Use of Industrial Simulation to Deliver Academic Knowledge Core Skill and Vocational Skill Outcomes for Surveying Learners in Higher Education

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Abstract

This paper is based upon the author's research into developing the use of industrial simulation as a method of delivering, academic knowledge, vocational skills and transferable skills to undergraduate surveying learners. The rationale behind research is that all four stakeholders to surveying education, learner, education provider, professional bodies and employers, desire that graduates be ready for employment. The paper establishes requirements for the equitable delivery of any form of education, and seeks to ensure that any simulation achieves these. It proposes a research methodology which allows the researcher to develop better prepared and delivered industrial simulations by use of an action research model and learning lessons from previously completed simulations. Using existing data from the author's practice a complex industrial simulation, was planned and executed. The details and outcomes of this simulation, run at the University of Salford in 2015, are discussed. Include is how the simulation was adapted from the usual format to accommodate a multidisciplinary cohort of learners. The tutor observations, academic achievement and participant feedback are evaluated using the action research methodology proposed within the paper, to see where lessons might be learned and used to improve a proposed further simulation. A further simulation, also adapted to meet specific learner requirements, is proposed. Conclusions based upon the focus simulation evidence a change in the outcomes envisaged at the commencement of research.

Key Words

Industrial Simulation, Action Research, Scaffolding, Evaluation of Performance Data

Introduction

There are four stakeholders to graduate level surveying education. These are the learner, the education provider, the accrediting professional body and employers. A plethora of research has been undertaken, by education providers such as Newcastle Northumbria University, and independent researchers which indicates that each stakeholder requires graduates to possess vocational and transferable skills in addition to academic knowledge. (Fisher et al 2006). The aim is for graduates to leave education with some degree of competence in the basic skills of

the profession they wish to enter. From that competence comes confidence, both from the graduate and their employer, (Dempsay et al, 2002). This debate has been extended to include providing graduates with skills which go beyond those currently common in practice, but also including new ones such as, using the new technology which will drive future practice, (Strong, 2015). What is not so widely researched however is how this might be achieved, without the collateral damage associated with the increased challenge brought about by any student focused learning as cited by Nunnington, (Nunnington, 2009). The potential negative impacts of these challenges are also noted by Edelson, (Edelson, 1999). Whilst this paper purely focuses upon the preparation, planning and evaluation undertaken when preparing a teaching and learning activity which delivers academic learning, transferable skills and vocational skills training outcomes, in one supported industrial simulation exercise, prevention of any adverse impact is a paramount consideration..

Methodology and Rationale

The method chosen for delivery was established by the author at the commencement of research, in 2010. This method is to use a realistic industrial simulation, resulting in assessment by the submission of industry accepted documentation. The rationale for this method of delivery is laid out in previous work by the author, (Mclean, 2010), (Mclean, 2015). Industrial simulation uses an enquiry based learning pedagogy. This methodology has proved successful in previous simulations both in terms of learner achievement and participant feedback, (Mclean, 2015). As identified by Nunnington, the enhanced learning from student focused learning comes from increasing the challenge placed upon those learners, (Nunnington 2009) They are effectively taken from the comfort zone of a classroom into often unfamiliar site based settings. It is the author's belief that collateral damage to some learners for the gain of additional learning for others is unacceptable, and can be avoided by the careful organisation and delivery of the activity. It is also the belief of the author that the evaluation of previous simulations can enhance future ones. It is the view of Savery that failure to undertake this evaluation and evolution is one of the reasons for a lack of success in any problem based learning pedagogy, of which enquiry based learning forms a branch , (Savery, 2006).

In order for this methodology to be a successful there needs to occur an evolution of the pedagogy. The results of all simulations must be evaluated and the lessons learned used to enhance the next one. This effectively describes action research, which is a circular process of planning, execution, evaluation, enhanced planning, execution, etc. and is in the author's view common sense teaching practice.

"Action research is the name given to a particular way of researching your own learning. It is a practical way of looking at your practice in order to check whether it is as you feel it should be. If you believe your practice is as it should be you will be

able to explain how and why you believe this is the case; you will be able to produce evidence to support your claims. If you feel your practice needs attention in some way you will be able to take action to improve it and then produce evidence to show in which way the practice has improved." (Mcniff & Whitehead, 2002).

Action research is often shown diagrammatically as a four stage process, which Waters and Adam describe as being, planning, action, monitoring and reflection, (Waters & Adam 2006), however the author has included a fifth stage by including ideas gleaned from external research reading and observation of the practice of others. The practice described later in this paper evolved over a five year period of research evaluation and practice.

