**Dixon, N. (2013). Scaffolding Fully Online First Year Computer Literacy Students for Success. *Irish Journal of Academic Practice*, 2(1), Article 5, 1-20.**

This paper reports on experiences from the delivery of a fully online computer literacy module which is provided for first year students of a degree programme. The author challenges the notion that the modern generation of learners are “digital natives” (Prensky, 2001). He argues that, while most first year students are reasonably experienced in the use of computers for internet and social media, this does not necessarily convert to proficiency in “desktop applications”, such as word processing, presentation software and spreadsheets.

The author examines the impact of providing supports to the students to compliment an existing commercial online IT skills module. His study considers the adoption of a scaffolding approach based on Bruner’s theory (which built on Vygotsky’s theory of the Zone of Proximal Development), of building learners skills to a point where they are encouraged to take on the next step of a task (Bruner, 1960). A mixed method approach to the research is taken with a combination of questionnaires (quantitative) and email correspondence, focus groups and interviews (qualitative).

The limitations of the study are apparent in the small numbers of face-to-face interviewees (4) and the authors own conclusion that significant variables in computer literacy exist between school leavers and more mature third level entrants in the student cohort. This indicates that deeper exploration of these differences may well be warranted to further explore the research question. The study is based on established learning theory though which would support the papers conclusions and the author has used both quantitative and qualitative methods in his research.

This paper is particularly relevant as the project I am working on is exploring the potential of online learning to enhance the outcomes of an existing up-skilling programme for construction workers. The issue of computer literacy as a barrier to engagement with e-learning is particularly relevant. Many of the author’s conclusions and recommendations point to the limitations of fully online delivery and the importance for learners of supports including face-to-face elements, such as induction and tutorials. This highlights the importance of careful design of e-learning to ensure that engagement and motivation is maintained. It also suggests that the mediums available for accessing online learning resources may be particularly important, e.g. smartphones, tablet interfaces may be more familiar to the target cohort. This is consistent with another study of learners from industry trades indicating preference for use of mobile phones (Callan, Johnston & Poulsen, 2015).

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Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon*, 9(5).

[**OECD**](http://ictlogy.net/bibliography/reports/contacts.php?idc=108) **(2008).** [**New Millennium Learners. Initial findings on the effects of digital technologies on school-age learners**](http://ictlogy.net/bibliography/reports/projects.php?idp=1627)**. OECD/CERI International Conference “Learning in the 21st Century: Research, Innovation and Policy”. Paris: OECD. Retrieved November 10, 2014 from** [**http://www.oecd.org/site/educeri21st/40554230.pdf**](http://www.oecd.org/site/educeri21st/40554230.pdf)

This paper provides a progress report on a Centre for Educational Research and Innovation (CERI) project entitled “New Millennium Learners” (NML) which examines the effects of digital technologies on school-age learners. The report provides an update on the first phase of the project, which considers the changes experienced by learners. The author is quick to caution on the dangers of assigning such a broad ranging label such as NML to all children and teenagers, acknowledging that factors such as age, gender and socio-economic status have an impact on the effect of digital technologies for learning. The paper examines the contrasts between how young people adopt technologies and how they are used in an educational context. For instance, while it is acknowledged that a high percentage of 15 year olds in the OECD countries frequently use computers at home (OECD, 2003), the vast majority of this time may well be spent on the internet (National Center for Education Statistics, 2004).

The research presented also points to an under-utilisation of computers in school, with 50% of students in the EU not having used computers within a twelve month period in 2007. This is certainly significant as it is the use of computers in a formal school setting where skills such as desktop applications are likely to be learned. The author highlights the lack of broad ranging research into the effects of digital technologies on cognitive skills development. While acknowledging positive impacts on visual spatial skills and non-verbal intelligence, he points to a lack of evidence of a relationship between technology and academic achievement. Research is noted, such as PISA results, indicating a correlation between factors such as access, previous experience, frequency of use and confidence levels and modest improvements in academic attainment (OECD, 2003). This is worrying in light of other assertions in the paper citing the influence of socio-economic disadvantage and the influence of a “family’s cultural capital” on children’s use of technology at home.

This paper, and Dixon’s (2013), provides support for the notion that broad ranging assumptions about the generational impact of technologies on learning are misleading. For my research project, I am developing a persona for the user of e-learning resources to be developed. From my own experience of learners from the construction trades, I am inclined to consider someone generally from a disadvantaged background who is unlikely to engage with computers and desktop applications with any regularity. This paper highlights that socio-economic circumstances and age profile of learners are significant factors to be considered in relation to engagement with technology for learning.

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**Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon*, 9(5). Retrieved online September 16th 2016 from:** [**http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf**](http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf)

In this opinion piece, the author presents an argument that a significant generational divide exists between those born in the previous two decades and older generations. The two generations are broadly categorised as being either “digital natives”, the young, and “digital immigrants”, the older people who struggle to adapt in the new ‘digital age’. The author points to a detrimental impact of this divide on education. He highlights a key implication in communication as teachers (digital immigrants) speak a different language to their students (digital natives). There are further, and perhaps even more profound, conclusions presented which suggest that students have different brain structures and think and process information differently than their older counterparts.

