ANGLIA RUSKIN UNIVERSITY

ACQUISITION OF HIGHER-ORDER PROFESSIONAL COMPETENCIES: A NEW SYNERGISTIC LEARNING MODEL

MARTYN QUARTERMAN

A thesis in partial fulfilment of the
requirements of Anglia Ruskin University
for the degree of Doctor of Philosophy

Awarded May 2017

Acknowledgements

The research study described in this thesis was carried out within the Department of Engineering and the Built Environment of Anglia Ruskin University. Firstly, I would like to thank the University for providing their innovative doctoral programmes and rekindling my interest in commencing a research journey.

Secondly, during this journey many individuals have kindly given up their time to participate in the research, provide information and give expert advice. There are simply too many to mention all individually, but there are some I must highlight and offer sincere thanks. Professor Pam Moule and associates from the University of the West of England, Faculty of Health and Applied Sciences, whose information on the use of simulations in nursing training and research was invaluable in the initial stages of this study. Suzanne Roberts-Smith from the Royal Institution of Chartered Surveyors, who politely and efficiently responded to my repeated requests for Assessment of Professional Competence data. Stuart Earl and Alasdair Thompson, who as experienced professionals provided invaluable advice and assistance on the direction and contents of this research. Thank you all.

Thirdly, much appreciation must be recorded to my supervisors Dr Michael Coffey and Dr Ian Frame without whose support and counsel I could not have completed this thesis.

Finally, I would like to thank my wife Sheila, family and friends who have supported me throughout this journey. Their forbearance over a number of years, during which my time has been spent in numerous libraries and shut away in my study, has been undaunting.

ANGLIA RUSKIN UNIVERSITY
ABSTRACT

FACULTY OF SCIENCE & TECHNOLOGY

DOCTOR OF PHILOSOPHY

ACQUISITION OF HIGHER-ORDER PROFESSIONAL COMPETENCIES: A NEW SYNERGISTIC LEARNING MODEL

MARTYN QUARTERMAN

May 2017

Context

This research centres on the acquisition of professional competencies by graduates who have recently entered the construction industry. Many professional competencies involve critical thinking and subjective decision-making under conditions of uncertainty and variability; and therefore require higher-order abilities to accomplish. The acquisition of these competencies has been shown to be problematic, difficult to achieve and to take longer than anticipated. The aim of this research was to determine if acquisition could be enhanced and/or accelerated.

Research Design

The research design adopted a mixed methods approach. The study commenced by identifying and defining the problematic competencies through a process of qualitative research. This was followed by analysis of existing learning theories and non-traditional learning techniques that had been applied in other contexts through a search of the literature and published accounts of applications. The analysis identified constituent parts of theories and practice which were developed into an innovative learning model. The model was tested through a process of quantitative research conducted using a controlled experiment with a sample of new-entrant graduates employed by professional firms.

Findings

The research produced a new model of learning comprising a unique combination of learning theories, practices and applicational constituents which acted in a synergistic way to enhance the acquisition of higher-order professional competencies. The research identified synergy as an important factor in the design and efficacy of the model, hitherto not recognised.

Conclusions

The research has shown that higher-order professional competencies can be acquired faster and more effectively. It has developed and extended the learning theory of Bancroft, Burguillo, Lui *et al* and others through the identification of synergy as a significant factor. The research concludes by demonstrating that the learning model can reasonably be transferred to other new-entrants within the built environment industry and generalised to the development of graduate new-entrants in other professional sectors.

Key Words: Higher-order learning, synergy, professional competencies, non-traditional learning theory, synergistic learning model

Table of Contents

List of Figures

List of tables

COPYRIGHT STATEMENT

Chapter One – Introduction to the research study

1.1 Introduction

This research centres on the acquisition of higher-order professional competencies by graduate quantity surveyors who have recently entered the built environment industry. Graduates entering the industry must acquire a number of professional competencies over and above the subject and technical knowledge attained in their qualifying studies. These professional competencies involve critical thinking and subjective decision-making under conditions of uncertainty and variability; and therefore require higher-order abilities to accomplish. The acquisition of these professional competencies has been shown to be problematic, difficult to achieve and take longer than anticipated, which is detrimental to both employers and the graduate surveyors. This research seeks to define and determine the extent of the problem involved in the development of these professional competencies and to develop a new learning model that will enhance and accelerate the efficacy of their acquisition.

1.2 Background and origins of the research

1.2.1 Background

Interest in the initial problem arose from the researcher's experience as a director responsible for training and development within a medium-sized firm of Chartered Quantity Surveyors and the issues encountered in getting graduate quantity surveyors to full professional competency. This experience is reflected in the widespread commentary across the industry, particularly amongst professional surveying practitioners, regarding the challenges faced in getting new-entry graduates to the required level of competence that will enable them to become professionally qualified and capable of undertaking fee earning work without the need for undue supervision. Typically, Sullivan (2010, p.5) states that “this is a topic of conversation that comes up again and again, completing a quantity surveying degree course does not make graduates into trained quantity surveyors”. Clare (2013, p.9) asserts that work experience is essential, surveyors cannot practice on their academic knowledge alone”. Garrett (2013, p.9) identified the cause of the problem when he stated that the challenge is “to train graduates how to behave like professionals, which cannot be taught by academic study”. Detailed interviews with a sample of graduate training managers responsible for bringing new-entry graduates to the required level of performance formed stage two of the research study and confirmed this problem amongst professional firms. The interviews and detailed analysis are reported in Chapter Three of the thesis.

Professional firms who employ graduates incur a significant amount of time and expense to develop these new-entrants to the required level of professional competence. During this period of development graduates are not fully fee-earning, are restricted with regard to the tasks and functions that they can perform and present a higher risk of committing professional errors. They also require additional supervision and the provision of training and development, both expensive in time and cost. In an increasingly expanding market there is growing demand for quantity surveying services, whilst at the same time there is also a shortage of qualified quantity surveyors to meet this demand. Employers need new entrant graduates to become competent professionals as quickly as possible, so that their full earning capacity can be realised sooner and at minimum cost to the firm.

The persistence and significance of the demand for qualified quantity surveyors has been recognised nationally. It was reported in 2008 that quantity surveyors were to be listed on the national shortage occupation list operated by the UK Government (RICS, 2008). The shortage remains, illustrated by the Building for Growth report (Lloyds Bank, 2015) which lists quantity surveyors amongst those professions where a shortage is most acute. The shortage of quantity surveyors places a tangible constraint on the economic activities in the built environment sector, limiting the capacity to commence and complete projects within a particular period of time. So whilst professional firms suffer losses by not having the capacity to meet the demands of the market, indirectly the economic performance of the built environment sector is also impaired.

1.2.2 Origins

Historically the traditional route of entry into the surveying profession was through a process of work-based training supported by part-time day release or distance learning study leading to examinations set by the professional bodies. With the passage of time the traditional route has declined to one where the primary route of entry to the profession is almost exclusively via a university-based first degree. Eraut (1994) suggests that this move commenced in the 1960s with a significant increase in available college or university based degrees. The effect was to provide a vehicle for a mutually acceptable qualification system where the professional organisations approved higher education awards or recognised them to give exemption from some or all of their professional examinations. Eraut argues that the effect of this shift to degree based entry was that professional education became knowledge led rather than practical or application based. This resulted in deficiencies in areas such as decision-making and judgement that were inherently essential to the overall competency of professionals, irrespective of their profession. Eraut is critical of this situation and states that universities have had an opportunity to introduce a broader mix of academic and experience related modes of study, but adoption has been low. The recognised solution being to develop practical and applicational knowledge and skills once in post-graduation employment. Plackett and Hoxley (2009) confirmed this assertion in relation to surveyors and further observed that a combination of academic based education and post-graduation training was not always fully effective. This is supported by research conducted by Lee and Hogg (2009) between 2006 and 2008 which revealed a low level of confidence in key competencies beyond core academic knowledge in some 4000 early career quantity surveyors who were the subject of the research study.

