

2014-11-17

Analysing the Impact of Digital Photography Projects on Student Engagement and Performance in a Higher Education Engineering Discipline

Michael Gleeson

Technological University Dublin, michaelj.gleeson@tudublin.ie

Follow this and additional works at: <https://arrow.tudublin.ie/engineduccon>



Part of the [Education Commons](#), and the [Other Engineering Commons](#)

Recommended Citation

Gleeson, M. (2014). Analysing the impact of digital photography projects on student engagement and performance in a higher education engineering discipline. *ICERI2014 Proceedings*, pp. 5623-5633.

This Conference Paper is brought to you for free and open access by the Engineering: Education and Innovation at ARROW@TU Dublin. It has been accepted for inclusion in Conference papers by an authorized administrator of ARROW@TU Dublin. For more information, please contact arrow.admin@tudublin.ie, aisling.coyne@tudublin.ie.



This work is licensed under a [Creative Commons Attribution-Noncommercial-Share Alike 4.0 License](#)

ANALYSING THE IMPACT OF DIGITAL PHOTOGRAPHY PROJECTS ON STUDENT ENGAGEMENT AND PERFORMANCE IN A HIGHER EDUCATION ENGINEERING DISCIPLINE

Michael J. Gleeson

College of Engineering & Built Environment, Dublin Institute of Technology, IRELAND

Abstract

Developing and implementing engaging activities aligned with the learning outcomes of a module within a higher education programme is essential to successful teaching practice in the 21st century. Substantial research evidence indicates that student engagement plays a pivotal role in the academic performance and success of the student. The aim of this research is to compare student performance after adopting an alternative pedagogic approach utilising digital photography as a tool to engage the student in an engineering discipline. The activity was designed to promote student engagement by integrating digital photography, replicating authentic construction professional practice and focusing on images as a key means of communication and to aid the learning. Such strategies can promote student inclusion by eliminating literacy challenges associated with the traditional lecturing approach. A questionnaire to students revealed that those from a construction background perceived that they gained a deeper understanding of the subject matter and a richer learning experience, and advocated that more teachers on their programme should adopt a similar teaching strategy. A comparison of assessment results from two previous student cohorts (n=36 students) found that the alternative approach yielded superior exam performance. The careful planning and implementation of combined teaching strategies in a single engaging activity can deliver improved student performance without the need for additional material or financial resources.

Keywords: Authentic learning activities; Construction professional practice; digital photography; student engagement; student inclusion;

1 INTRODUCTION

Over the years, teachers have reported a clear sense of achievement and satisfaction when their students become so engaged in a learning activity that they lose all sense of time, and become so immersed that they have to be reminded that the session has already run over schedule. Anecdotally, this has also been regularly observed in the context in which this research study was implemented. Students delay further to clarify a few last questions before leaving, and there is a sense that they will be eagerly waiting for the next class. Current research indicates that 'student engagement' has become a key focus for educators seeking to improve the learning experience and performance of their students (Trowler, 2010) (Floyd, et al., 2009). Evidence from the literature suggests that engaging activities play a significant role in student retention, attendance and performance (Thomas 2012; Kuh 2001; Skinner et al. 2008; Harper & Quaye 2009; Doyle, 2011). Exploring the topic from a curriculum perspective, Zepke & Leach, (2010) have argued that developing and implementing engaging activities aligned with module learning outcomes is an essential component to successful teaching practice in the 21st century.

This paper reports on the findings of a case study that involved the development and implementation of an authentic learning activity involving digital photography as the principal learning tool in a Building Services Engineering module.

1.1 Context & rationale

The inspiration for this research was driven by the desire to engage students who view the subject of Building Services as a low priority in their programme, and not relevant in a professional capacity for their future career. For example, the subject of Building Services although taught to Quantity Surveyor and Site Management students, will not be essential to them in a real professional context. Building Service Engineers oversee the design and installation of services in new builds and retrofit construction projects and are available to answer any queries by the project team. The students are aware of this and do not see the value in recognising the benefits of having a thorough understanding

of Building Services. Consequently, a professional challenge exists; cognitively engaged students would be invested in their learning, would seek to go beyond the requirements, and would relish challenge. This has been evidenced in the literature Hernández, (2010) argues that one of the crucial challenges that teachers encounter in their day-to-day practice is keeping their students engaged. This challenge is further augmented if the subject matter being taught is perceived by the student as not being of value or relevant in their future professional career (Floyd, et al., 2009).

Teachers today can create impressive presentations with an assortment of high quality images which provide excellent detail for their student audience using digital software tools (Green, 2006). Reversing the roles of teacher and student provides an opportunity for the student to participate in a deeper learning experience by locating and recording the necessary digital images to reflect a specified concept (Clements, 2010).