According to the author, these differences carry serious consequences for learning. As teachers are by default “digital immigrants”, they fundamentally lack understanding of the way their students interact with information and, while they may attempt to update their knowledge of digital technologies, they will never be “native speakers” of this new language. He suggests that characteristics of digital natives include: searching the internet for information as a first port of call; reviewing information onscreen rather than printing hard copies; receiving their information fast and with random access rather than incrementally. He believes that “smart adult immigrants” will accept the change and benefit from learning from their own kids.

The sweeping generalisations made by Prensky in this article are based on an assumption that an entire generation has become proficient in the use of digital technology and an associated ‘new’ language. I was interested in this article for its relevance to my research project and the profile of the learners for which I will be developing e-learning supports. If we were to accept Prensky’s conclusions, we would assume that all young people are already computer literate on the basis of their exposure to technology. However, I believe that he is ignoring the possibility of variables in young people’s use of technology based on gender differences or socio-economic factors (OECD, 2008).

Prensky also fails to consider the usage patterns of digital technology among young people (Dixon, 2013). While, in effect, insisting that teaching should be tailored specifically for these new “digital natives”, he is effectively ignoring established theories on learning preferences which encourage the use of multiple modalities in delivery (Sankey, Birch & Gardiner, 2010; Mayer & Moreno, 2003).

The lesson from this is to avoid broad assumptions about target learners. Rather there should be a focus on establishing a clear learner profile and developing e-learning resources that accommodate different learner characteristics while considering the best medium to make these available and accessible.

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**Helsper, E. J. & Eynon, R. (2010). Digital natives: where is the evidence? *British Educational Research Journal*, 36(3), 503-520.**

This research paper challenges the notion that a generation of “digital natives” has led to an unbridgeable gap between educators and young students (Prensky, 2001). Specifically, the authors question the idea that age is the sole factor determining digital native status. They examine typical digital activities that are associated with “digital nativeness” and then consider the types of people likely to engage in these. The authors explore the impact of three different factors affecting whether someone qualifies as a digital native:

1. Age – the affect of growing up in the digital age surrounded by technology
2. Experience – the duration that someone has been exposed to internet use
3. Breadth of use – the extent to which internet use has been integrated into someone’s daily life, regardless of their age or experience

The study adopts a quantitative methodology employing a nationally representative survey with 2,350 respondents. The survey of internet use and non-use looked at access, usage patterns and impacts on everyday life. Consideration was given to the “media-richness” of a household, that is, the number of information and communication technologies present. Twelve categories of internet use were identified: fact checking, training, current affairs and interests, travel, finance, shopping, entertainment, social networking, diary functions, person to person networking, e-government and civic participation. It was acknowledged that, while all of these activities may indicate some level of learning, the three most related to education are fact checking, training and current affairs.

The authors conclude that age is not the sole determining factor affecting interaction with digital technology and the internet. Other variables identified include gender, education, experience and breadth of use. Therefore, it is the level of immersion in digital technologies that in effect determines if someone is a digital native. This means that a young person who has a superficial exposure to internet, for activities such as social networking and shopping, may be less of a digital native than someone in their mid-thirties with an office job that involves regular internet use for research and training. In terms of age as a factor, the study points to a generational divide after the age of 55. This finding would challenge the notion that teachers are incapable of speaking the same ‘digital language’ as their students.

The study does not explore the issues of access to technology, social disadvantage and the importance of a family’s “cultural capital” in affecting usage of technology for educational activities (OECD, 2008). However, the authors do acknowledge this to some extent in their conclusions and recommend that qualitative research be undertaken to explore family learning and what activities people actually engage in online.

The design of e-learning supports on my research project are based on the premise that many of the target learners are not necessarily computer literate or familiar with an online learning environment. The conclusions of this study, Nixon’s (2013) and the OECD report (2008) would support suggestions that there are a number of factors such as age, gender, educational levels and access to technologies which are creating variables in the capacity and motivation of people to engage with online learning.

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Dixon, N. (2013). Scaffolding Fully Online First Year Computer Literacy Students for Success. *Irish Journal of Academic Practice*, 2(1), Article 5, 1-20.

[OECD](http://ictlogy.net/bibliography/reports/contacts.php?idc=108) (2008). [New Millennium Learners. Initial findings on the effects of digital technologies on school-age learners](http://ictlogy.net/bibliography/reports/projects.php?idp=1627). OECD/CERI International Conference “Learning in the 21st Century: Research, Innovation and Policy”. Paris: OECD. Retrieved November 10, 2014 from <http://www.oecd.org/site/educeri21st/40554230.pdf>

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**Honey, P. & Mumford, A. (1986) *The Manual of Learning Styles*, Peter Honey Associates.**

This book introduces a theory that learners have particular preferences for how they learn which can be divided into four distinct categories. The authors believe that people fall into one or two of these learning styles and that they tend to learn more efficiently and effectively when engaged in activities that are aligned with these. They feel that knowing which learning style category that you favour helps you to select the type of learning activities that are most suited to you.