Examining the effectiveness of degree-based entry to the surveying profession is outside the scope of this research. Indeed, the research is not proposing a move away from this academic entry route, especially as Eraut (1994) contends that degree level education is a major contributor to the status of professional bodies. The focus of the research is on enhancing and accelerating the acquisition of these professional competencies within the current academic entry and post-graduation development framework.

1.2.3 Professional body response

The professional body representing quantity surveyors, the Royal Institution of Chartered Surveyors (RICS), recognised the deficiency of academic entry routes which did not or could not develop a number of essential professional competencies and acknowledged the need to develop these before certifying new-entrants as professionally qualified. The RICS initially instituted a Test of Professional Competence (TPC) in 1973 which evolved into the Assessment of Professional Competence (APC) in 1997 as a means of ensuring that candidates had developed the necessary professional competencies before admitting them to full membership. The APC requires new entrants to complete a minimum of two years relevant professional work (Graduate Route 1) recorded in a diary and certified by a professionally qualified supervisor, complete a critical analysis report relating to their working experience and pass a final assessment in the form of a professional interview.

The APC makes the distinction between subject/technical competencies (referred to as core competencies) and wider professional competencies (referred to as mandatory competencies). Analysis of these competencies is discussed further in Chapter Four.

1.3 Confirmation of the problem

Evidence to confirm the problem and establish the case for the research was obtained using two approaches, an analysis of APC referral data provided by the RICS and a survey conducted with professional surveying firms.

(i) Analysis of APC referral data

An analysis was undertaken of the referral data for quantity surveyors taking the APC provided by the RICS Membership Operations Manager. The results cover the period from 2009 to 2012 and are summarised in Table 1.1 below.

Table 1.1 – Summary of APC referral results 2009 – 2012

Assessment of Professional Competence (APC) – Referral analysis Quantity Surveying and Construction Pathway			
APC Session	**Number of Candidates sitting final assessment**	**Number of candidates referred**	**% referred**
Session 2 - 2009	308	95	30.84%
Session 1 - 2010	234	84	35.90%
Session 2 - 2010	273	99	36.26%
Session 1 – 2011	246	102	41.46%
Session 2 – 2011	289	90	31.14%
Session 1 – 2012	213	83	38.97%
Session 2 – 2012	241	85	35.27%
		Average	**35.69%**

(Data not available for Session 1 – 2009)

The results showed that 30.84% to 41.46% of candidates who presented themselves for final interview following the requisite period of post-graduation professional experience failed to achieve the required levels of competency and were referred for further experience. This represents an average referral rate of 35.69%, which indicates that the current approaches to the development and acquisition of professional competencies are not fully effective for a significant proportion of candidates.

(ii) Experiences of professional employers

To further confirm the problem, a small scale survey of professional surveying firms who consistently employ a number of new entry graduates each year was undertaken. This involved a series of semi-structured interviews (face to face or telephone based) as advocated by Saunders *et al* (2009, p.324). A sample of five companies/organisations was selected; this provided a representative sample of employers of new-entrant quantity surveyors. Details of the participating companies/organisations are provided in Appendix A.

Interviews were conducted with the Senior Partner/Managing Director or the Director who was responsible for graduate recruitment and development from each participant company/organisation and as such would have first-hand knowledge of any problems in getting new-entrant quantity surveyors to professional competence. The interviews sought to determine two issues:

(i) Establish the existence of any deficiencies in the professional competencies of graduates and if so how significant the deficiencies are

(iii) Establish the importance to the firm that new entrant graduates develop the requisite professional competencies quickly.

The results of the interviews are presented in Table 1.2 below.

Table 1.2 – Results from initial significance investigation

Company/organisation	1	2	3	4	5
How significant are the deficiencies in professional competencies when new entrant graduates join the company?	5	5	4	4	4
How important is it that new entrant graduates develop the requisite professional competencies quickly?	5	5	4	4	3
KEY: 5 = Very significant/Important 4 = Significant/Important 3 = Neutral 2 = Less Significant/Important 1 = No Significance/Importance					

The results showed that all the firms encountered deficiencies in the professional competencies of their new entrant graduates. These deficiencies were considered to be 'very significant' or 'significant' by all the firms; none of the firms considered the deficiencies to be insignificant. Further discussions and questions concerning the nature of deficiencies revealed that they were particularly evident in areas requiring higher-order thinking such as judgement and decision making.

The importance of developing the requisite professional competencies quickly was either 'very important' or 'important' to four of the five firms interviewed. This finding identified a difference between SMEs and the larger firms. The SMEs regarded developing graduates quickly as more important than the larger national/international firms. Follow-on questioning established that the larger national/international practices generally had a specific budget for graduate recruitment and development. Consequently the time taken for competency acquisition and full "fee earning" capability was less important. However, the larger firms stated that in a competitive market budgets were under pressure and developing newly employed graduates quickly is increasingly important to them.

1.4 Research Question, hypothesis, sub-objectives and design

The preliminary investigations described above confirmed that the development of professional competencies, particularly those requiring higher-order thinking, are a problem for new entry graduates and their employers as the graduates seek to become professionally qualified. Thus the aim of this research was to resolve the problem of acquisition of these higher-order professional competencies. This led to the development of the research question, hypothesis, sub-objectives and outline design of the research shown below.

1.4.1 Research Question

The primary research question is:

Can the acquisition of higher-order professional competencies be enhanced and/or accelerated?

1.4.2 Research Hypothesis

This is expressed as a hypothesis tested within a controlled experiment in the research study:

"The acquisition of high-order professional competencies by new entrant graduate quantity surveyors can be enhanced and/or accelerated by a new learning method using non-traditional learning techniques"

1.4.3 Sub-objectives

Addressing the research question and hypothesis leads to the following sub-objectives, to:

- Identify the most problematic professional competencies for new entrant graduate quantity surveyors
- Develop a new learning model to apply non-traditional learning techniques within the structured experiential learning process undertaken by new entrant quantity surveyors.

1.4.4 Research design

The strategy that the research adopted was a logical sequence of tasks:

(i) Confirm and define the problem

(ii) Identify the professional competencies that were deficient and difficult to acquire

(iii) Analyse professional competencies and non-traditional learning techniques to determine the learning and applicational constituents

(iv) Develop a new model of learning to enhance and/or accelerate the acquisition of higher-order professional competencies

(v) Test the new model

(vi) Test the hypothesis and conclude.

The outline design of the research uses a sequential mixed methods methodology. This was selected because it logically addressed the evolving nature of the research through the main elements of the study. The first element confirms the problem, establishes the case for the research and the gap in knowledge. The second element defines the problem and identifies the deficient competencies to be addressed through a process of qualitative research. The third element analyses professional competencies and their development, together with an analysis of non-traditional learning techniques, through a literature search of learning theories and published accounts of applicational research in related areas. The fourth element develops a new learning model that combines theoretical and applicational constituents. The fifth element tests the learning model through a process of quantitative research in the form of a controlled experiment involving new-entrant graduates employed by professional firms. The fifth element presents and analyses the results enabling the hypothesis to be tested and the research question to be answered. Further explanation and justification of the research design is included in Chapter Two.

1.5 Expected contribution to knowledge

1.5.1 Expected contribution

The expected contribution to knowledge from this doctoral research is:

(i) To discover if acquiring professional competencies, involving higher-order thinking, can be achieved faster and more effectively

(ii) To produce a new learning model, comprising a combination of theories and applicational constituents that can overcome the problems encountered in the acquisition of higher-order professional competencies.

The extant published research does not address the enhancement and/or acceleration of higher-order competency acquisition within a professional development context. The research aims to provide empirical evidence relating to the efficacy of enhancing and accelerating the acquisition of essential higher-order professional competencies within a new entrant development framework.

1.5.2 Expected impact

The expected impact of the research can be considered in five categories:

(i) New entrant quantity surveying graduates – The outcome of the research aims to provide a new learning model for the development of higher-order professional competencies. This will provide new entrant graduates with an enhanced learning opportunity leading to less time spent gaining the competencies and becoming qualified quicker. It also reduces the chances of being referred at the APC assessment and so increases the first time pass rate.

(ii) Professional firms who employ new entrant graduates – Professional firms who employ new entrant quantity surveying graduates need them to become competent professionals as quickly as possible. The impact of the research aims to reduce the time to professional qualification, reduce the cost of training and supervision and provide greater confidence in their abilities.