1.2 Aim & objectives

The primary aim of this research is to compare student performance with previous first year Site Management students studying Building Services when digital photography is used as the primary learning tool as opposed to a more conventional lecturing approach. The research question sets out to establish if student performance and engagement can be enhanced by using mobile phone photography as the primary learning tool in this context? A second strand of the research is to establish if a predominant learning style exists in the student group. Research suggests that students from an engineering background indicate learning style preference for active visual types (Kolmos & Holgard, 2008).

2 LITERATURE REVIEW

As providers of higher education begin to harness the power of digital technologies, a relevant application for these new tools is that of supporting student engagement. The student experience is central to the quality of education in the host institution and by engaging with students in this discipline, it is anticipated that the programme team can develop their provision to suit the evolving needs of their cohort.

An extensive and diverse range of teaching strategies and resources are available and are promoted by different experts and disciplines to the progressive teacher in the 21st century (West 2013; Prensky 2010). For this current study, a student centered approach was implemented using real /authentic projects supported with digital technologies with the potential to promote transferable skills for students in preparation for professional employment. Active learning utilising technologies are promoted by leading educators spanning a number of years (West 2013; Purcell et al., 2013; Thomas 2012; Prensky 2010; Clements 2010; Lombardi 2007; Solvie & Kloek 2007; O' Neill & McMahon 2005).

The practice of recording digital images and introducing student centred photography projects in this study was informed by the literature on the concept of student cognitive engagement with a focus on the use of visual technologies, but also by addressing student learning styles with an emphasis on visual learning. Further literature led to the exploration of how best to promote student inclusiveness through active and authentic learning in a professional discipline like Building Services.

2.1 Student engagement

In recent years significant literature confirms that student engagement plays a pivotal role in the academic performance and success of the student. Many studies in the literature point to student engagement being addressed with the development of stimulating learning activities that are learner centered, placing the onus on the learner to be active in the process.

Evidence indicates that Higher Education Institutes (HEIs) supporting student engagement by using activities aligned with the learning outcomes may claim to deliver a richer learning environment when compared with those that do not implement such a strategy (Kuh, 2001; Floyd et al. 2009; Thomas 2012). Evidence also suggests that students who are more engaged in class, progress to achieve higher levels of academic success and tend to avoid many of the social tribulations associated with adolescence (Skinner et al. 2008; Axelson & Flick 2010).

Student engagement has been defined by Kuh, (2009a, p.683) as "the time and effort students devote to activities that are empirically linked to desired outcomes of college and what institutions do to induce students to participate in these activities". Coates, (2007, p.122) defines engagement as "a broad construct intended to encompass relevant academic as well as certain non-academic aspects of

the student experience". Although the student plays a pivotal role in student engagement, the organisation and its staff have responsibility to nurture, support and encourage the culture of student engagement.

2.2 Inclusion through active learning

A key element of this study was to promote student inclusion utilising active learning strategies. In their seminal, study Chickering & Gamson (1987) promoted the use of active learning techniques and argued that learning is not a spectator's sport and that tutors need to develop activities that are student centered, encouraging both engagement and inclusivity. Student centered learning permits a diverse range of learning strategies to be employed addressing the different learning styles within the group thus promoting inclusivity (Debnath & Pandey 2011; Weimer 2014). Supporting this perspective Pashler et al. (2008) contends there is insufficient evidence supporting the popular hypothesis that designing the instruction for specific learning styles yields improved performance. Arguing that tutors should instead focus their energies and time on learning strategies that have a successful track record, i.e. project-based learning.

A study by Kolmos & Holgaard in 2003 found the majority of first year engineering students to be active learners as opposed to reflective. The term 'active learning' applies to students who prefer to learn by doing, participating in real life activities (Kolmos & Holgaard, 2008). Lombardi (2007) & Russell (2006) support this concept by explaining that students often show a preference for learning by doing rather than listening, and that active learning enhances recall. In addition to this, previous research identified the explanation for the decline in student numbers in secondary school science being attributed to the transition from the primary school student centred hands-on approach to the more traditional theoretical approach used in secondary education (Woodgate, et al., 2011).

In the current study, the nature of the activity identifying and photographing services, provides all the students with an opportunity to participate in the learning, especially those that may be otherwise challenged by lectures and academic tutorials. Building Service students have to be able to visualise the components before locating and photographing them, and then acquire the necessary knowledge to critique the services. The concept is congruent with Clements, (2010) who believes this type of activity promotes student inclusivity and requires high levels of sophisticated thought. Supporting this concept, Mignot (2000) argues that visual methods promote inclusion in education when compared with traditional literary practice which can be oppressive and marginalising for many individuals.