Honey and Mumford define these four distinct learning style preferences as follows: 1) Activist – those that learn by doing; 2) Reflector – those that prefer to stand back and observe; 3) Theorist – those that feel the need to know the theory behind what they are doing and; 4) Pragmatist – those that prefer to see learning put into practice before they ‘believe’.

In my research, I was initially fascinated by the concept of learning styles. From my own education in construction skills, and my experience of training construction workers, I am very familiar with the traditional approach ‘learning by doing’. This training follows a model of introducing learners to the theory of aspects of their craft in a classroom followed by an opportunity practice in a workshop, completing related exercises. I could see certain parallels with this learning styles theory, suggesting tom me that many construction students fall into categories of ‘activist’ or ‘pragmatist’.

There is also a lot of support in literature for learning styles theory (Gardner, 2006; Felder & Silverman, 1988), with some suggesting that “Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity” (Bonk & Cunningham, 1998, p. 29). However, there have been a number of recent challenges which point to a lack of scientific research supporting the theory (Galagan, 2014; Wilson, 2012; Willingham, 2009; Coffield, Moseley, Hall & Ecclestone, 2004).

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**Mayer, R. E. (2014). Research-Based Principles for Designing Multimedia Instruction. *Applying Science of Learning in Education*, Infusing Psychological Science into the Curriculum. Division 2 American Psychological Association.**

This paper asserts that “people learn more deeply from words and graphics than from words alone”, a theory that is fundamental to my own approach to artefact development in my 2nd year project. The author provides an overview of his experience with multimedia instruction and research that he and his colleagues have carried out (“11 experimental comparisons”) which prove the advantages of employing a combination of words (both text and verbal) and graphics (including illustrations, charts, photos, animation, video and simulations which are possible due to recent advances in technology).

The author outlines his cognitive theory of multimedia learning (Mayer, 2009) and the process by which words and pictures are assimilated in sensory, working and long-term memory. He acknowledges similarities with cognitive load theory (Sweller, Ayres & Kayluga, 2012) and suggest the need for focus on three kinds of instruction: reducing ***extraneous processing*** – minimising related but non-essential information; managing ***essential processing*** – to ensure that it does not exceed a learner’s cognitive capacity; and fostering ***generative processing*** - where a learner makes sense of the material and is most likely to assimilate into their long-term memory.

The author goes on to present 12 research-based principles for effective design of multimedia instruction. These principles are sub-divided to align with the three kinds of instruction identified earlier as follows: five principles to reduce extraneous processing; three principles intended to manage essential processing; and four principles aimed at encouraging generative processing. These principles have been tested by the author and his colleagues by means of a meta-analysis, calculating the median effect size (d) and only considering effect size greater than d = 40 as being significant from an educational perspective.

The following is a summary of the 12 principles as presented:

**Reducing extraneous processing**

1. The Coherence Principle – learning is deeper when extraneous material is excluded from a multimedia message.
2. The Signalling Principle – learning is deeper when cues are added to highlight the organisation of the essential material.
3. The Redundancy Principle – learning is deeper when a multimedia message uses graphics and narration than when it includes graphics, narration and on-screen text.
4. The Spatial Contiguity Principle – learning is deeper when on-screen text is presented near to the corresponding graphic rather than further away (e.g. bottom of screen/page).
5. The Temporal Contiguity Principle – learning is deeper when narration of graphics is simultaneous rather than successive.

**Manage Essential Processing**

1. The Segmenting Principle – learning is deeper when the material is presented in “learner-paced” segments, i.e. chunking of information
2. The Pre-training Principle – learning is deeper when learners are already aware of the names/terms relating to the concepts being presented and explained.
3. The Modality Principle – learning responds better to words that are spoken rather than written.

**Foster Generative Processing**

1. The Personalisation Principle – people respond better to a conversational style in narration rather than a formal one.
2. The Voice Principle – people respond better to a human voice than a computer generated version.
3. The Embodiment Principle – people respond better to onscreen agents that display human traits and gestures, e.g. eye contact, hand gestures, facial expressions.
4. The Image Principle – learning is not necessarily deeper when the narrator’s image is on-screen.

The author continues to outline practical applications of these principles. He acknowledges that, while his study is grounded in research and established cognitive theory, it is limited by the fact that most of the available research employs short-term laboratory studies. While I found this paper to be very well presented and structured, using simple language to explain the concepts, the majority of the references provided involve the author himself. This does not question the validity of his research, it just indicates to me that further exploration of literature beyond the work of the author would be important for my own research.

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**Hartfield, T., Panko, M., Davies, K. & Kenley, R. (2007). Towards a Learning-Styles Profile of Construction Students: Results from New Zealand. *International Journal of Construction Education and Research*. 3, 143-158.**

This study seeks to identify the learning styles of construction students in New Zealand. The area of learning styles is of particular interest to me in the context of my research project. From my experiences on the QualiBuild project, from which my own research draws, I worked with many colleagues who were convinced of the strong learning preferences of construction workers as visual and active learners, i.e. they prefer to see and do. I was interested to see if this was in fact supported in the literature.