(iii) Other Chartered Surveyor disciplines - On a broader front, the same impacts extend directly to other chartered surveyor disciplines who are faced with developing comparable and very similar competencies, therefore the impacts apply to building surveyors, real estate managers and other related disciplines within the RICS who are subject to qualifying via the APC.

(iv) Other professions in the built environment sector - There is evidence that similar problems of developing higher-order professional competencies exist in other professions engaged in the built environment, both in context and form. The potential magnitude of the impact has been assessed by examining student membership levels within other professional bodies represented in the sector. Five main professional organisations have been considered:

- Institution of Civil Engineers (ICE)
- Institution of Mechanical Engineers (IMechE)
- Institution of Engineering and Technology (IET), formerly Institution of Electrical Engineers
- Chartered Institute of Building (CIOB)
- Association for Project Management (APM)

All these bodies recognise the need for professional competency development and have student (or equivalent) grades of membership for entrants who aspire to become professionally qualified. Table 1.3 illustrates membership numbers for each of the above organisations, together with the RICS, as at December 2015. All numbers are rounded to nearest whole thousands.

Table 1.3 – Student membership numbers for main professional organisations

Professional Body	**Membership Numbers**	**Student (or equivalent) numbers**
RICS	118,000	38,000
ICE	86,000	21,000
IMechE	111,000	32,000
IET	164,000	49,000
CIOB	46,000	13,000
APM	21,000	1,000
Totals	**546,000**	**154,000**

Thus, the outcomes of this research have the potential to impact upon a population of approximately 154,000 professional new entrants across the sector as a whole. To place the significance of the potential impact in context this equates to 7.2% of the total workforce employed in the built environment sector as at March 2015 of 2.124 Million (Office for National Statistics, 2015).

(v) Wider context - It is also contended that the findings will be generalizable to a number of other professionals, such as doctors, lawyers, managers, etc. all of whom are expected to make complicated, subjective decisions under uncertainty; exactly the characteristics of higher-order professional competencies identified for quantity surveyors. There are some example of initiatives in this respect that are beginning to be developed, such as Barker (2011) and Fitzpatrick *et al* (2015) but these are generally limited to lower-order and/or defined outcome competencies, these are discussed in Chapter Four.

1.6 Structure of the thesis

The structure of the thesis provides a sequential progression through the research. The order and content of the chapters is summarised below.

Chapter One – Introduction to the research study: This chapter provides the background and context to the research. It identifies and establishes the problem for the research and defines the research question and hypothesis.

Chapter Two – Research design, methodology and methods: Chapter two justifies the selection of a mixed methods research paradigm that supports the epistemological and ontological position on which this thesis is presented. The chapter then discusses the research design and the methods applied.

Chapter Three – Initial identification and definition of deficient competencies: This chapter is concerned with the initial study to identify and define the deficient professional competencies challenging new entrant graduates. The chapter identifies the most significant deficient competency which is used to test the new learning model.

Chapter Four – Literature review: This chapter establishes the current state of knowledge in respect of professional learning and professional competencies. This includes the differentiation of higher-order competency and the link to critical thinking and subjective decision-making. The chapter then reviews the theory and application of non-traditional learning techniques in other settings and identifies their higher-order learning and applicational constituents used to inform the development of the new learning model.

Chapter Five – Design of the new learning model: Chapter five describes the design of the new learning model, explaining the structure and constituents of the model and the theoretical basis for their inclusion.

Chapter Six – Controlled experiment: This chapter describes the design and application of the controlled experiment used to test the new learning model.

Chapter Seven – Presentation and analysis of results: Chapter seven presents the data produced by the controlled experiment. The effectiveness of the learning model is determined through statistical analysis of the results, including examining the correlation of results between variables within the data set.

Chapter Eight – Discussion of the findings: This chapter discusses the main findings produced by the research and provides an explanation of why the results and findings have occurred. The chapter concludes by discussing the case for transferability of the findings to the wider population of new entrant graduates within the built environment industry and other sectors.

Chapter Nine – Conclusions and recommendations: The final chapter draws conclusions from the research and makes recommendations for further study. This includes a review of the research question/hypothesis and the extent to which each have been answered. Finally, the chapter revisits the gap in knowledge proposed at commencement and demonstrates the clear contribution to new knowledge emanating from this doctoral research.

1.7 Scope, assumptions and limitations

The scope of this research involves enhancing and accelerating the acquisition of higher-order professional competencies through the application of a new learning model. The research is focused on the professional competency deficiencies experienced by new entrant graduate quantity surveyors. The professional competencies are those defined by the professional body, the RICS, as part of the requirements to achieve professional qualification. The competency selected to test the new learning model in the controlled experiment was shown by preliminary study to be the most challenging and important competency, thereby providing the most stringent test. The sample used to test the new learning model comprised new entrant graduate quantity surveyors employed by professional firms located in the United Kingdom. The sample size is statistically significant to be sufficiently representative of all new entrant graduate quantity surveyors in the UK and to provide valid and reliable results. The characteristics of the sample are shown to be representative of all new entrant graduate quantity surveyors employed in the UK. The statistical limitations are considered and addressed in Chapter Seven of the thesis.

It is proposed that the results can reasonably be generalised to new entrant graduates in other professions in the wider built environment industry and other sectors, but these do not form part of the research. This proposal assumes that all new entrant graduates irrespective of their profession have similar issues with the deficiency and development of higher-order competencies. The contention of this research is that this is a reasonable assumption given the general nature and structure of degree courses.

1.8 Publications

The initial case for the research was presented at the RICS built environment research conference (COBRA) held at Dauphine University, Paris, 2-3 September 2010. This was followed by publication of a research paper (Quarterman *et al,* 2011) that proposed the use of non-traditional learning approaches to assist in enhancing and accelerating the acquisition of aspects of professional competency. The initial proposal presented formed the basis for the research described in this thesis.

1.9 Chapter conclusion

The aim of this chapter was to provide a rationale for the research, identify the focus on higher-order professional competencies and as a result introduce the primary research question:

Can the acquisition of higher-order professional competencies be enhanced and/or accelerated?

In conclusion, professional competency acquisition for new entrant surveyors is an important issue. Individuals must acquire a range of competencies to be effective in their roles and deliver full business benefit to their companies/organisations. Evidence suggests that the process of post-graduation competency acquisition is not always efficient or fully effective and this applies particularly to higher-order competencies which include complicated and subjective decision making. The aim of the research is to define and determine the extent of the problem and develop a new learning model that will enhance and accelerate the efficacy of higher-order competency acquisition. Chapter One has established the basis for this aim which is now developed further in the remainder of the thesis.

Chapter Two – Research design, methodology and methods

2.1 Introduction

Chapter Two discusses the philosophical basis of the research, the rationale for the choice of a mixed methods paradigm and a description of the research methods applied to each stage of the study. The objectives of this chapter are to:

(a) Identify and justify the theoretical paradigm that supports the epistemological and ontological position on which the thesis is presented

(b) Explain the design of the research process that underpins the study

(c) Provide a description of the methods applied to the fieldwork carried out in the qualitative and quantitative stages of the research

(d) Outline the ethical issues considered within the research design.

2.2 Theoretical paradigm for the research

The research paradigm adopted for this research is mixed methods. Johnson *et al* (2007) argue that mixed methods is one of the three major research paradigms, comprising quantitative, qualitative and mixed methods; and is a fully valid research paradigm for social inquiry of this nature.

Collis and Hussey (2009) assert that it is important to establish a clear research paradigm because it provides the theoretical framework for the study and the essential starting point in research design. Creswell (2009) describes the paradigm as being the researcher's "worldview" and basic set of beliefs that guide the research and therefore the contextual validity of the research. Collis & Hussey describe two main paradigms:

(i) Positivism – This paradigm originated in the natural sciences and rests on the assumption that social reality is singular and objective and is not affected by the act of investigating it. The research involves a deductive process with a view to providing explanatory theories to understand social phenomena. Creswell (2009) describes this paradigm as principally quantitative in that research methods focus primarily on experiments and the potential for generalisation of findings.