In contrast to student centered active learning, research suggests that the traditional lecture prevents the tutor from achieving the best performance from the students for the following reasons: the short attention span of students (Smallwood & Schooler, 2006), the various learning styles in the group (Felder & Silverman 1988; Chickering & Gamson 1987) and students in the 21st century want interactive learning (Prensky 2007; Windham 2005). Folley, (2010) believes the lecture may be described as a one way learning activity with no opportunity for the students to interact.

Anecdotally, over eighteen years teaching students in Building Services in Construction related programmes, it has been witnessed that the introduction of a variety of active learning strategies, stimulate the students to engage with both the subject content and each other. Lectures can also play an important role in the learning if they are interactive and encourage student inclusion by integrating a variety of student focused activities such as this study proposes.

2.3 Learning with visuals

"There can be no words without images" – Aristotle.

Visual literacy is becoming more important today because of the amount of information communicated through images. The internet and mobile phone technology is continuing to revolutionise the way we communicate (Lester, 2014). Simple instructions often appear in the form of images rather than the written word, and 'smiley' icons are used to communicate an emotion. In the subject discipline of this study, the use of images is considered crucial both as a learning aid and communication tool among students. The construction industry use drawings as a principle means of communication. In recent years, anecdotal observations have indicated that Building Service students use mobile phone photography more often in their learning, for example seeking clarification on Building Service pictures taken outside the classroom, and recording white board content or electronic presentation images.

A study by Najjar (1998) concluded that humans are three times more likely to remember visual rather than oral information, and six times more likely to remember information that was communicated using both visual and oral media. Medina (2008) maintains humans have a fantastic ability to remember pictures, stating that they will remember approximately 10% of what they hear after three days; however if this information is communicated orally, and supported with a picture, the person is likely to

remember 65% of the information after three days. Hegarty (2004) argues that external visualisations can substitute internal visualisation, and provide a greater insight/understanding to specific subject matter. If the individual has poor spatial ability, the external visualisation can act as a prosthetic aiding the learner.

Gardner's theory of multiple-intelligence identifies nine intelligences; spatial intelligence can be defined as the capacity to think in images and pictures, to visualize accurately and abstractly (Gardner, 1983). Newcombe & Frick (2010) highlight the importance of spatial intelligence by emphasising the need to visualise a tool and its purpose before it can be designed and fabricated. According to Felder, & Silverman (1988) most people of age attending higher education and older are visual learners, and most of the information in colleges is transmitted verbally, with an alternative approach possibly yielding a more valuable outcome. This method of learning is very important in disciplines such as architecture, engineering and science (Kolmos & Holgard 2008; Newcombe & Frick 2010). Images have always played a significant role in the learning process in primary education, and are now becoming increasingly more popular in higher education. By encouraging students to understand and communicate through visual modes, tutors can empower their students with the necessary tools to succeed in an increasingly media rich environment (Riesland, 2005). Green's (2006) report on the use of digital images in education in over thirty different institutions, investigated both the teachers' and students' perspective on digital images being used in the learning environment. The findings indicate the potential for digital images to revolutionise teaching practices because they are accessible, flexible, shareable, and annotatable. The capacity for visual communication is also supported by Gray who states "Visual literacy is:-the ability to both read and write visual information; the ability to learn visually; and to think and solve problems in the visual domain- this will, as the information revolution evolves, become a requirement for success in business and in life" (cited in Baker, 2012, p.41).

2.4 Learning with authentic practice

Authentic learning is defined as a method of teaching that focuses on real world, complex problems and their solutions, using role play exercises, problem-based activities, case studies and participation in virtual communities of practice (Lombardi, 2007). In the context of the current study, authentic learning helps to motivate, engage, rationalise and create a deeper learning experience for the Building Service students. The activity emulates professional practice of a Building Service engineer. For example, in the event of water damage to a property or a complaint of a poor wiring installation, the engineer will record the physical damage or danger using photography. He/she later writes up the report outlining the issues, and supports the claims with the photographic evidence. The activity emulates this authentic practice and puts the student into a real work environment. This also has the advantage of placing the student in a multisensory environment, especially with Building Services as they are often hidden away in ducts, attics are purpose provided compartments, each having its own individual environmental characteristics including humidity, air temperature, odours etc. stimulating the students' senses. In a research study by Doyle (2011) when multiple senses are employed in the learning, better encoding of the subject matter takes place, hence improving recall of the new information. Medina (2008) believes people receiving information in a multisensory environment are more successful at recalling that information accurately later. Prensky (2010) believes that relevance is important, but maintains it does not go far enough to connect with the student. Making the subject real goes much further, and Prensky uses the term 'real' in the context of making a connection between the new knowledge and how the student may use it to do something worthwhile in the real world. Reporting on the standard of the Building Services in their own property is a real professional activity requiring increased levels of higher order thinking (Floyd et al., 2009).