The authors begin by acknowledging the vast quantity of research into the area of learning styles and the debate and differing opinions that this has fostered. They also accept that there are limitations in accommodating the multiple individual preferences of learners. Their objective is to identify a group-learning styles profile for construction students which would inform instructional design and teaching strategies. One of the main justifications that they provide for their research is a dearth of studies into the learning preferences and characteristics of construction students.

The literature review in this paper summarises some of the main theories and arguments for learning styles, including reference to seminal authors in the area such as Felder and Silverman (1998), Kolb (1984) and Honey and Mumford (1992). While they consider the categories of learners put forward by these theorists they are particularly interested in the smaller number of studies that take account of the “instructional dimension”. They believe that the preference of learners for learning with or without others is a significant factor. There is also an acknowledgement that adult learners are often motivated by internal as well as external factors. This is particularly significant for this study which focuses on students in a classroom setting, where environmental factors need to be considered, e.g. temperature, seating arrangements and lighting.

The study employs an instrumental case study (Stake, 1995) with a purely quantitative approach to the research, relying solely on a survey questionnaire, the Productivity Environmental Preference Survey (PEPS) as suggested by Dunn, Dunn and Price (1989). They use a self-selecting (due to access and financial constraints) sample of 164 students across 12 different classes, ranging from carpentry diploma to final year degree-level students.

The findings of this study indicate that construction students are not usually intrinsically motivated and prefer a high level of structure, predominantly being surface rather than deep learners. With regard to learning modalities, the strongest preference was found to be listening followed by tactile, although neither by a particularly large score. The authors acknowledge that other research indicates that the majority of any population tend to have multiple preferences and therefore no one modality is likely to score very high or very low.

I found the conclusions of this study to be interesting in that they did not highlight any specific ‘strong’ preference for visual or active learning. However, I believe that it is a limited piece of research that relied on a relatively small sample for a purely quantitative study. I would have preferred a mixed methods approach that incorporated some qualitative analysis that went beyond an analysis of statistics, particularly as the authors acknowledge other studies of construction students that found high preferences for visual learning (Abdelhamid, 2003) and hands-on learning (Stein & Gotts, 2001). However, this study does provide further justification for the multimodal approach to my artefact development in my own research project.

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**Callan, V. J., Johnston, M. A. & Poulsen, A. L. (2015). How organisations are using blended e-learning to deliver more flexible approaches to trade training. *Journal of Vocational Education & Training*, 67(3), 294-309.**

This study considers the potential of e-learning to enable effective blended learning approaches in trades training in a number of industries, including bakery, building and construction, plumbing and stonemasonry. It appears that this has been prompted by skills shortages in a number of crafts in Australia and a drive to explore ways of accelerating and improving efficiency of delivery in apprenticeship. The study explores the successfulness of training organisations adopting more ‘employer-driven’ strategies for flexible and innovative training solutions.

The authors are quick to acknowledge that e-learning in its own is not an effective solution, suggesting that it has most potential when complementing traditional face-to-face training models. The advantages of incorporating e-learning for teachers, learners and employers are discussed. The flexibility of time and place is acknowledged as being the main attraction, both for access opportunities for learners and smaller employers benefitting from less time away from the workplace for their staff.

A literature review is provided that focusses on the benefits of e-learning and the also the barriers to adopting it. There is reference to the advantages of e-learning such as flexibility of time and place, improvements to teacher-student and student-student communication, and cost effectiveness for businesses. Barriers are also acknowledged including upfront investment of time and resources, technology availability, ease of use and reluctance of some instructors to adopt new approaches.

The authors employ a descriptive case study approach “to describe an intervention or phenomenon and the real-life context in which it occurred” (2003). Purely qualitative methods are used with semi-structured interviews of VET professionals and employers along with a number of focus groups involving apprentice students. A narrative description of the findings is provided, outlining the main viewpoints arising from the three parties. While this provides some interesting insights, many of the findings would benefit from further specific research, particularly into the effects of teacher and student attitudes to engagement with e-learning.

Some of the findings were particularly interesting though, specifically the importance of using technology that learners are comfortable with (example given of apprentice bakers using mobile phones). There was also an identification of the best type of learning objects as those “that are much smaller chunks of learning than units or modules” which are interactive and take “20 to 30 minutes to complete”.

The paper was of particular interest to me as it is one of few to specifically consider the potential of e-learning in blended programmes for learners from construction trades. While it highlights some of the barriers to engagement with online learning, not all of the findings are completely relevant to my own project as the study considers apprentice learners only who are likely to be more disposed to engagement with technology than the adult learners that I am considering. However, it was interesting to note that the attitudes of teachers was highlighted as being of such importance, a point that has come up repeatedly in my readings around successful e-learning (Sun, Ray, Finger, Chen & Dowming, 2006; Murray, Donohoe & Goodhew, 2004; Le Gallais, 2001).