(ii) Interpretivism – This paradigm developed as a result of the perceived inadequacy of positivism to meet the needs of social scientists. It rests on the assumption that social reality is in the researcher's mind, is subjective and is affected by the act of investigating it. The research involves an inductive process with a view to providing interpretive understanding of findings within a particular context. Creswell (2009) describes this paradigm as principally qualitative in that research methods focus on subjective interpretation and understanding of the meanings individuals or groups ascribe to particular social or human problems.

Creswell cites Newman & Benz (1998) in asserting that quantitative and qualitative paradigms should not be viewed as polar opposites. He states that in practice they represent different ends of a line or continuum of paradigms that can exist simultaneously. As one moves along this continuum the features and assumptions of one paradigm are gradually relaxed and replaced by those of the next.

In order to determine the research paradigm for this doctoral study the primary philosophical assumptions were first examined and analysed. Table 2.1 provides a summary of these assumptions adapted from the work of Collis and Hussy (2009).

Table 2.1 – Assumptions of the main paradigms - adapted from Collis & Hussey (2009, p. 58)

Philosophical Assumption	**Positivism (principally Quantitative)**	**Interpretivism (principally Qualitative)**
Ontological Assumption (How researcher sees the nature of reality)	Reality is objective and singular, separate from the researcher	Reality is subjective and multiple as seen by each of the participants
Epistemological Stance (What constitutes valid knowledge)	Researcher is independent of that being researched	Researcher interacts with that being researched
Methodological Assumption (Process of research)	Process is deductive, generally draws on large samples and objective facts, results are accurate through validity	Process in inductive, sample sizes small, theories developed for understanding, results are accurate through verification

Based on this analysis at a philosophical level the research design commenced towards the interpretivism end of the paradigms continuum. In the initial stages the ontological position was that of subjectivity, with small scale samples of participants surveyed through interviews with each having a view on acceptable levels of competency for new entrant surveyors. The epistemological stance was principally interpretivist in that the researcher interacted directly with senior professionals/training managers within firms and the findings are primarily inductive. As the research progressed the study moved towards a deductive process through design and application of a controlled experiment. The experiment draws on larger samples and objective data, accuracy of the results is ensured through the reliability of the sampling strategy. Cresswell (2009) asserts that a study may begin with qualitative data collection and follow on with quantitative approaches which he describes as a sequential mixed methods strategy.

Thus, this doctoral research was conducted as a sequential mixed methods study. This was chosen because it logically addressed the evolving nature of the research and allowed evidence and meaning to emerge as the study progressed. Greene (2008, p.11) supports this logic and endorses the validity of mixed methods as a valid ‘paradigm stance’ within this context.

2.3 Design of the research process

Zeisel (1984, p.231) defines research as “a purposeful, systematic way to improve knowledge”. The basic characteristics of research according to Blaxter *et al* (2001) are that it is planned, cautious, systematic and provides reliable ways of finding out or deepening understanding. According to Creswell (2009) research is “a process of steps used to collect and analyse information in order to increase understanding of a topic or issue". The key issue emerging from all of these definitions is that research is primarily a process, aimed at collecting, analysing and drawing conclusions from information or data in an organised way. Collis & Hussey (2009) assert that whatever type of research approach is adopted, there are fundamental stages in a research process which must be passed through. According to Maxwell (2005) this process needs to be ongoing "involving 'tacking' back and forth between different components of the design". Collis & Hussey (2009) and Saunders *et al* (2009) support this assertion and affirm that although typical process models indicate one research stage leading logically on to the next, in practice research is rarely like this and failure at one stage may mean returning to an earlier stage, in practice there are repeated iterations in a research process model. For this research an iterative process approach has been applied and the design flowchart showing the methodological steps and iterations undertaken is shown in Figure 2.1.

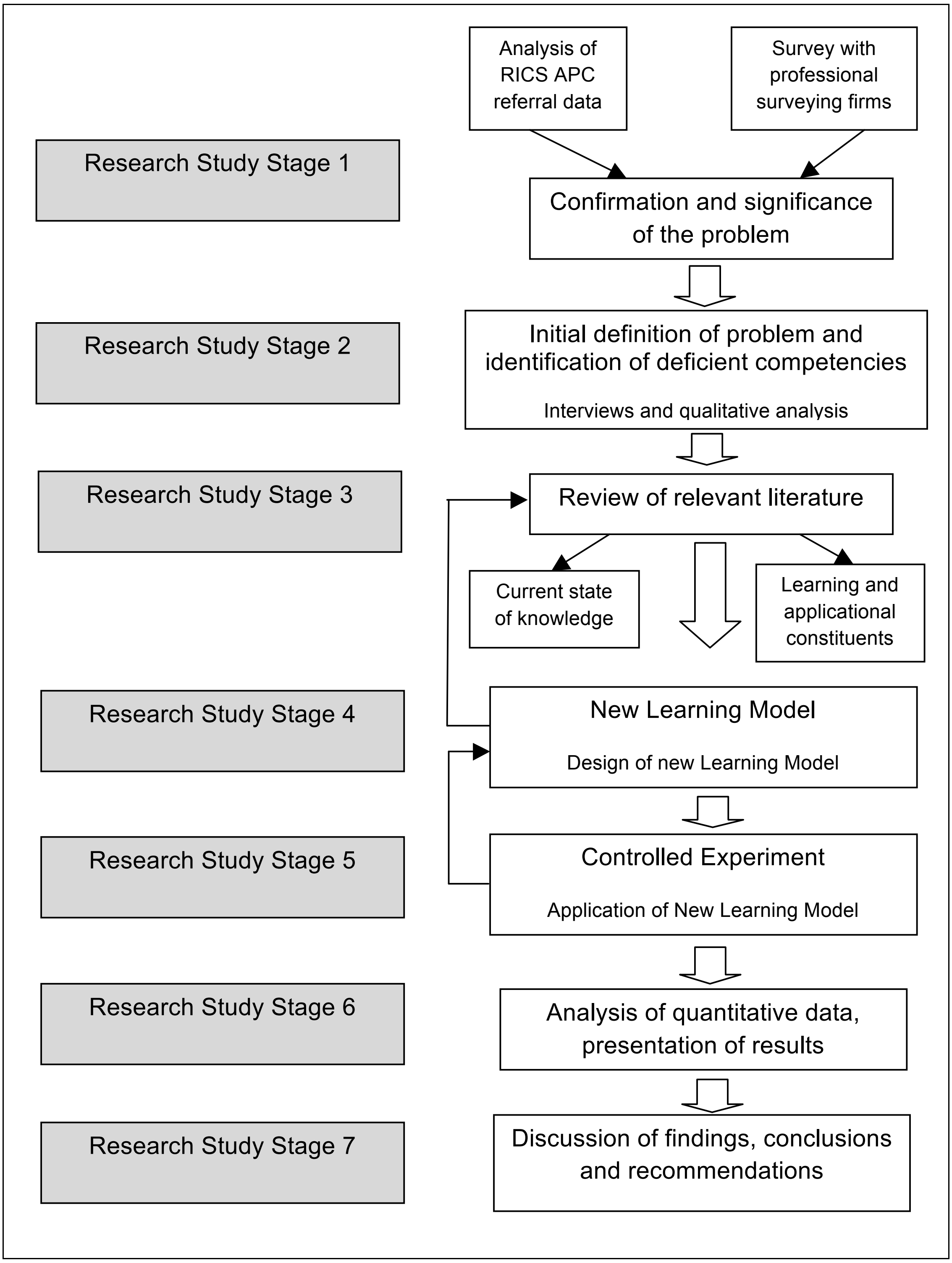


Figure 2.1 – Research Process adopted for this research – Adapted from Collis & Hussey (2009, p.10) and Saunders et al (2009, p.11)

2.4 Research methods

The research design for this study was divided into seven stages; the research methods applied to each stage are described below.

(i) Research Study Stage 1: The research began in 2010 with confirmation of the problem. The methods applied comprised an analysis of RICS APC referral data and a small scale pilot investigation with professional surveying firms. The outcome of this stage has been described in Chapter One.