In summary the literature indicates that student engagement in their learning is crucial to their success and that educators should focus their efforts on developing rich educational activities that immerse their learners in the subject matter, empowering them to exploit their full potential, and hence optimising their performance (Harper & Quaye, 2009; Zepke & Leach 2010). Substantial evidence validates the adoption of authentic learning strategies utilising digital photography to promote an inclusive learning environment through meaningful engagement.

3 PROJECT IMPLEMENTATION

The digital photography activity was implemented over a single semester where students attended a two hour session once a week on the subject of Building Services. All sixteen first year students agreed to participate in the study, and fifteen completed the research questionnaires.

The level 1 Building Services module covers seven specific topics; for example Cold Water Storage & Distribution, Space Heating, Electrical Installation etc. Prior to the beginning of the semester, a project brief was devised for each of the seven topics. This brief was uploaded to the college Virtual Learning Environment (VLE) Blackboard for adaptive release on specific dates over the semester. The briefs were made available to the students, one per week after week three for seven weeks. The brief requested information pertaining to the design and installation of each of the services in a residential property of their choice. A draft of the task was submitted by the student two weeks after the adaptive release, for review and feedback by both peers and the tutor. The students were divided into small groups of four for the purpose of peer reviewing. Based on the feedback received, students completed each of the seven projects creating a portfolio for submission on the final week to be graded by the tutor. Each group also made a 15 minute presentation on week 12 explaining their finest installations and explaining why this was the case.

4 RESEARCH DESIGN

A case study research methodology was adopted to capture information concerning student engagement and performance after implementing the digital photography activity. This took place over one semester to first year students studying Building Services Engineering. According to Baxter, Hughes and Tight (2008) a case study is the most appropriate research methodology to observe the cycle of a class with a view to establishing a generality. Qualitative data was collected using questionnaires to analyse the student experience and establish if a particular learning style was dominant amongst the participants. Quantitative data was used to compare the exam results with two previous classes and evaluate the performance.

The class consisted of sixteen students, and all agreed to participate in the research study. Sixteen completed the VARK™ 7.3 survey questionnaire on week 10 to identify individual learning styles. The VARK™ 7.3 questionnaire takes into account four different learning styles: Visual, Aural, Read-Write and Kinaesthetic.

Fifteen completed the research questionnaire on week 12. This questionnaire was divided up into four sections, which included 'Student Profile', 'Student IT Skills', 'Student Experience' and 'Strengths and Weaknesses of the teaching and delivery of the Building Services module'. End of semester exam results were compared with two previous cohorts to determine performance.

The results from the VARK™ 7.3 survey illustrated in Figure 1 indicate a marginal preference for kinaesthetic learning at 30% while a 29% preference for aural learning was shown. Read/write provided a result of 22% and contrary to previous research, the result for a visual learning preference was least favourable at 19%.

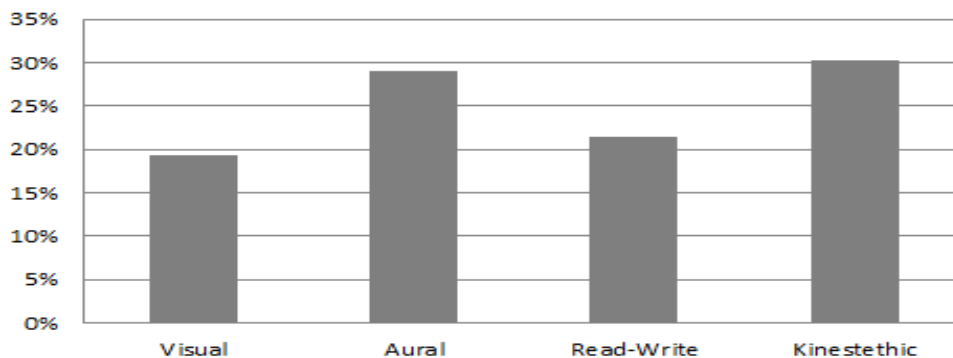


Fig 1 Building Service Students' Learning Styles

Although the learning activity had a strong focus on images and visual learning, kinaesthetic learning played a significant part in the various tasks that the students were required to undertake. It provided the students with the opportunity of using all their senses, and a hands-on approach, locating and photographing real life components and identifying their principle of operation from the activity. Kinaesthetic learning is associated very much with a practical approach to the learning (Gardner, 1983); (Flemming, 2011).