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**Murray, P. E., Donohoe, S. & Goodhew, S. (2004). Flexible learning in construction: a building pathology case study. *Structural Survey*, 22(5), 242-250.**

This paper outlines a student centred flexible learning approach to delivery of construction studies programmes that has been adopted by a number of UK universities. The project was prompted by a quality assurance agency review that pointed to low percentages of students achieving high grades and an identified over-reliance on lectures in delivery. The response of developing a standardised ‘Toolkit’ to provide support for lecturers adopting flexible and student-centred teaching methods is outlined in the paper.

There is an excellent rationale provided for the change in delivery methods which is supported by existing literature on student-centred learning. This outlines the advantages to the learners of having the privacy to make mistakes and build up their confidence and self-esteem. The authors acknowledge the importance of student centred techniques that allow instructors the time to provide timely feedback to their learners, providing encouragement and support. The significance of having flexible learning options is also extolled for how it allows learners to move at their own pace at times that suit them best.

The ‘toolkits’ developed comprised resources covering 8 subject areas. They each comprise a combination of adaptable flexible learning resources, examples of previous work and some guidance for converting existing learning materials into interactive learning aids.

The case study approach was interesting to me as it relied largely on feedback from lecturers on the development of the resources and toolkit, similar to the instructor evaluation which underpins my own research project. However, the feedback data collected appears to be quite informal and lacking in any robust structure or analysis of findings, i.e. it counts the number of toolkits taken-up by institutions and no specific method is cited for collecting the feedback from lecturers, it is just referred to as general comments.

This paper is one of the few that I was able to identify that specifically considered student-centred learning and potential for e-learning with construction students. While the subjects are students of university level construction programmes, rather than the blue-collar workers that my project is considering, there are a number of similar characteristics in learning and modal preferences. However, in my opinion, the paper is more of a dissemination piece than a comprehensive piece of research. The evaluation of the effectiveness of the resources developed is very limited and not evidence based in teaching practice over a period of time with analysis of impact on learning performance.

**Wilson, R. (2012). The Emperor's New Clothes: Learning Styles and Multiple Intelligences. Education Matters, 8(2), 1-4. Retrieved online October 2nd 2016 from:** [**http://scholarworks.gvsu.edu/cgi/viewcontent.cgi?article=1171&context=colleagues**](http://scholarworks.gvsu.edu/cgi/viewcontent.cgi?article=1171&context=colleagues)

This opinion piece questions the veracity of learning styles theory, as extolled by such recognised figures as Gardner (2006) and Honey and Mumford (1986). The author believes that many educationalists have been seduced by the notion that there are distinct learning styles and that it is their duty to design instruction that best facilitates their learners and their array of preferences. He notes, with some disdain, that learning styles theory has developed into a somewhat lucrative enterprise, with many organisations and educational institutions prescribing instructional design approaches that align.

However, the author goes on to highlight a lack of scientific research which supports the effectiveness of instructional design which is influenced by learning styles theory. Part of the issue that he has is the sheer volume of numbers of learning styles inventories that exist. He also appears to question the motivation of those presenting learning styles models, suggesting that there is a dearth of “‘robust” independent research available to support their claims. The author points to only one study (Dunn & Dunn, 1992) that indicates any significant effect (on 8% of subjects) which he believes is attributable to a combination of personality and learning style. He goes on to cite other authors who have debunked Gardner’s theory of multiple intelligences (Willingham, 2004).

Wilson concludes that the explanation behind this misguided uptake of learning styles theory is a combination of commercial marketing strategies and the willingness of teachers to seek to improve their practices. However, he believes that what has emerged is some kind of pseudoscience that, while it may have some origin in scientific fact, is misguided and not useful in informing instructional design.

Initially in my research, I was attracted to the concept of learning styles and how they affect learning performance and motivation to engage. This was prompted by my own experiences of teaching construction workers, my personal preferences for highly visual learning materials and feedback from colleagues with extensive experience of teaching construction skills. However, the more that I explored the research in this area it became increasingly obvious that there is a lack of unequivocal scientific study evidencing significant impact of learning styles on performance. In the literature, I found more compelling evidence of the effects of modal preferences and combinations on cognitive load and memory processing which could better inform instructional design that accommodates different learning characteristics.

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**Le Gallais, T. (2001). Innovative Construction Training: Introducing Information Communication Technology into the Curriculum. *Research in Post-Compulsory Education*, 6(3), 285-304.**

This paper provides an overview of an initiative at Stourbridge College in the UK to introduce an Advanced Technology Centre supporting the use of information communication technology (ICT) in teaching and learning of construction subjects. This includes an insight into the staff and student experiences of introducing multimedia into the curriculum and some general commentary on the barriers for the construction industry and training providers adopting ICT to enhance competitiveness.