The areas identified as requiring careful organisation

"The problem should be interesting, relevant and engaging to foster learner ownership", (Jonassen, 1999),

Realism and Appropriate Level of the Activity, It is the professional experience of the author that an undergraduate when told that they will adopt the role of a senior professional in a simulation will often not engage with the role as it is unrealistic for their level, therefore they do not believe they can deliver at the required level. When asked however to fulfil the role and tasks commensurate with the level of a newly graduated surveyor, the learner can more often engage realistically with the simulation. Khan and ORourke cite the need for learners to own sufficient skills or access to the required knowledge to participate in a realistic manner, which means the activity needs to be realistic for the knowledge and skill level of learner, or they are incapable of learning at a high enough level to complete the simulation's outcomes, (Khan & ORourke, 2004). Doyle and Brown cite the need for a simulation to be realistic, in order for it to match the material delivered in the classroom, (Doyle and Brown, 2000). This effectively means every activity is designed by the author to be realistic at the level of the least able member of the participating cohort. An activity analysed later, is a multi-disciplinary one where care was required to keep the activity relevant to learners from different backgrounds, and not lose realism by taking learners in to a different discipline. This avoided what Claxton described as disinhibition where learners disengage and withdraw from the learning, (Claxton et al 1996).

Location, Safety and Access to the Site.   Education as with every other form of activity is very much embedded within a strong health and safety culture. Unfortunately most kinds of construction and surveying sites, required for a surveying simulation, offer some degree of danger. This is exasperated in teaching by the numbers of learners who are present on site.

*"Risks should be balanced against the benefits of taking part in an experience. This way outdoor learning can be safe and stimulating" (*Educating Scotland 2015).

Places of learning regardless of type should be safe and simulating, but still well controlled. The nature of this control, if activity takes place off-campus is laid down by the management of the institution, in documents like "Guidance Notes for University Field Trips", (MMU, 2011). The health and safety factors and resources required for large numbers of learners, particularly where stated supervision to tutor ratios are low, can impact upon the realism of the activity, and make a simulation practically unviable . Three methods of performing realistic simulations in safe environments will be discussed later.

Support Offered to Every Learner As previously stated it is the author's view that no learner disadvantage should arise from simulated activity. This involves the implementation of a robust regime of learner support commonly referred to as scaffolding. It is the presence of high levels of scaffolding which Hmelo-Silver , believes defines enquiry based learning, and thus allow it to; "*address important goals of education that include content knowledge, epistemic practices, and soft skills such as collaboration* and self-directed learning". (Hmelo-Silver et al, 2007**).** It is believed that for simulations to be successful, there needs to be a joint ownership of the activity between tutor and learner (Dempsey et al, 2001). This means that the tutor cannot facilitate the activity and then allow learners to participate alone. The outcome of such would be outside of the tutor's control.   Lack of support or perceptions of isolation can create disengagement with the activity. Realism and success often require a discreet tutor presence. Mckenzie proposes that it is the visible but discreet presence of their tutor which keeps learners on track throughout the simulation, reduces uncertainties and mitigates against disappointment, (Mckenzie, 2000). One important point made by McKenzie is that realism can be lost is the activity takes an unrealistic length of time, and proposes that any regime of scaffolding should include measures to, "distil the work effort", and prevent the simulation from meandering towards becoming unrealistic, (Mckenzie, 2000). A further support measure offered to every learner as advocated by Blumenfeld, should be an easily accessible source of the essential information, through a dedicated database, (Blumenfeld et al. 1991).

Role of the Tutor Within the Activity Learners traditionally expect to be taught and to have tutorial support. The role of a tutor within a realistic simulation changes to being a facilitator. This role described by Tosey as being one who acts in collaboration with the learner in a cooperative enterprise within which leadership roles, dependent

upon time and purpose, may change (Tosey, 2006). Unlike leading a classroom session the leading role of the tutor in enquiry based learning is not so obvious, as it does not provide leadership of all learning. The use of industrial simulation could therefore be perceived by students as diminishing the role of the lecturer (Askham, 2009). This clearly is not an advantage to the learning process, so the tutor must establish a role within the simulation which does not detract from realism in the simulation. Additionally the tutor must remain visible with a senior role which owns a superior level knowledge to the learner. (Khan & O'Rourke 2004). This if successfully planned and executed can prevent the detachment from occurring, as the tutor is present at the point that challenge starts to concern a learner. The expertise of the tutor is often the most valuable asset available. Having a central but discreet role allows the tutor to be in position to support any learner during the simulation, and maintain the realism of the simulation. An unsupported simulation would offer a poor message about the industry that the learner intends to enter.