4.1 Student profile

The survey population consisted of an all-male group aged between 20 and 50. They were all qualified construction craftsmen. Of the group, 40% had attended school/college in the last 5-10 years, and the remainder had not attended either for more than ten years. The highest level of education reported by 73% of the students was a FETAC level 6 craft certificate. The majority of the group (39%) used their own home to complete the activity, while 28% used their parent's property. No student indicated that they could not select a property for the project.

4.2 Student IT Skills

When questioned about their IT skills, all the participants indicated they owned one or more of the IT devices listed; these included smart phone, desk-top computer, laptop and tablet, with 93% owning both a smart phone and laptop. The majority (80%), use a computer at least once a day and 76% have a social network account. 20% have received some type of prior IT training, leaving the majority without having attended any formal IT development. They all agreed that IT skills are essential for construction site managers. These unexpected results indicate the high level of interaction that today's construction workers have with various emerging technologies.

86% of the participants had used their phone for the purpose of photography outside the Building Services module. 46% indicated that they consider themselves as satisfactory in using MS Word, while 40% indicated that their use of word processing was good, and 7% indicated that their skills in basic IT were poor. When asked to rate themselves, in terms of their skills in using e-mail or the Internet, the majority of students indicated good to very good. 73% indicated that they had the necessary IT skills to complete the Building Services project, while 7% indicated they had encountered difficulties. 40% strongly agreed that the information on the college VLE Blackboard was helpful, while 47% agreed and 13% indicated a neutral stance.

4.3 Student experience

When asked if they enjoyed the module, 100% of students indicated Yes. 93% considered digital photography as an appropriate activity through which to learn the subject. 73% had never used photography previously in the learning environment. When asked to rate their knowledge of Building Services after the module, 80% indicated that they had a good knowledge, while 13% indicated a very good knowledge, and 7% a reasonable knowledge of the subject matter.

47% strongly agreed and 53% agreed that the digital photography activity was an appropriate method to encourage them to engage with the subject matter. When asked if they had sufficient time outside college to take the necessary digital photographs, 33% indicated that it was difficult to find the time, 33% indicated neutral and 27% disagreed, indicating they were able to allocate sufficient time to the project. 27% strongly agreed that it was a good method to motivate them into learning the subject matter and 63% agreed with the question. When asked if the activity was boring, 47% strongly disagreed and 53% disagreed. When asked if the activity provided opportunity for all to be involved, especially those that dislike traditional teaching methods, 88% supported the concept, while 20% took a neutral stance. 33% strongly agreed that the digital photography activity gave them a better understanding of the subject matter, while 60% agreed. 27% strongly agreed that they would like to see other teachers adopt the practice, while 53% agreed, and 20% took a neutral stance. When asked if they received an appropriate level of feedback on their project work, 20% strongly agreed, 46% agreed, 27% took a neutral stance and 7% disagreed.

4.4 Strengths and weaknesses of the teaching and delivery

Students were asked for their opinion on the strengths and weaknesses of the digital photography activity for the module. The analysis of the responses produced a number of common themes which were prioritised accordingly, providing the study with an insight to the learners' perspective to the alternative learning approach. There were a number of key strengths identified by the students; foremost was that taking photographs of the services was enjoyable and a good way to learn about the subject. Students indicated it gave them a better understanding of the subject matter and how the different systems function. It has made them more aware and given them a deeper understanding of the regulations and standards applicable to the different services. The approach was more interactive and encouraged students to be involved in the topic. Being allocated project briefs every week was regarded as a good way of motivating learners. Deadlines for draft submissions kept the students

focused so that they could participate in the peer reviews and tutor feedback process. The weekly feedback on the draft submission allowed for revision before final submission. Some students indicated they learned significantly from peers in small group discussions.

In contrast to these positive aspects, students indicated that if they fell behind on the project work, it would be very difficult to catch up. The project work they perceived to be very time consuming, and they believed that a brief instructional input on editing images and placing them into a word document should be provided early in the semester.

4.5 Comparison of exam results

The module exam results illustrated in Figure 2 compared two previous cohorts and the findings indicate that the study group performed marginally better than the two previous cohorts. Although no one in the 2014 cohort scored as high a mark as the top student in 2013, the group as a whole performed better than previous groups. The structure of the 2014 exam mirrored the previous two years, indicating that the approach with the digital photography has the potential to outperform a traditional pedagogic approach in this discipline.

This improvement may be attributed to a number of factors; primarily it may suggest that the activity facilitated the different learning styles within the group in a positive way. The consistently higher grade throughout the class suggests that the activity was engaging for the students, leading to improved performance. The activity broke down social barriers between the students and promoted a cohesive and collaborative learning environment; this arguably would encourage students to support each other in the learning, hence creating a richer learning experience for themselves.