(ii) Research Study Stage 2: This stage comprised an initial practice-based investigation. The method used semi-structured interviews, this technique was selected as the most appropriate research method to allow focused probing of interviewees in order to ascertain which competencies were the most difficult to acquire and created the biggest challenges. The interviews were constructed within a framework of questions as advocated by Saunders *et al* (2009). A content analysis approach was applied to analysis of the qualitative data collected from the interviews. This is described in Chapter Three. The research stage concluded with a cross-tabulation analysis of the deficient competencies to identify a priority area for testing of the new learning model.

(iii) Research Study Stage 3: This stage established the current state of knowledge in respect to professional learning, competency and higher-order thinking. The method used was literature review. The data and information derived from this review was used to provide the theoretical basis for development of the new learning model.

(iv) Research Study Stage 4: This stage developed the new learning model. This involved numerous iterations of the literature review in order to develop, establish and confirm the theoretical validity of the model.

(v) Research Study Stage 5: This stage comprised a major period of fieldwork in the form of a controlled experiment to test the learning model. A controlled experiment was selected as the logical approach to test the impact of the new learning model on a representative sample of new entrant graduates. The design of the controlled experiment was a reiterative process to ensure that all theoretical and applicational constituents that comprised the learning model were addressed. The methods used in this stage are described in further detail in Chapter Six.

(vi) Research Study Stage 6: This stage involved an in-depth analysis of the empirical data generated by the controlled experiment and presentation of the results.

(vii) Research Study Stage 7: The final stage analysed the results of the study to identify reasoning and correlation. This permitted a discussion of the findings, drawing of conclusions and recommendations to be made.

2.5 Ethical issues considered

Being responsible and ensuring the protection of others are the principles adopted throughout the research. The research involved working with professional firms, their representatives and new entrant graduate surveyors. Although there was no direct physical risk to participants, risk relating to company and individual confidentiality, personal development and career progression arose during the research. The three main ethical considerations were as follows:

(i) There is potential for participants' career progression to be influenced by assessing their knowledge and rate of professional competency acquisition

(ii) Information on APC referral rates is personal and individually sensitive

(iii) Information on graduate training schemes and performance may be commercially sensitive to firms.

To ensure these issues were addressed the research has been undertaken subject to Anglia Ruskin University ethical procedures. A copy of the approval is included at Appendix B. All participants received a Participant Information Sheet and a Participant Consent Form informing them of how the data collected would be used and stored together with their right to withdraw from the research at any time.

Every effort was made to ensure participants would not be disadvantaged or discriminated against through participation in the research. Possible concerns regarding impact on career progression were addressed by ensuring that individual participant results were not made available to the graduate training managers who participated in the study. All results were aggregated and presented on a group or firm basis. Confidentiality issues were addressed by ensuring that participants and data could not be individually identified. This was achieved by the use of designation references to maintain anonymity. Approval to use data provided by the RICS was received in writing on 18 December 2012, subject to maintaining confidentiality around the information relating to specific firms and individuals.

2.6 Chapter conclusion

This chapter has discussed the mixed methods research methodology applied to this research, outlined the methods applied to each stage and therefore established the epistemological robustness of the research. Further detail of methods applied to each stage of the study is provided in the relevant chapters of the thesis.

Chapter Three – Initial identification and definition of deficient competencies

3.1 Introduction

Stage two of the research is concerned with the initial practice-based investigation to identify and define the deficient competencies challenging new entrant graduates. The findings and results from this stage form an important element of the research process as they not only identify the deficient competencies, they also permit ordering of the deficiencies to provide a prioritisation for testing the learning model in research stage four.

3.2 Methodology

3.2.1 Semi-structured interviews

Semi-structured interviews were used as the main method of data collection in this stage of the research. The interviews were conducted with graduate training managers in each of the eight large private practice firms identified in Section 6.2.1. One firm had two respondents as there was a division of responsibility for graduate training within the company. A total of nine interviews were carried out between November 2013 and January 2014. Seven interviews were carried out face-to-face at the London or Regional offices of the firms, the remaining two interviews were conducted as telephone interviews. The duration of the interviews varied from 45 minutes (for the telephone interviews) through to 1 hour 30 minutes for the face-to-face interviews.

3.2.2 Sample selection

Large professional firms of quantity surveyors were selected as the most appropriate for the interviews because they have consistently employed and trained large numbers of graduate quantity surveyors each year for a number of years. As such they are aware of the professional competencies that pose the greatest challenge to their new graduates and which prevent speedy professional qualification. These firms would provide an informed and knowledgeable sample that would be representative of professional quantity surveying firms across the UK. In addition, the larger firms have the resources to appoint a senior member of staff to manage the training of new entrant graduates and their development to fully qualified professionals and beyond. These senior staff have specific responsibility for training and development as a significant part of their work, they have a more pro-active approach to training and acquisition of professional competencies and will have developed informed perspectives on them. Smaller firms of quantity surveyors do not have the resources to devote to graduate training and development, and generally treat it as a supplementary responsibility for a senior or less senior member of staff. As such they adopt a more reactive approach, which does not support the development of an in-depth perspective.

It was unrealistic in resource terms to contact all the employers of graduate quantity surveyors engaged on the RICS APC Quantity Surveying and Construction Pathway, of which there were 1,221 as at December 2012. The firms selected for the sample have the highest probability of providing reliable data and information in respect to the learning of professional competencies; they are also most likely to know the problems.

Selection and initial contact with the firms was established in discussion with the Membership Operations Manager of the RICS. The manager contacted representatives of the sample firms to ascertain their willingness to participate in both the interviews regarding professional competencies and in the testing of the new learning model. A deliberate feature of the administration of the interviews was to contact each of the participants, agree a date for the interview and send an outline of the interview aims and areas of questioning. The objective of this was to encourage interviewees to consider in advance the issues embraced by the interview, therefore provide better quality and more detailed information.

3.2.3 Interview design

To provide a framework for the interviews a detailed template was drawn up comprising fourteen primary questions. Additional points were added to the template for certain questions, these were for prompting interviewees at particular points in the interview to help them focus on the alternatives offered. Provision was made for sub-responses where interviewees provided further detail. The template was designed to form a Contact Summary Sheet as advocated by Miles and Huberman (1995, p.53) and included contextual information concerning the interviewee and the firm represented. The questions were as follows:

Questions 1 to 6 – Role of the interviewee in the firm and nature of the firm's graduate training programme? The purpose of these questions was to open discussions and confirm the form and structure of the graduate training programmes within the participant firm.

Question 7 – What teaching/delivery methods are used within the structured training programmes? The purpose of this question was to establish the extent of the programme and the methods adopted for the new entrant graduates to acquire professional competencies.

Question 8 – How does your company judge whether trainees are sufficiently competent? Prompt points were used to ensure that the broad range of competencies were considered and not limited to some of the more technical or topical. Competency and characteristic prompts included presentation skills, interpersonal skills and etiquette issues. The purpose of this question was to cross-check the judgement of sufficient competency against deficiencies identified in later questions.

Question 9 – Typically how long does it take for new entrant graduates to become sufficiently competent? The purpose of this question was to determine the length of time that each firm took to get graduates to achieve professional competence discussed in Question 8 and whether there was consistency between firms.

Question 10 – What aspects of competency do graduates trainees find most difficult to achieve? The purpose of this question was to identify those competencies that were the most difficult to acquire and those in which the graduates were most deficient. Prompt points were again used to generate discussion across the range of professional competencies; these included the role of a surveyor, problems in administration of contracts, communication, application of sustainability, RICS rules, professionalism, leadership and health/safety.

Question 11 – For those aspects identified as difficult to achieve what:

a) Are the main reasons for the difficulties from your firm's perspective?

b) What you feel are the main reasons from the graduate trainees' perspective?

The purpose of this question was to determine what the training managers considered to be the main reasons for the difficulties. It was also intended to identify if, and the extent to which any common reasons existed.

Question 12 – Repeated Question 10, but focussed on specific RICS APC competencies that graduates find most difficult to achieve.

Question 13 – Returning to those aspects of competency most difficult to achieve, which are most significant to your business? The purpose of this question was to assist in identifying the priorities for which competencies should be improved.