Requirements for Learner Preparation, (Student and Tutor Driven) For a simulation to be successful learners must own sufficient knowledge and have access to the relevant research resources to complete the tasks. There is also a need for a shared ownership of the activity, (Dempsay et al, 2001), which can only occur if the tutor's role as teacher continues. When planning a simulation exercise there must be clear input of the required skills pre-activity, clear direction towards achieving any student focused learning required and clear direction on how to deal with the data collected during the activity. There being a regime of formal training and instruction before undertaking any site based work is not an unrealistic industrial scenario.

Nature of the Output The author favours the production of industry approved documents as assessment submission. For building surveying these provide a number of diverse reports and presentation formats, however other construction disciplines produce reports and documents which serve equally well. They can also be simplistic or complex as level requires, and can therefore be used at different teaching levels. The compilation of a stock industry format report is also a strong vocational skill requiring the practice of many transferable skills, and if completed well provides evidence of skill in surveying to show a prospective employer. Completion of such reports allow vocational skills, ethical knowledge and commercial skills to be demonstrated. When using this medium, scaffolding must include instruction on completing the report to an industry accepted format, content and presentation, ideally supported by an industry body template. The manipulation of the output to cover all the required outcomes is achieved by the preparation of a

specific client brief or survey instruction, requiring a particular set of client needs and a set of tasks required.

Level of Prior Knowledge Required. A different consideration to preparation knowledge is an assessment of learner capacity. There is no amount of preparatory work can ensure a simulation is successful and realistic, if it is pitched at too high a level for the learners. (Kirschner et al, 2006). In building surveying terms a first year undergraduate could realistically record the condition of a domestic residence or a lock up shop, but might be overwhelmed if asked to undertake a development survey of a complex multi-storey building. In assessing the nature of the activity heed must be taken in respect of prior knowledge. A building surveying learner, who has previously studied pathology could thrive within a setting containing complex defects, and a learner with prior knowledge of landlord and tenant law would have greater success undertaking a dilapidations survey. If prior knowledge is absent it must be fully taught or researched pre-simulation, and if that is not practical the simulation will never be realistic and should not be attempted.

Previous Simulation

The last simulation run by the author prior to writing this paper, differed from previous building surveying only simulations, where a client brief related to a specific building, and a survey on site resulted in a client focused survey report, showing outcomes such as professionalism, surveying skill, ability to meet client needs and ethical awareness. The module was entitled Conservation of the Historic Environment, and was delivered to what turned out to be not just building surveying learners, but in fact a multi-disciplinary cohort of final year construction, surveying and design technology students. The set module outcomes required the learner to demonstrate knowledge and understanding of;
1. Understanding of the philosophic approaches to the conservation of the historic environment
2. Understanding of the legal framework for conservation of the historic environment in the UK
3. Ability to record the condition of a building.
4. Ability to undertake research into the historic environment
5. Ability to evaluate the cultural significance of the historic environment
6. Ability compose effective plans and policies for the care, maintenance and future use of the historic environment

The assessment submission chosen was the appropriate completion of two complimentary industry accepted reports widely used in conservation planning. These are the conservation statement and the conservation management report with a supporting schedule of condition. Successful completion of these reports would meet all of the required outcomes. The template for producing these reports and the likely content for each section of a report is clearly laid out within a guide book publication from the Prince's Trust entitled How to Write Conservation Reports, (Prince's Regeneration Trust, 2013). The introduction to this work describes it as being,

"This guide is for non-specialists. It explains how to write a Conservation Statement and Conservation Management Plan." (Prince's Regeneration Trust, 2013),

It is therefore ideal for guiding a multi-disciplinary cohort looking at undertaking this kind of work for the first time. The prince's trust document also offered a specific template which could be used to establish the completeness of any submission, for any marker or internal moderator.

Due to a concern that non-building surveying students might feel disadvantaged if the entire class were taken on to a site together for the first time in an activity they might believe is effectively a building survey, it was decided to allow each student to find and focus upon an at risk significant building of their choice. Each were encouraged to look for a building which required actions which leaned towards their discipline skills, i.e. repair, reuse, funding, redesign, managing, etc. The caveat was that each student must provide a photographic safe access risk assessment before doing any field work. This had the dual purpose of ensuring property was safe to enter, and allowed the tutor to participate remotely by establishing if a building was likely to be unsuitable for the task, or too large for the learner to adequately tackle. This allowed tutor input at the start of all field work. Tuition commenced by delivering sessions describing how different professions are involved with work on historic buildings. This allowed the various disciplines to understand their roles and see the relevance of the tasks required to them. Additionally the grading scheme for the schedule of condition was written so as not to reflect building surveying excellence, but rather the value of the information provided in supporting the two reports. The schedule was a mostly photographic document completed to a tutor supplied template.

