successful download by students. On sunny days these codes were found to be difficult to scan through the glazing.**

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.


**Figure.7. Differing format for data transfer - Barcode and QR Code**


**Figure.8. 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.

**Outcome of pilot**

Analysis of the data 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 [5] who proposed that a student preference for experiential and technology-led learning can lead to increased 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 [6]. 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[7], who suggested that podcasts can offer flexibility in teaching and learning to support a diverse student population through their university experience.

The research suggests that the routes taken by the cohorts observed align with research carried out by Peter Ingwersen. Ingwersen examined Information Retrieval and suggested a cognitive model that would map the interpretation of complex issues derived from synthesizing concepts within their learning [8].

5. Prensky, M, *H. Sapiens digital: from digital immigrants and digital natives to digital wisdom.* (Innovate, 2009)5, p.1 – 9.
6. Beldarrain, Y, *Distance Education Trends: Integrating new technologies to foster student interaction and collaboration.* (Routledge, 2006). 27(2). p.139-153
7. Salmon, G. & Nie, M, *Doubling the life of iPods, Podcasting for Learning in Universities*. (New York: Open University Press, 2008) p.1 – 11
8. Ingwersen, P, *Cognitive perspectives of information retrieval interaction: elements of a cognitive IR theory.* (Journal of Documentation, 1996) 52(1), p.3-50.

Ingwersen modelled categories of learning mapped within information retrieval taxonomy of interaction. The key dynamic of this research was the enabling of learning opportunities for the cohort. Ingwersen's research showed the design of learning material, based on instructional design and pedagogical factors, as vital to learning via use and optimisation of electronic media in order to enhance the learning process.
Within the cohort studied 6% were known to have varying levels of dyslexia. This group was further questioned on the format of this study. The response to the format for learning was that 66% of this group stated that the existing format of uploading lectures on eLP (electronic learning portal), via the Northumbria University intranet were enhanced by the podcasts. The format allowed for the students to pause the podcast in order to clarify a word or meaning prior to continuing the learning. This allowed an overall feeling of not 'missing out' on information that would have been missed in the usual lecture format.

The data collected from the cohort of this study suggests that the learning outside of the lecture space allows for interpretation of the learning material and provides a cognitive summary of the lecture material. This is based on three critical factors (1) the student(s); (2) the QR codes sited at locations around campus; (3) the overlapping or mapping of these on the initial lecturer-student learning from the lecture. The QR codes act as Ingwersen's original 'information objects' that becomes resources and learning activities undertaken by the student(s) [8].


**Figure.9. Example of Resource Lecture – Additional learning material, accessible via webpages on PCs or mobile devices by the cohort in the study.**

8. Ingwersen, P, *Cognitive perspectives of information retrieval interaction: elements of a cognitive IR theory.* (Journal of Documentation, 1996) 52(1), p.3-50.

The findings of this study have indicated that the 'extra learning created by the QR codes allows the cohort to interact with the learning material. This learning is then taken into the lecture situation where the transformation of the blended learning occurs. The influence and interaction of the QR code material, allowed the student to experience the facts and 'see for themselves' how the technology of design of the building is assembled to create the final building.

The findings from the study reflect the need for a greater synthesis between direct and indirect learning. The QR codes allowed access to learning at times when the student wished to learn, in their own time. This allowed them to be reflective in their thinking and understand the material they accessed whilst within a building on campus and able to link the 'real' example of the facts being processed cognitively with the physical building around them. Even though the direct teaching of a lecturer to cohort did not occur, the communication of the learning material was shown to improve significantly. Channels of communication have been studied by Gery [9], Reeves[10] in 1993 and Chickering and Ehhrmann[11], 1996. All of these studies established critical factors for successful blended learning were enhanced when performance and importance of the learning material are made clear and create a learner-centred environment using technology to enhance accessibility and convenience to these learning opportunities.