The author explains that Stourbridge College were successful in accessing European Social Fund finance to develop their Advanced Technology Centre, which provides ICT hardware and software to support delivery of construction training. The benefits of incorporating e-learning in construction training are seen as threefold: 1) increasing student numbers without a need for more teaching space and staffing; 2) the benefits to students of flexibility of time and place and; 3) the benefit to industry, particularly for SME’s who are generally reluctant to release workers for training, for up-skilling staff while minimising impact on productivity.

There is further discussion of the potential of multimedia instruction to enhance the curriculum delivery. Particularly, there is acknowledgement of the potential for students to practise and self-evaluate while becoming more independent as learners. This greater self-reliance is noted for its potential to improve the possibility of students utilising hypertext links that promote learning beyond the outcomes of the training intervention.

The author considers the potential barriers to engagement with ICT for both teachers and the students. For staff, the provision of training is identified as important, along with an acknowledgement that there are varied roles within development teams which may suit the strengths of individuals, i.e. a combination of subject matter expertise, pedagogical nous and technology mastery is most desirable. From a student perspective, the author cites the varying levels of computer literacy and the diversity of student characteristics, with a need to accommodate mature and non-traditional learners. She also highlights the issue of access to ICT hardware and software and internet quality/accessibility.

I was interested in this paper for its relevance to one of my research sub-questions, namely the factors affecting engagement/non-engagement with e-learning for construction workers. The author considers many of the issues affecting adoption of digital resources to address demands for increasing numbers of people trained within financial constraints, which is directly comparable to the objective of the QualiBuild project to support a national roll-out of training for the Irish construction workforce.

**Sankey, M., Birch, D. & Gardiner, M. (2010). *Engaging Students through multimodal learning environments: The journey continues.* Proceedings ascilate Sydney 2010. Retrieved online June 6th 2015 from:** [**http://www.ascilite.org/conferences/sydney10/procs/Sankey-full.pdf**](http://www.ascilite.org/conferences/sydney10/procs/Sankey-full.pdf)

This study explores the potential of multimodal e-learning resources to enhance learning outcomes for students with different learning styles. This is based on the hypothesis that multimodal (combinations of audio, text, video, simulations, interactive elements) presentation of course material can appeal to a wide variety of learning and modal preferences of students. The authors acknowledge the challenge of educating ‘non-traditional’ learners that may not succeed with the read/write methods that has been successful with traditional students in higher education.

The authors reflect on existing research and literature around learning styles but also reference the work of pre-eminent figures in the field of cognitive load and multimedia instruction (Mayer, 2008; Moreno & Mayer, 2007; Mayer 2003; Moreno, 2002). They adopt an experimental design employing a mixed methods approach; a quantitative analysis of a controlled multimodal learning experiment conducted under 6 separate conditions (combinations of delivery modes) designed to explore four research questions; followed by the collection of qualitative data from responses to open-ended questions providing a deeper insight into student opinions on the presentation modes.

The research subjects were 60 undergraduate university students who were profiled to determine their learning style using a VARK questionnaire (Fleming, 2001). The subjects were then divided into 6 experimental groups of 10 with the intention of representing a mix of learning styles in each group.

The study considers four research questions as follows: 1) Do multimodal presentations of content improve learning outcomes and does this vary with learning style; 2) What combination of modes are most effective and is this affected by learning styles; 3) Is there a risk that multiple representations will lead to cognitive overload; and 4) what is the best combination of to improve learning outcomes.

The findings of this study are very inconclusive with the quantitative data suggesting negligible differences between outcomes across different conditions and learning styles. The authors rely in most cases on the qualitative data from the responses to the open-ended questions to confirm their view that multimodal presentation improves learning by accommodating different learning preferences. However, they do acknowledge the limitations of the study, particularly the small sample sizes and the effect of controlled experiment conditions. In my opinion, where the research is particularly weak is in the fact that the subjects where not representative of the lower achieving learners that the authors had hypothesised would have the most potential to benefit from multimodal learning environments.

The study is particularly relevant to my own research project which will explore multimodal e-learning and motivations for engagement with online learning. However, while it provides some evidence of positive outcomes for learners, it is engaging with subjects which would have a different profile to the ‘non-traditional’ learners that I am considering.

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**Sun, P. –C., Ray, J. T., Finger, G., Chen, Y. –Y., Dowming, Y. (2006). What drives successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education*. 50 (2008), 1183–1202.**

This study considers learner satisfaction with e-learning. The authors acknowledge existing research which has considered specific elements of learner engagement but rationalise that their approach is the first to adopt a holistic framework which integrates a range of factors under a number of category headings as follows:

* Learner dimension – including the impact on learner satisfaction of attitudes and anxieties with computer use and the effect of learner internet self-efficacy. For this study, these factors were not deemed to be a major factor, probably explained by the strong computer literacy levels of the subjects.
* Instructor dimension – examining the effects of instructor behaviour and attitudes such as timely feedback and predisposition towards the usefulness of e-learning influencing student perceptions.
* Course dimension – considering the importance of flexibility in e-learning courses and the quality of the resources (specific positive mention is given to interactivity and multimedia presentation in course materials). This was found to be the most important dimension effecting learner satisfaction.
* Technology dimension – including the quality and reliability of the technology/software and internet connection. This was found to be less of a factor than indicated in previous research, accounted for by advancements in technology in the intervening period.
* Design dimension – relating to the learner perception of usefulness of the e-learning course to their development and the ease of use of the resources. This study found these to be very significant factors affecting learner satisfaction.
* Environmental dimension – which identifies a positive correlation between diverse assessment methods and learner motivation and the level of perceived interaction with others in the learning environment.