In addition to input at the start of the work, students were advised to use their tutor as a specialist consultant, and as the representative of the heritage legislation administrators, throughout the work. Issues that arose were discussed in class, and where appropriate all taught material was focused back to the assessment tasks. This was the first time that the author had not been present during the field work part of the simulation, but felt that control had been maintained, and an appropriate role established. Lecture notes and useful materials were made available through the university Blackboard learning environment.

The simulation was supported by a regime of nine weeks of teaching, plus a field trip to see the regeneration and refurbishment of a significant local building, which had once been at risk, but was benefiting from a lottery funding grant. The teaching schedule was organised to mirror the tasks required to complete the reports, from understanding the concept of cultural significance, through working with legislation and funding application, report writing, to appropriate reuse and repair techniques. Additional sessions on preparation of simple schedules of condition, and preparation of planned maintenance schedules were run for non-building surveyors and each discipline presented a conservation theme from within their scope of expertise to the other disciplines, i.e. architectural technologists looked at the use of BIM in conservation planning.

In addition to the module outcomes practice of the following transferable skills were desirable'
1. Ability to process information from diverse sources
2. Ability to carry out evidence-based evaluation
3. Ability to evaluate different viewpoints on complex and controversial subjects
4. Ability to write well-justified, evidence-based reports

Data Collected From The Activity

Data collected indicated that the simulation was successful. The module outcomes were fully met. Evidence that the students had assimilated and understood the main themes of the module was obtained in all cases.

Of 36 participants all 36 submitted on time and were successful in completing the module. Module grades ranged from 91% to 44%, with 17 students exceeding a mark in excess of 70% and a further 16 exceeding 60%. Average cohort mark was 69% albeit with a standard deviation of 11.38. This evidences motivated learners striving for excellence, competent to complete the required tasks and capable of producing a high standard of work.

Participant feedback was obtained through the university module evaluation process. 50% of participants thought the assessment was very clear and 50% thought it was clear, none though it to be unclear. Similarly 50% were very certain what they needed to do to gain a good mark and 50% knew what they needed to do. 67% highly valued the support role of the tutor, whilst 33% valued it. 67% felt very engaged, 28% felt engaged whilst only 1 student was not engaged. 67% were very satisfied by what was given to them and 33% were satisfied. The learning and assessment programme was designed to take 5 hours of personal study and activity per week. 50% reported that as being their figure, however 33% spent more than 10 hours studying this module and only 17% managed in less than 5 hours. Feedback from participants indicated that many were engaged to thoroughly research their chosen building.

In summary the use of a simulation to teach and assess a module requiring both academic knowledge and vocational skills was very successful. It delivered the required outcomes as observed during grading the resultant reports, it delivered the required knowledge at a high standard as evidenced by the marking, and delivered outstanding levels of participant satisfaction. There are however lessons to learn and move forwards into future simulations.

Evaluation of the Simulation

In spite of the success of this simulation and teaching regime, there are lessons to learn. Allowing each student to pick their own case study building did mean that some students were dealing with buildings which were too large or complex than an ideal case study should be. If this was repeated a maximum footprint size might prove beneficial. Conversely some students chose buildings which had limited significance or were not really at risk and had to work too hard to justify proposed management activity, which might have been mitigated by more detailed examples of the factors which causes risk. Consequentially these students, albeit through

their own choice, might have started at a small disadvantage. As evidenced above whilst the role and control of the tutor was established, the fact that the tutor was not present on site at some point of the simulated field activity did result in a dilution of that supporting role, for students who did not seek assistance. The solitary manner of each participant working on a different building meant that opportunities for students to work in groups, and interdisciplinary activity were missed.

As evidenced by this and previous simulations, the use of industry accepted documents not only provided an ideal method of submission, but added opportunities for the inclusion of other skills and made the simulation realistic, which has been identified as essential for a successful simulation.

Proposal for the Next Simulation

The module, Building Surveying Discipline Project 1, is delivered to first year building surveying students. They have limited exposure to surveying and no exposure to building pathology or ability to successfully deal with complex building defects, property layout or complicated construction technology. The simulation is required to deliver.