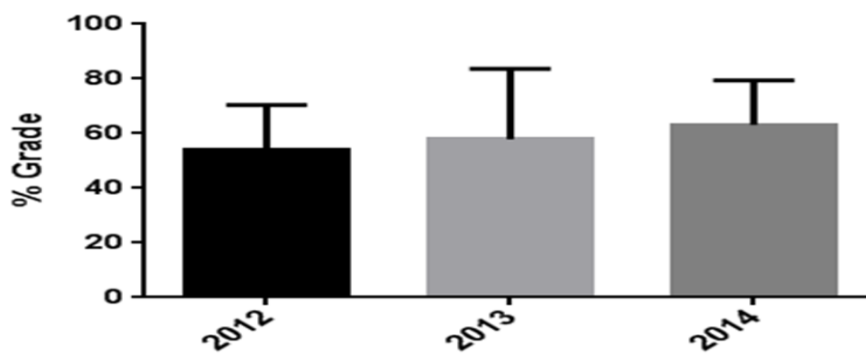


Figure 2 Comparison of Cohort Exam Results

5 DISCUSSION OF FINDINGS

The study set out to examine if student engagement and performance could be enhanced after digital photography was adopted into the learning environment rather than solely using the lecture approach in Building Services. The research indicated that consistent with current perspectives in the literature such as that by Thomas (2012), students who engage more with academic activities aligned with the learning outcomes are more likely to perform better in their exams. Crucial in this context are the activities that the students are expected to engage in; they must be aligned with the learning outcomes, achievable for the student and essentially interesting to undertake and complete (Zepke & Leach, 2010). The findings of this study are congruent with Skinner et al. (2008) who maintain that students will work harder when the activities are interesting and enjoyable.

The current study indicated that although a small number of the students used digital photography in a previous educational activity, they all enjoyed the current more extensive activity, and would like to see other lecturers adopt it into their practice. They indicated that the alternative approach was motivating and promoted inclusion for full class engagement (Debnath & Pandey, 2011). The majority felt that the activity gave them a deeper understanding of the subject matter, which is reflected in the exam results (Lombardi, 2007). These indicated a better group performance than the previous two cohorts. The activity put the student into the actual environment of each of the services and required them to photograph different aspects of the real life surroundings, and arguably this immerses the student with the subject matter using a superior method of learning over the classroom lecture (Prensky, 2010). Although electronic presentation tools can be an excellent medium for the transfer of information, the actual environment or habitat of the subject matter stimulates all the senses and is more compelling for the learner (Doyle, 2011). Taking the digital photographs of the different services

required considerable thought, and selecting the individual scenes containing relevant components is a thought-provoking task for those not familiar with Building Services.

The VARKTM revealed, contrary to previous research that the group had the least preference for a visual learning style, and the kinaesthetic learning style was most favoured. A possible explanation for this result may be due to the students being from a construction background, many having served an apprenticeship where practical application would be a popular approach to learning. As construction craft personal work in a variety of environments using different materials, it may be concluded that kinaesthetic abilities are more instinctively active.

The activity took place on the first semester of the three year part time programme, and arguably the activity went a considerable way in breaking down social barriers between students and creating a high level of cohesion within the group (Tuckman, 1965). The level of interaction between the students and the activity within the classroom was notably more apparent due to the weekly peer reviews on the progress of the project-work. The students welcomed the hands-on approach and were happy that the fear of academic failure and personal embarrassment was removed by the intervention of the practical activity (Clements 2010; Mignot 2000). Many indicated that they achieved a deeper understanding of the services, which is confirmed by the exam results. Two explanations may account for this phenomenon; firstly, the student has to develop a drawing illustrating the operating principle of each of the services based on the digital photographs recorded. Then write a report stating the current standard of compliance for each service, this requires considerable inquiry to gain a comprehensive understanding of each individual service and complete the reports. A second explanation is the discussion between students during the peer review sessions. Based on observations, it appeared that the mature students are more likely to ask each other questions and seek clarification from each other when working in small groups, and that students are less likely to ask questions in a whole class scenario for fear of embarrassing themselves (Jones, 2007). On reflection it appeared that small groups were more likely to engage with the tutor and seek direction when challenged, rather than individual students in previous cohorts. Students that feel isolated and excluded often fail to engage with the learning and consequently drop out of the course or under-perform in exams (Thomas, 2012). This improvement may be attributed to a number of factors; primarily it may suggest that the activity facilitated the different learning styles within the group in a positive way. The consistently higher grade throughout the class suggests that the activity was engaging for the students, leading to improved performance. The activity broke down social barriers between the students and promoted a cohesive and collaborative learning environment; this arguably would encourage students to support each other in the learning, hence creating a richer learning experience for themselves.