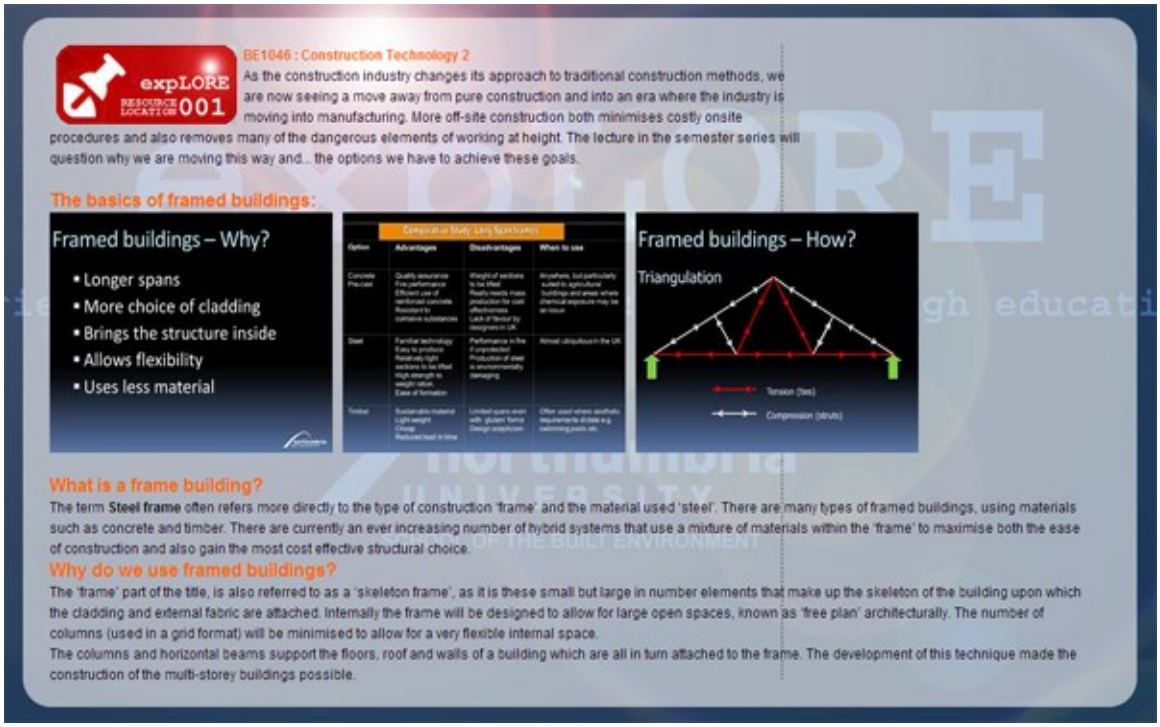


**Figure.10. All lecture material via power point contained the logo above to web pages for additional learning material. An example of this is shown.**

9.Gery, G, *Making CBT happen: prescriptions for successful implementation of computer based training in your organization.* (Boston: Weingarten, 1987)
10. Reeves, T.C, *Evaluating technology-based learning. The ASTD handbook of instructional technology*. (New York: McGraw-Hill,1993)
11. Chickering, A.W., & Ehrmann, S.C, *Implementing the Seven Principles: Technology as Lever.* (Journal of Hospitality, Leisure, Sport and Tourism, Education, 1996). 49(2), p.3-6.


**Figure.11. Example of resource lecture page (004). The layout of these pages was formatted to allow for ease of navigation via mobile devices. The two large images on each page indicated the building being used to explain a construction typology from the BE1046 Module (Pilot Module for study).**


**Figure.12. The links between lecture(s) and podcasts explained on the explore web pages.**
**Example above for Technology 2 Lecture on Brickwork.**

**Results**

On completion of the pilot, the cohort were asked to complete a questionnaire to assess the outcome of this mode of learning and reflect on any changes in their learning journey. 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) and 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 asked to indicate how the material on the explore website was used. A resulting 29% of the cohort stated that this learning had strongly increased their understanding of the material, with a further 23% stating that the format and possibility of learning at their own pace, i.e. via podcast(s), allowed them to navigate the lecture material more effectively. 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 gain 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 PowerPoint 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:**
There is a need to consider the type of printing for the QR codes and the timescale they will be used and their location, as there may be a need to have a level of weather resistance. The initial study indicated that during the study several instances of scanning problems of laminated QR tags were noted. Investigation of these during the study revealed that 'sealing' the QR tag in a shiny surface, such as laminating the QR tag for external use, rendered it unreadable on sunnier days, due to high levels of reflection.

**Consideration 2:**
The printed size of the QR tags rendered them unreadable on certain 'free' scanning apps on both IOS and Android devices. Using a final ratio of 50mm x 50mm resolved this issue for 94% of the free scanning apps.

**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 to the screen).

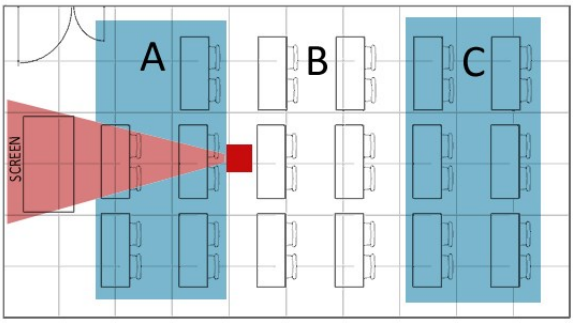


**Figure.13. Zoning for Scanning of QR tags from power point slides.**

**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 Android devices, Optiscan (Airsource), Kaywa Reader (Kaywa), Blackberry Messenger (includes scanner for Blackberry Devices) and EsponceQR Reader (for Windows mobile devices). Currently there are no QR scanning apps included on IOS, Android or Windows mobile devices.

**Consideration 5:**
The cost of downloading content from the explore website was also highlighted in early feedback sessions from the cohort. It was found that podcasts over 8 minutes in length would create an increased cost to the student accessing and downloading 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 using the free wi-fi to download the podcasts and content prior to reading or listening to the content later. time.