1. Perform a basic building survey
2. Identify building styles and ages.
3. Identify and advise on remediation of simple building defects
4. Complete a building survey report for a given instruction

In addition the following transferable skills are desired

1. Ability to process information from diverse sources
2. Ability to carry out evidence-based evaluation
3. Ability to write, evidence-based reports

Also the following key skills

1. Working with others
2. Ability to use independent thought
3. Use of basic surveying and recording equipment
4. Use of information technology

The Proposed Simulation

ASSESSMENT BRIEF
Scenario You are a newly graduated building surveyor employed by a practice which works with Salford City Council. It has been brought to the attention of the council that the Victorian exhibit, known as Lark Hill Place which was salvaged from demolished period buildings and rebuilt within Salford Art Gallery and Museum, is historically incorrect. The perceived problem is that whilst the street endeavours to take the visitor back to experience the Victorian era, the current condition of the buildings reflects the date of demolition, not as each building might have looked in the mid-19th century. Before the museum curators department can make any required adjustments, they need to establish the current condition, and likely construction date of each building on Lark Hill Place. As this is within a building surveyor's area of professional specialism, you have been asked to perform these tasks and submit an illustrated building survey report, written to an industry approved format, to the Head Curator of collections at Salford Council's Art and Culture department.
Tasks You will attend Lark Hill Place at a pre-appointed time, and perform condition surveys upon the exterior and visible internal areas of all the buildings contained therein. Using the Head curator as your client, and the survey purpose as stated, produce a survey report which meets the needs of your client, (The date of restoration is to be approximately 10 years after the original construction date of the newest building on Lark Hill Place). You are not required to advise on performing any of the changes required, just identify overall <u>condition</u>, major defects and <u>likely construction date</u> for each of the buildings, based upon their architectural style, materials used and their components, (i.e. type of any original sash windows).
Required Outcomes Perform a condition survey Record survey data Produce written reports in accepted format specific to the requirement of your client. Research building defects and remedial actions Research architectural styles and uses of building materials Working with others Independent study Professional communication techniques Use of information Technology Use of basic surveying tools and recording media
Submission Although the surveying may, (and should), be undertaken in teams of up to 4 students, submissions will be wholly individual. Each student will submit a building survey report to an industry used format. Each report will advise your client, on the current condition of each building on Lark Hill Place, and based upon the architectural style and materials used in construction, will propose a construction date for each property and a golden age restoration date for Lark Hill Place, 10 years after the build date of the newest property.
Assessment Weighting Reporting of condition – (40% of marks) Evidence of research into dating the property – (20% of marks) Evidence of focus upon the stated needs of your client – (20% of marks) Production of a professional survey report – (20% of marks)
Submission Required 1 building survey report which will contain the following. Executive Summary Details of the Instruction

Explanation of the nature of the survey, property and date of survey.
Terms of Business
Limitations to surveying
Illustrated technical report based upon observations, investigations and any testing
Summary and Recommendations
Recommendations for further specialist investigation, (if required).

(Refer to Bb notes " How to Produce a Building Survey Report*".

Rationale for the Proposed Simulation

The proposed simulation was borne out of the location being discovered and successfully used to teach the non-building surveying participants on the conservation module the rudiments of condition scheduling. The venue can be booked for uninterrupted field work, and is not impacted by adverse weather. The properties are simplistic, the defects obvious and not complex, and feedback from previous students was that it was an enjoyable place to learn. The venue being within the area of the University of Salford Peel Park campus and an open public building it is safe to enter and work in, without additional safety measures.. It can be booked for that initial group simulated survey, with the tutor being in a senior role, but also available for students to return to as required. Whether the brief is realistic enough to allow museum exhibits to engage learners in the same way as full buildings have in the past remains to be established, however pilot study evidence so far suggests so. The venue does however allow for all of the issues noted from the previous simulation to be addressed, and provides survey material suitable for the level of learner, with health and safety and working off campus issues catered for.

Conclusion

The pedagogy proposed is simplistic and easy to adopt. Much of it was being undertaken by the author as common sense practice before the study commenced. If successfully implemented it will address the desire of all four stakeholders to surveying education for vocational knowledge, vocational skills, transferable skills and evidence of academic ability. As evidenced by the outcome data from the completed simulation the results from a properly organised and supported industrial simulation exercise can be significantly good. The particular activity did evidence to the author a basic flaw in the initial aim of the research to produce the best pedagogy for delivering industrial simulations. The methodology as originally proposed would produce a linear progression of pedagogy as the data from one simulation drives changes to the next. Whilst this is a good teaching practice model, the conservation simulation showed that practice is not linear and differences in outcome requirement or the backgrounds of the participant learners might result in changes away from already tried and tested simulation format. The research methodology is therefore no longer purely progressing in a linear direction towards that one near perfect industrial simulation pedagogy, but also creating a library of evaluated practice to cover a number of situations, potential problems and learner groups.

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