6 CONCLUSION AND RECOMMENDATIONS

This research indicated that integrating digital photography and replicating authentic construction professional practice can deliver enhanced student engagement and performance. The novel learning activity played a role in accelerating the stages of group development and encouraged a high level of cohesion between the students promoting a richer learning environment. The digital photographic activity encouraged student inclusion by utilising a variety of learning styles and addressing the challenge of academic literacy. Congruent with Skinner et al. (2008) the students did work harder because they found the activity interesting and enjoyable. In addition, the engaging authentic professional practice promotes the acquisition of transferable skills crucial in the 21st century.

In the context of Building Services the photographic activity is limited to learning the fundamental aspects of the subject matter, and not appropriate to more advanced stages, addressing commercial and industrial installations. Careful consideration should be given to establish if such an activity is appropriate to different subject disciplines and levels before endeavouring to implement a similar digital photography activity

Acknowledging this, the current research was limited by the small number of participants and only took place over one cycle with a Building Services module. The research requires additional cycles to be undertaken to corroborate this initial result and offer a detailed explanation as to why the activity delivers a positive outcome.

REFERENCES

- [1] Axelson, R. D. & Flick, A. (2010) Defining Student Engagement. *Change: The Magazine of Higher Learning*, 43(1), pp. 38-43.
- [2] Blaxter, L., Hughes, C. & Tight, M. (2008) *How To Research*. 3rd ed. New York: Open University Press.

- [3] Chickering, A. W. & Gamson, Z. F. (1987) Seven Principles for Good Practice in Undergraduate Education. *American Association of Higher Education*, March, 39(7), pp. 3-7.
- [4] Clements, P. (2010) 'Picture This: Complex historical concepts: A simple technique through which to teach them'. *Teaching History*, Issue 140, pp. 30-36.
- [5] Coates, H. (2007) A Model of Online and General Campus-Based Student Engagement. *Assessment and Evaluation in Higher Education*, 32(2), pp. 121-141.
- [6] Debnath, M. & Pandey, M. (2011) Impact of project based learning on recruitment of engineering students. Kuala Lumpur, s.n.
- [7] Doyle, T. (2011) *Learner Centered Teaching; Putting the Research on Learning Into Practice*. Virginia: Stylus Publishing.
- [8] Felder, R. & Silverman, L. (1988) Learning & Teaching Styles in Engineering Education. *Engineering Education*, 78(7), pp. 674-681.
- [9] Flemming, N. D. (2011) *VARK a guide to learning styles*. [Online] Available at: <http://www.vark-learn.com/english/page.asp?p=kinestheticprint> [Accessed 17 May 2014].
- [10] Floyd, K. S., Harrington, S. J. & Santiago, J. (2009) The Effect of Engagement and Perceived Course Value on Deep and Surface Learning Strategies. *Informing Science: The International Journal of an Emerging Transdiscipline*, Volume 12, pp. 181-190.
- [11] Folley, D. (2010) The Lecture is Dead Long Live the e-Lecture. *Electronic Journal of e-Learning*, Volume 8, pp. 93-100.
- [12] Gardner, H. (1983) *Frames of Mind: The theory of multiple intelligence*. New York: Basic Books.
- [13] Gray, D. (2012) Chapter 3 Visual Literacy. In: *Media Literacy*. 1st ed. America: International Society for Technology in Education (ISTE), pp. 41-71.
- [14] Green, D. (2006) *Using Digital Images in Teaching and Learning, Perspectives from Liberal Arts Institutions*, s.l.: National Institute for Technology and Liberal Education Wesleyan University .
- [15] Harper, S. R. & Quayle, S. J. (2009) Beyond Sameness, with Engagement and Outcomes for All. In: *Student Engagement in Higher Education*. New York: Routledge, pp. 1-15.
- [16] Hegarty, M. (2004) Hegarty, M. (2004). Diagrams in the mind and in the world: Relations between internal and external visualizations.. In: A. F. Blackwell, K. Marriott & A. Shimojima, eds. *In Diagrammatic representation and inference*. Berlin Heidelberg: Springer-Verlag, pp. 1-13.
- [17] Hernández, R. (2010) [Online] Available at: <http://icep.ie/wp-content/uploads/2010/01/Hernandez.pdf> [Accessed 12 December 2013].
- [18] Jones, L. (2007) *The Student-Centered Classroom*. New York: Cambridge University Press.
- [19] Kolmos, A. & Holgard, J. (2008) *Learning Styles of Science and Engineering Students in Problem Based and Project Based Education*. s.l.: Sense Publications.
- [20] Kuh, G. D. (2001) *The National Survey of Student Engagement: Conceptual Framework and Overview of Psychometric Properties*. [Online] Available at: http://nsse.indiana.edu/2004_annual_report/pdf/2004_Conceptual_Framework.pdf [Accessed 7 November 2013].
- [21] Kuh, G. D. (2009a) What Student Affairs Professionals Need to Know about Student Engagement. *Journal of College Student Development*, 50(6), pp. 683-706.
- [22] Lester, P. M. (2014) *Visual Communications, Images with Messages*. 6 ed. Boston: Wadsworth, Cengage Learning.
- [23] Lombardi, M. M. (2007) *Authentic Learning for the 21st Century: An Overview*, s.l.: Education Learning Initiative (ELI).
- [24] Medina, J. (2008) *Brain Rules*. Seattle, WA.: Pear Press.