Question 14 – Would you be willing to invite participation of your graduate trainees in a learning workshop covering the most significant deficient competency identified from this research? The purpose of this question was to gauge the level of interest in participating in the application of the new learning model as part of a controlled experiment. The discussion also addressed preferred duration for a learning workshop. The purpose of this was to establish the duration that training managers would support for the controlled experiment and be practical for future roll-out within structured training programmes. It also provided a benchmark for the length of the new learning approach, so that its efficacy could be compared on an equal time basis with the methods currently employed by the firms.

Conclusion/Follow-on? The final discussion invited participants to raise any further points in relation to deficient competencies and any other aspects of the acquisition of professional competencies.

The interviews closed with an invitation to provide further assistance in the design of the learning workshop.

3.2.4 Administration of the interviews

The initial intention had been to record interviews utilising a digital recording device. Saunders *et al* (2009) asserts that recording allows material to be revisited as well as enabling the interviewer to be more attentive in the interview, including the possibility of picking up more easily on non-verbal cues. The interviewees felt this may constrain open and honest discussion; as a result the interviewees' answers were recorded contemporaneously as the interview proceeded using hand-written notes on the contact summary sheet. The validity of this approach is justified by Stake (1995) who asserts that recording interviews for future listening, transcription and analysis is time consuming and unnecessary unless an audio presentation is to be included in the research report. However, there are potential drawbacks with the written notes approach. Walford (2001) asserts that written responses constructed from an interview can be affected by inaccurate perception, imperfect memory and incomplete knowledge. Maxwell (2005) extends this point and highlights that written recording of responses can lead to interviewer bias. Although important to reduce interviewer bias, Maxwell acknowledges that it is impossible to do so entirely; the interviewer will always be influenced by the interviewee and the interview situation. To counter these potential drawbacks the interview technique adopted the summarising of responses as the interviews proceeded, following the approach suggested by Saunders *et al* (2009). During the interviews each response captured was 'read back' providing the opportunity for interviewees to validate responses, confirm correct comprehension, amend or add to the response.

Following each interview the hand written notes were typed-up as soon as practicable following the interview, normally within 24 hours, to provide accurate and consistent records. Where appropriate, reflective comments were added, particularly of the follow-on discussion, for example noting the significance of what interviewees had said with respect to the broader application of traditional and non-traditional learning techniques. Copies of the Contact Summary Sheets are provided in Appendix C.

3.3 Analysis

A content analysis approach as advocated by Taylor-Powell and Renner (2003) was applied to the qualitative data emanating from questions 7, 8, 10/12, 11 and 13. The steps to this approach were as follows:

Step 1 – Categories and Codes

Response data from the first interview was searched and an initial set of recurring themes or categories highlighted for each question. Each recurring theme was given a designating code, for example "LEAD" was utilised for leadership and confidence within the responses for Question 10 – Aspects of competency most difficult to achieve.

Step 2 – Emergent Categories

The full data set from all contact summary sheets was then manually searched and each occurrence of the categories referred to in Step 1 highlighted and coded. During the search process further answers/themes emerged and these were allocated additional codes.

Step 3 – Summarising the data

The resulting data was abstracted to pre-formatted tally-sheets and the number of occurrences for each particular code calculated. In total over 500 items of data were noted and analysed, approximately 50 to 75 items for each interview. Several potential software tools were considered to assist with the coding and analysis process, these included SPSS, NVivo and Excel. Of these SPSS was found to be the most sophisticated, with a focus on complex statistical analysis. NVivo offered qualitative data analysis, particularly suited to very rich text-based and/or multimedia data. Although the volume of data emanating from the interviews was extensive, the range was less so and therefore NVivo was considered unnecessarily detailed. As a result it was therefore decided to adopt Excel which included effective data sorting functionality and a selection of suitable built-in charting facilities.

3.4 Interview findings

3.4.1 Questions 1 and 6 – Role of the interviewees and nature of graduate training programmes

Questions 1 and 6: *What is your role in the firm and format of your graduate training programme?* The findings from these questions are summarised in Table 3.1 below.

Table 3.1 – Role of the interviewees and nature of graduate training programmes

Firm	Role of Interviewee	Graduate training programme
F1	Associate Director Graduate Training Manager	Structured training based on RICS APC Competencies together with general development programme
F2	Graduate Trainee Coordinator (Graduate Trainee Scheme led by Human Resources)	As for Firm F1
F3	Associate Director Graduate Training Manager	As for Firm F1
F4	Associate Director Graduate Training Manager	As for Firm F1 but together with formal and informal development programmes
F5	Graduate Trainee Coordinator (Graduate Trainee Scheme administered by Human Resources)	As for Firm F1 but together with formal development programme
F6	Development Director Member of Graduate Recruitment & Development Team	As for Firm F1 but together with formal development programme
F7a	Partner Chair of firm's Training Committee	As for Firm F1 but together with formal and informal programmes
F7b	Graduate Training Manager	As for Firm F1 but together with formal and informal programmes
F8	Director Lead for Graduate Training Scheme	As for Firm F1 but together with formal skills programme

The findings confirmed all interviewees are responsible for and directly involved in the graduate training programmes within their firms; and therefore meet the requirements for valid participants able to provide informed opinions. There was consistency amongst all firms who operated similar structured graduate training programmes based on the competencies required by the RICS APC. All firms had formal training plans to achieve the APC competencies through a range of formal and informal training programmes; typically, formally arranged sessions during working hours, supplemented by breakfast, lunch time or after-work sessions. In most firms the training was organised by the training manager, however in two firms the graduate trainee scheme was organised and administered by the Human Resources department. However the design and professional content remained with the graduate training managers or training committee.

3.4.2 Question 7 - Teaching and delivery methods

Question 7: *What teaching/delivery methods are used within your structured training programme?*

The objective of this question was to establish the learning techniques that are currently used to develop the professional competencies. The findings are recorded in Table 3.2 and presented graphically in Figure 3.1.

Table 3.2 – Data coding table – Teaching and delivery methods

Category	Code	Tally	Total Occurrences
Workshops	**WS**	1,1,1,1,1,1	6
Training Sessions	**TS**	1	1
Coaching	**CO**	1,1,1,1	4
Lectures	**LE**	1,1,1,1,1,1	6
Writing Exercises	**WR**	1	1
Role Plays	**RP**	1,1,1,1	4
Intranet/On-Line	**WEB**	1,1,1,1	4
Case Studies	**CS**	1,1,1,1,1	5
Problem Solving Exercises	**PSE**	1,1	2

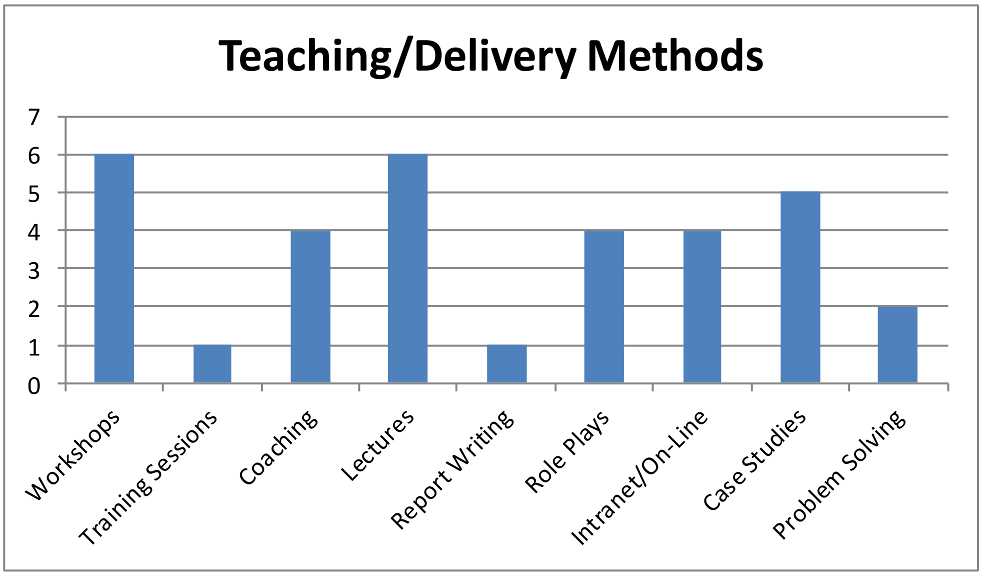


Figure 3.1 – Teaching and delivery methods (learning techniques) currently used

The responses showed that the predominant teaching and delivery methods were lectures and workshop sessions, which included process training and the use of external speakers. Workshops included topics such as presentation skills and typical APC assessment questions. Two firms described the use of scenarios within problem solving exercises and one firm referred to an approach as “Hypotheticals”, which were included within facilitated problem-solving exercises. Beyond this no evidence was found for the use of non-traditional learning techniques. One interviewee described the sessions as “chalk and talk”, which encapsulates the learning approach to the development of professional competencies as being very traditional; this was consistent across all the firms.