Adopting an instrumental case study methodology (Stake, 1995), the research relies solely on the result of a survey questionnaire, with quantitative methods used to measure satisfaction and the potential reasons for non-engagement/withdrawal of engagement. In my opinion, satisfaction is something that is particularly subjective and I think that this research would have benefited from some qualitative methods for a deeper exploration of the hypotheses, e.g. interviews, focus groups.

The limitations of the study are acknowledged by the authors, including the number of respondents (297), the use of a single digital system for testing and the fact that other measures of successful engagement such as learning performance and scores.

I was interested in this study as one of the sub-questions under consideration in my current research are the factors affecting engagement/non-engagement with e-learning. This insight into satisfaction factors was very relevant and I found the paper to be well structured and easy to navigate with good use of headings. However, the subjects for the study are not consistent with the profile of the learners targeted in my own research, i.e. I am focussing on construction workers who are predominantly adult learners in the 25-65 age range with limited ICT experience as opposed to the mainly 20-30 year old subjects of this study, the majority of whom are identified as having intermediate computer skills.

Some of the findings are significant for me though as they highlight the importance of quality of course materials, usefulness and ease of use. I believe that this will be useful in guiding the instructional design process and help in establishing the criteria for testing and evaluation.

**References:**

Stake, R. E. (1995). The art of case study research. Thousand Oaks, CA: Sage.

**Wong, A., Leahy, W., Marcus, N. & Sweller J. (2012). Cognitive load theory, the transient information effect and e-learning. *Learning and Instruction*, 22, 449-457.**

This study is concerned with the implications of cognitive load theory for e-learning. The authors acknowledge the potential of digital technologies to present information in audio-visual format and the advantages for learning that this offers by engaging the separate working memory processors for words and visuals. However, they caution that hard copy information that is converted to narrated animations has effectively been transformed into transient information. According to the authors, the transient nature of this format can overload the working memory capacity of the learner if the animations are too long or complex. They hypothesise that audio-visual presentation can be more effective than hard copy if the information is given in small segments which are within the working memory processing capabilities.

An instrumental case study (Stake, 1995) is adopted using two experiments with a total of just over one hundred primary school children. The first experiment involves the children in paper-folding exercises (origami) and compares their performance between instruction with short section animations, short and long section static graphics and longer animations. The second experiment adapted a science lesson on reading temperature-time graphs. This involved presenting the graphics with a comparison of short and long audio text and short and long written text.

Through the results of the experiments, the authors were able to support their hypothesis that longer duration animations lead to a transient effect where learners are unable to process all of the information in their working memory. This leads to a disadvantage over hard copy presentation of information where the learner can quickly refer back to the previous steps in the instruction. However, they find that shorter segments of animated information with audio text achieved the best results for the learners.

The researchers are careful to acknowledge the limitations of their study, recommending that further research is conducted with adults with whom it is possible to gather more subjective measures of cognitive load effect. They are also thorough in referencing existing research which offer alternative theories on the modality effect which suggests that it is due to limits in sensory memory rather than working memory (Rummer, Schweppe, Furstenberg, Scheiter & Zindler, 2011).

This study is interesting to me for my own project which is considering the effectiveness of multimodal presentation of course materials. I was particularly drawn to the evidence referenced for increasing the effectiveness of animations by adding segmentation (Mayer & Chandler, 2001; Moreno, 2007) and user control (Hasler, Kersten &Sweller, 2007; Schwan & Riempp, 2004). I am intending to develop animations/3D simulations with audio and text support to explain concepts. By splitting the e-learning artefacts into relatively small presentations and adding interactivity and user control to navigate the pace of the lessons, I hope to reduce the risk of cognitive overload.

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Stake, R. E. (1995). The art of case study research. Thousand Oaks, CA: Sage.

**Wong, A., Marcus, N., Ayres, P. Smith, L. Cooper, G. A., Paas, F. & Sweller, J. (2009). Instructional animations can be superior to statics when learning human motor skills. *Computers in Human Behavior*, 25, 339-347.**

This study considers the effectiveness of animated instructions over static graphics when learning human motor skills in the context of cognitive load theory.

The study adopts an instrumental case study methodology (Stake, 19to explore their hypothesis that animated instruction is more effective than static graphics. They choose to experiment with paper folding exercises (origami) for schoolchildren in the 8-13 year range. While the research is limited to small groups of children, the authors are quick to acknowledge the limitations of the scale and alternative theories put forward in research, such as….