- [25] Mignot, P. (2000) Using visual methods in careers education and guidance. *Pastoral Care in Education*, 18(2), pp. 8-16.
- [26] Najjar, L. J. (1998) Principles of educational multimedia user interface design. *Human Factors: The journal of the human factors and ergonomics society*, 40(2), pp. 311-323.
- [27] Newcombe, N. & Frick, A. (2010) Early Education for Spatial Intelligence: Why, What, and How. *International Mind Brain and Education Society and Blackwell Publishing*, 4(3), pp. 102-111.
- [28] O' Neill, G. & McMahon, T. (2005) Student-Centred Learning: What Does it Mean for Student and Teacher. Dublin: AISHE.
- [29] Pashler, H., McDaniel, M., Rehrer, D. & Bjork, R. (2008) Learning Styles: Concepts & Evidence. *Psychological Science in the Public Interest*, 9(3), pp. 105-119.
- [30] Prensky, M. (2007) Keeping both teachers and students comfortable in an era of exponential change. *Emerging Technologies of Learning*, Volume 2, pp. 40-46.
- [31] Prensky, M. (2010) Teaching Digital Natives Partnering for Real Learning. California: Corwin A Sage Company.
- [32] Purcell, K., Heaps, A., Buchanan, J. & Friedrich, L. (2013) *How Teachers Are Using Technology at Home and in Their Classroom*, Washington: Pew Research Center.
- [33] Riesland, E. (2005) *Visual Literacy and the Classroom*. [Online] Available at: <http://education.jhu.edu/PD/newhorizons/strategies/topics/literacy/articles/visual-literacy-and-the-classroom/> [Accessed 6 May 2013].
- [34] Russell, S. S. (2006) An Overview of Adult Learning Processes. *Urologic Nursing*, 26(5), pp. 349-352.
- [35] Skinner, E., Furrer, C., Marchand, G. & Kindermann, T. (2008) Engagement and Disaffection in the Classroom: Part of a Larger Motivational Dynamic. *Journal of Educational Psychology*, 100(4), pp. 765-781.
- [36] Smallwood, J. & Schooler, J. (2006) The restless mind. *Psychological Bulletin*, 132(6), pp. 946-958.
- [37] Solvie, P. & Kloek, M. (2007) Using Technology Tools to Engage students with Multiple Learning Styles in a Constructivist Learning Environment. *Contemporary Issues in Technology and Teacher Education*, 7(2), pp. 7-27.
- [38] Thomas, L. (2012) What Works? Student Retention & Success; Building Student Engagement and Belonging in Higher Education at a Time of Change., s.l.: Paul Hamlyn Foundation.
- [39] Trowler, V. (2010) *Student engagement literature review*, York: The Higher Education Academy.
- [40] Tuckman, B. W. (1965) Development Sequence in Small Groups. *Psychological Bulletin*, 63(6), pp. 384-399.
- [41] Weimer, M. (2014) *The Teaching Professor Blog. Whats the Story on Learning Styles?*. [Online] Available at: <http://www.facultyfocus.com/articles/learning-styles/whats-story-learning-styles/> [Accessed 30 April 2014].
- [42] West, D. M., (2013) Mobile Learning: Transforming Education, Engaging Students, and Improving Outcomes. *Centre for Technology Innovation at Brookings*, September.
- [43] Windham, C. (2005) The Students Perspective. In: D. G. Oblinger & J. L. Oblinger, eds. *Educating the Net Generation*. Washington DC: Edcause.
- [44] Woodgate, D., Fraser, D. S. & Martin, S. (2011) Bringing school science to life: Personalisation, contextualisation and reflection of self collected data with mobile sensing technologies. Bristol: ESCalate.
- [45] Zepke, N. & Leach, L. (2010) Improving student engagement; Ten proposals for action. *Active Learning in Higher Education*, November, 11(3), pp. 167