3.4.3 Question 8 - Judging whether trainees are sufficiently competent

Question 8: *How does your company judge whether trainees are sufficiently competent?*

For this question interviewees were prompted to discuss the skills and characteristics that were being sought and observed to assess the competency of graduate trainees. The findings are recorded in Table 3.3 and presented graphically in Figure 3.2.

Table 3.3 – Data coding table – Judging whether trainees are sufficiently competent

Category	Code	Tally	Total Occurrences
Technical knowledge	**TECH**	1,1,1,1,1,1	6
Client facing skills	**CFS**	1,1,1,1,1,1,1	7
Leadership and confidence	**LEAD**	1,1,1,1,1,1,1,1,1,1 1,1,1,1	14
Construction process awareness	**CPA**	1,1	2

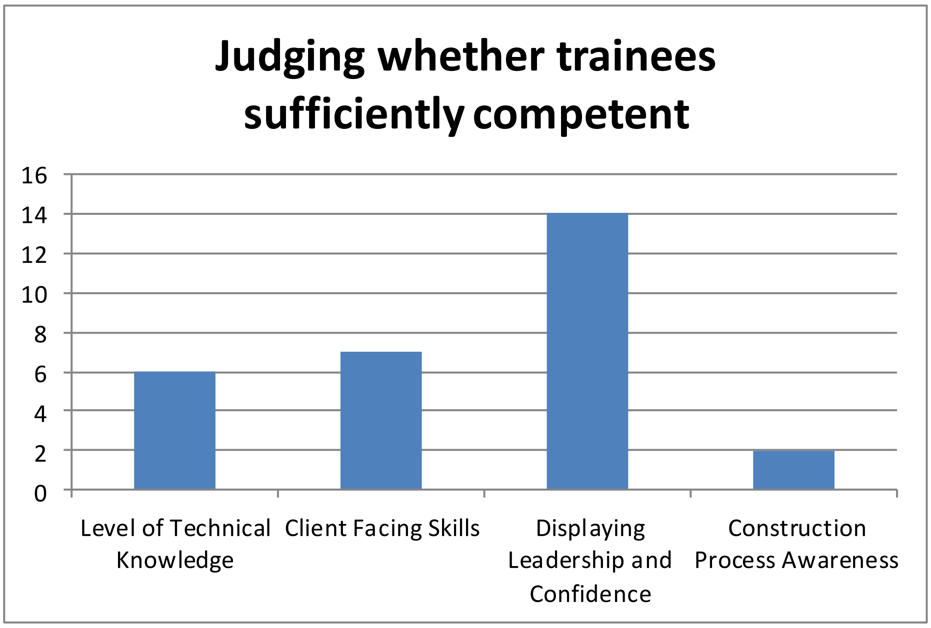


Figure 3.2 – Judging whether trainees are sufficiently competent

The findings revealed that displaying leadership and confidence was considered to be the most important aspect when judging whether graduate trainees were sufficiently competent. Within this theme interviewees highlighted elements such as ability to lead meetings, challenge and probe, display appropriate judgement and confidence in giving sound and justified advice. This indicates that softer skills and competencies are judged as more important than technical and process skills, however the assessment is very subjective and dependent on the perspective of the assessor, situation, time, etc. The responses confirmed that assessment was undertaken by the individual Supervisor in consultation with the Training Manager, however none had a formalised and consistent system of assessment, possibly because of the subjective and loosely defined nature of the competencies.

3.4.4 Question 9 – Duration to become sufficiently competent

Question 9: *Typically how long does it take for new entrant graduates to become sufficiently competent?*

This question focussed on the period it takes for new entrant graduates to become sufficiently competent, as assessed by the context of the discussion in Question 8. All interviewees interpreted this question as a discussion on the period required for graduate trainees to complete their APC experience records and successfully pass the final assessment process, thereby achieving full professional membership. The findings are summarised in Table 3.4.

Table 3.4 – Duration to become sufficiently competent

Firm	Duration	Category
F1	Average 3 years (2 years is exceptional)	3 years
F2	Average 2.5 to 3 years	2.5 – 3 years
F3	Average 2 years	2 years
F4	Average 2.5 to 3 years (2 years is exceptional)	2.5 – 3 years
F5	Average 3 years (2 years is exceptional)	3 years
F6	Average 3 years (2 years for bright candidates)	3 years
F7a	Average 3 years	3 years
F7b	Average 3 years (2years is exceptional)	3 years
F8	Average 3 years	3 years

The findings show only one firm considered two years was a sufficient period, all the other firms cited longer periods with the majority, six out of nine, stating an average of three years. It is evident that the minimum period of two years structured training required under APC Graduate Route 1 is shown to be insufficient. This finding may contribute to explaining why the first time referral rate for the APC final assessment is relatively high.

3.4.5 Questions 10 and 12 - Aspects of competency most difficult to achieve

Questions 10 and 12: *What aspects of competency do graduates find most difficult to achieve?*

Analysis of the responses to these questions were combined because of their repetitive nature. The objective of the questions was to identify aspects of competency, including specific APC competencies; that graduates find most difficult to achieve based upon those where they show most deficiency. The findings are recorded in Table 3.5 and presented graphically in Figure 3.3.

Table 3.5 – Data coding table – Aspects of competency most difficult to achieve

Category	Code	Tally	Total Occurrences
Leadership and confidence	**LEAD**	1,1,1,1,1,1,1,1,1,1	10
Application of Ethics	**ETH**	1,1,1,1,1,1,1,1,1,1 1,1,1	13
Measurement and Estimating	**MST**	1,1,1,1,1,1	6
Construction Technology	**TECH**	1,1,1,1,1,1	6
Administering Contracts	**CON**	1,1,1,1,1	5
Health and Safety	**H&S**	1,1,1	3
Role of Surveyor	**ROLE**	1,1,1	3
Sustainability	**SUST**	1	1