I was interested in this paper in the context of my research into the effectiveness of multimodal presentation of course materials. It was interesting to consider the advantages of animation in e-learning interventions in the context of cognitive load theory, specifically to consider the limits of animated instruction resulting from the transient information effect (Wong, Leahy, Marcus & Sweller, 2012). The concept that working memory capacity can be increased by utilising the separate processors for visual and auditory information is fascinating to me and very relevant to my development of multimodal e-learning resources.

While my research project for the MSc programme is not concerned with the acquisition of skills (focus on knowledge and attitudinal change), my background in skills training for craftspeople makes this particularly interesting to me. That there may be an additional separate working memory processor for movement is significant to me for future instructional design of skills training programmes.

**References:**

Wong, A., Leahy, W., Marcus, N. & Sweller J. (2012). Cognitive load theory, the transient information effect and e-learning. *Learning and Instruction*, 22, 449-457.

**Picciano, A. (2009). Blending with Purpose: The Multimodal Model. *Journal of Asynchronous Learning Networks*, 13(1). Retrieved online September 23rd 2016 from:** [**http://www.york.cuny.edu/academics/academic-affairs/assets/Blended%20Learning.pdf**](http://www.york.cuny.edu/academics/academic-affairs/assets/Blended%20Learning.pdf)

This article outlines a conceptual multimodal model for blended learning that may inform instructional design and course delivery. The author acknowledges the potential of technology to enhance traditional modes of course delivery. He bemoans the fact that while there is data readily available for numbers enrolled in online learning programmes, there is a dearth of similar records for blended learning. This, he believes, is exacerbated by a lack of a common definition in educational circles for blended learning.

Picciano’s argument in favour of blended learning approaches centres on the possibility to incorporate multimodal strategies for different pedagogical objectives in order to best cater for learners with different learning styles, personalities and age profiles. He proposes a model which outlines appropriate (mostly technology enabled) approaches for 6 different pedagogical objectives: 1) Content; 2) Social/Emotional; 3) Dialectic/Questioning; 4) Synthesis/Evaluation; 5) Collaboration/Student Generated Content; and 6) Reflection.

While the author does not cite exhaustively, he does include reference to debates around generational factors (Florida, Kaimal, Oblinger & Blessing, 2008: Prensky, 2001) and learning styles (Willingham, 2008: Gardner, 1983). He also introduces statistics from the U.S. Department of Education to support his point on the age profile diversity in degree programmes.

I was interested in this article for its relevance to my own study which explores the potential for incorporating blended learning to enhance outcomes. To support his hypothesis, the author cites learning theory including learning styles (Gardner, 1983) and cognitive science, both of which are central to my own research. Beyond this, he also acknowledges the diversity of student populations and the need to accommodate not just learning styles but also personality and generational characteristics. He also challenges the veracity of the ‘digital native’ classification of millennials (Prensky, 2001). Picciano also appears to be another prominent educationalist who perceives e-learning as a tool to enhance teaching rather than as a replacement for face-to-face interaction with learners.

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**Stuart, A. (2014). A blended learning approach to safety training: Student experiences of safe work practices and safety culture. *Safety Science* 62: 409–417. Retrieved online September 23rd 2016 from:** [**http://eprints.teachingandlearning.ie/3755/1/Stuart%202014.pdf**](http://eprints.teachingandlearning.ie/3755/1/Stuart%202014.pdf)

This paper outlines a study of students of a Timber Product Technology third level programme. The author is investigating means by which formal learning of safety in wood machining workshops can be translated into work practices. His study considers the effectiveness of adopting a blended learning model which combines e-learning elements (asynchronous discussions using VLE and developed reusable learning objects [RLOs] on safe work practices) with traditional practical workshop and classroom theory classes. He outlines the challenges of teaching a diverse student cohort from three distinct backgrounds: 1) those with a timber related trade qualification and industry experience; 2) those with a timber related NQAI Level 6 qualification; and 3) a remaining number (10%) of school leavers with no industry experience.

The study adopts an action research methodology (McNiff & Whitehead, 2006) and a combination of observation, questionnaires and semi-structured interviews to collect data. Three main themes emerged: 1) level of interaction with VLE/RLOs; 2) behavioural change in work practices; and 3) perceptions of a safety culture.

With regard to the level of interaction with e-learning, the results showed significant variance depending on the background of the student, i.e. those with previous industry and workshop experience displayed a strong preference for the practical labs while the school leavers where more inclined to utilise the RLOs to improve their basic knowledge. The author concludes that, while the use of VLE/RLOs had a positive impact, they are not a substitute for traditional delivery modes.

I was attracted to this paper for its relevance to my own project which considers the effectiveness of blended learning approaches and, specifically, how they might support training for attitudinal change. The target learner cohort, while not identical, have some similarities, particularly as the majority have existing trade qualifications. The author is also considering a similar theoretical framework, including reference to the impact of learning styles (Pasher, McDaniel, Rohrer & Bjork, 2008; Kolb, 1984). It was interesting to see how the background and characteristics of the students in this study affected their preferences for the different modes of course delivery. I also particularly noted the author’s conclusion regarding the limits of e-learning interventions.

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