**Figure.14. At the beginning of the study, example pages were published on the expLORE website to guide the cohort in the new format.**

**Consideration 6:**

The most successful QR code creating software used within the pilot was Kaywa QR Creator. This is freely available to use directly from the Kaywa website. The QR code is created by cut and pasting the hyperlink into the webpage, a QR tag is then automatically generated. The website offers 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 allowed for a cut and paste directly into power point slides and was 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. The use of web pages also allowed for the use of a screen reading option, available for PC's and Apple computers. These allow highlighted text on the screen to be 'spoken' to the user, using text-to-speech software.

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 mixed 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 study 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 pointing and clicking to download learning material onto the mobile devices appealed greatly to students 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 [12]. The feedback from the cohort showed that 62% of the students worked collaboratively in groups to find the locations of the QR tags, learning together in study groups agreed amongst themselves. This result was supported in the finding that podcasting provides a forum for collaborative learning and student knowledge creation by Fisher & Baird [13].

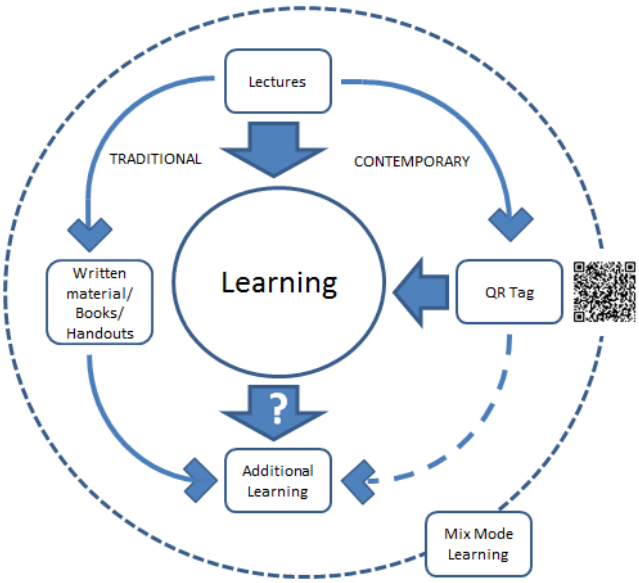


**Figure.15. Mix mode learning diagram (D.Morton)**

The mixed 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 studied. This 'blended' approach is the optimum balance between what is understood as the traditional mode and mixed with one that is required by today's learner.

12.Dale, C, *Strategies for Using Podcasting to Support Student Learning.* (Journal of Hospitality, Leisure, Sport and Tourism, Education, 2007). 6(1), p.49–57.
13. Fisher, M. & Baird, D. E, *Making m-Learning work: Gen Y, learning and mobile technologies*. (Journal of Educational Technology Systems, 2006) 35(1), p.3 – 30.

The cohort attended lectures with many of the questions that they have been reflected and eager to share these with their colleagues, as part of a lively debate during the lecture session. This notion readily occurred in both lectures and seminars from week 3 onwards and continued through to the end of the study in week 12. The dialogue in these sessions became richer and indicated Schön's original idea of reflection-in-action, Schön [14]. Interestingly Schön did not provide evidence of reflection-in-action in settings such as lectures or seminars where the dialogue would be from multiple origins and multidirectional, student to lecturer, student to student and lecturer to student[15].
This study indicates that Schön's theory exists in these environments, but is further enhanced in terms of students becoming far more proficient at reframing what they have understood due to the addition of a larger timeframe between the QR based self learning and the lecture or seminar session. This may account for an element of metacognition to the original idea of reflection-in-action.

The dialogue with the cohort during this study was significantly quicker and can be aligned to the concept of reflection by Dewey[16]. The QR codes allowed the cohort to reflect upon what they have learnt in the formal learning sessions of the lecture and seminar and apply this in a real setting, within a building that has either a constructional or technological system visible to them that was merely on a slide before them. This allows them a deeper understanding of its relationship to its context the ideas and functionality. These experiences allow the students to create a central thread by which all of these factors can be connected, ensuring a deeper understanding of those facts.
The study has also highlighted benefits of reflection in a 'community' i.e. the cohort, allowing multi-layered learning via interaction with others.
The learning experienced, via the use of QR codes around campus, allows students to construct meaning from that experience and thereby giving it value. These experiences become the elements that can be formulated into meaning. The physicality of being within a building whilst learning about the technology that can be seen and experienced, allows for spontaneous interpretation of the experience and the generation of problems, questions and explanations. Such experiences were discussed at length from week 3 onwards during the study and seemingly enriched the cohort's learning experience.

This paper has aimed to encapsulate the delivery of mixed mode learning for today's cohorts. Allowing the cohort to search out the 'learning' around them, interact with it via the QR codes and add a deeper element of enquiry to their learning, becoming reflective practitioners. Dewey de-scribes this connective step as "an intellectualisation of the difficulty or perplexity that has been felt (directly experienced) into a problem to be solved, a question for which the answer must be sought" [17]. The cohort began the lecture posing questions to the lecturer and each other that were far more considered and by this action, already on the route to the answer. "A question well put is half answered" Schön. There is also clear evidence of more active learning, via the podcast and mobile learning from this study. The paradigm that students sit and are 'filled' passively with learning by the lecturer is now reset. The students now have the opportunity to explore, question, and consolidate knowledge.

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