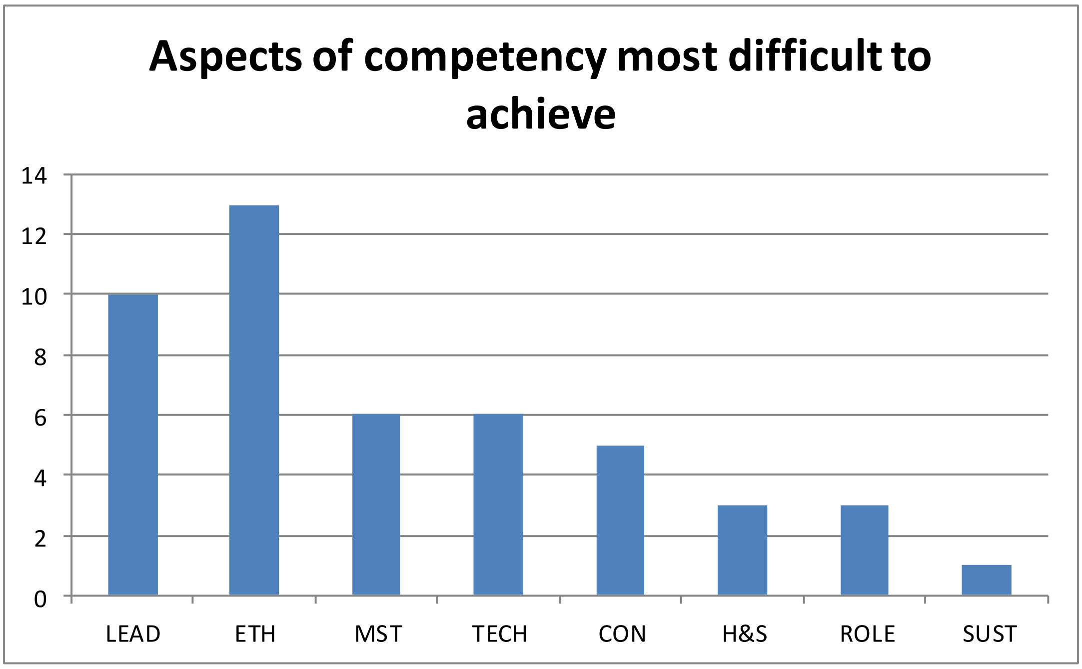


Figure 3.3 – Aspects of competency most difficult to achieve

The findings reveal those competencies that new entrant graduates have the greatest problems achieving, the majority of these were predicted from anecdotal and personal experience of assessors and trainers, however the responses also provided a clear order of difficulty of these deficient competencies not previously known. The results, together with subsequent discussions within the interviews, revealed that the application of professional ethics, especially to actual day to day issues to be the most problematic. One training manager stated that whilst typically ethical rules are taught at university, understanding their application is difficult to learn unless experienced in a practical scenario.

3.4.6 Question 11a - Main Reasons for the difficulties (from the firm's perspective)

Question 11a: *For aspects identified as difficult to achieve what are the main reasons from your firm's perspective?*

The objective of this question was to seek opinion on what the training managers considered to be the main reasons for the difficulties identified in Question 5. The question was sub-divided to identify the extent to which any common reasons existed between the firm's perspective and those of graduate trainees. The findings are recorded in Table 3.6 and presented graphically in Figure 3.4.

Table 3.6 – Data coding table – Main reasons for the difficulties (from firm's perspective)

Category	Code	Tally	Total Occurrences
Application opportunities	**OPP**	1,1,1,1,1,1	6
Time limitations	**TIME**	1	1
Fee earning balance	**FEES**	1,1,1	3
Client requirements and preferences	**CLIENT**	1,1	2

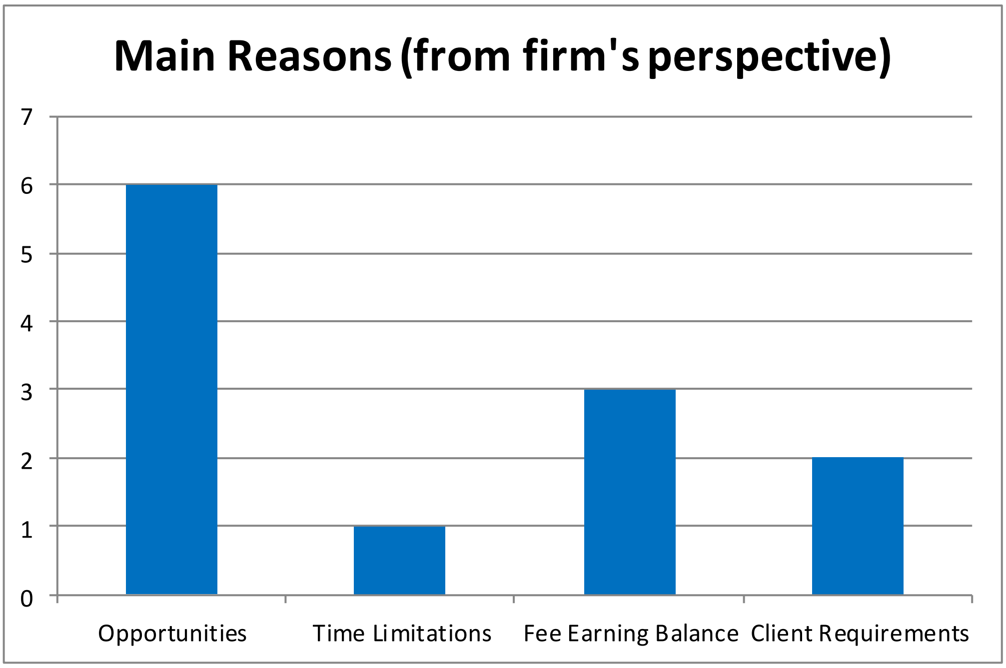


Figure 3.4 – Main reasons for difficulties in achieving competencies (from firm's perspective)

The findings revealed that reasons were predominantly centred around the difficulties of providing appropriate training opportunities within the constraints of a fee-earning professional practice. Inevitably work-load and client demands would take priority reflecting the reality that exists within firms and their operations.

3.4.7 Question 11b - Main Reasons for the difficulties (from graduate trainee perspective)

Question 11b: *For aspects identified as difficult to achieve what do you believe are the main reasons from the graduate trainee's perspective?*

This question followed-on from Question 11a and requested that interviewees consider what they had deduced to be the reasons from the graduate trainees perspective. The findings are recorded in Table 3.7 and presented graphically in Figure 3.5.

Table 3.7 – Data coding table – Main reasons for the difficulties (from graduate trainee's perspective)

Category	Code	Tally	Total Occurrences
University limitations	**UNIV**	1,1,1,1,1,1	6
Site exposure	**SITE**	1,1	2
Practical application	**PRAC**	1,1,1,1,1	5
Experience range	**EXP**	1,1	2

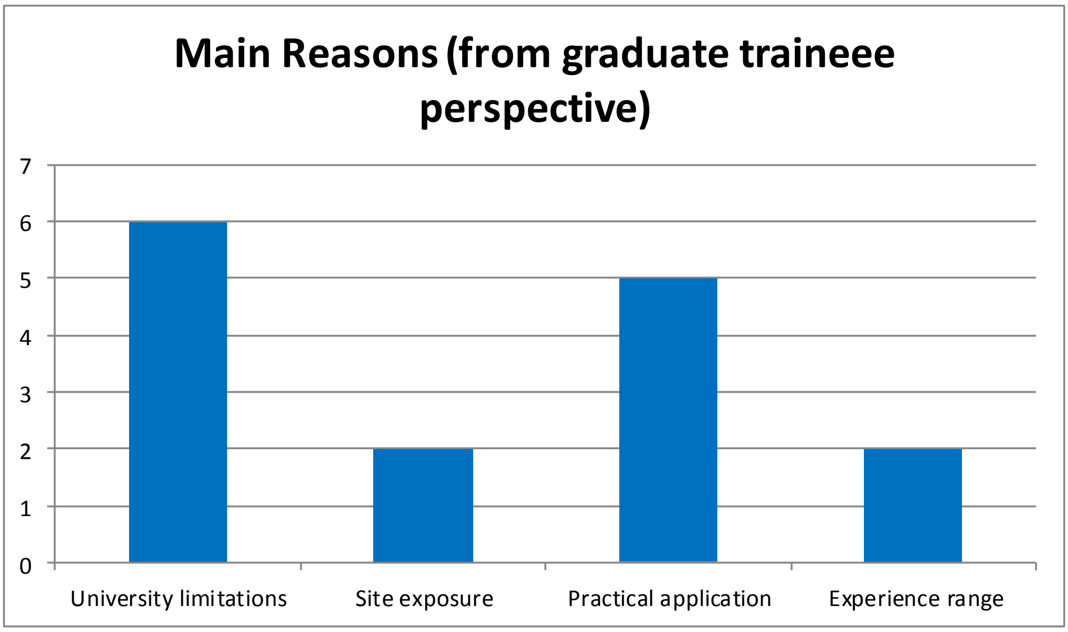


Figure 3.5 – Main reasons for difficulties in achieving competencies (from graduate trainee's perspective)

The findings showed commonality with those from Question 11a with three of the main reasons related to the practicalities of training opportunities within the constraints of a professional practice. However, the results also showed the perceived limitations of university training resulting in difficulties with the achievement of professional competencies. This correlates with the criticism of Eraut (1984) concerning the limitations of degree based professional education.

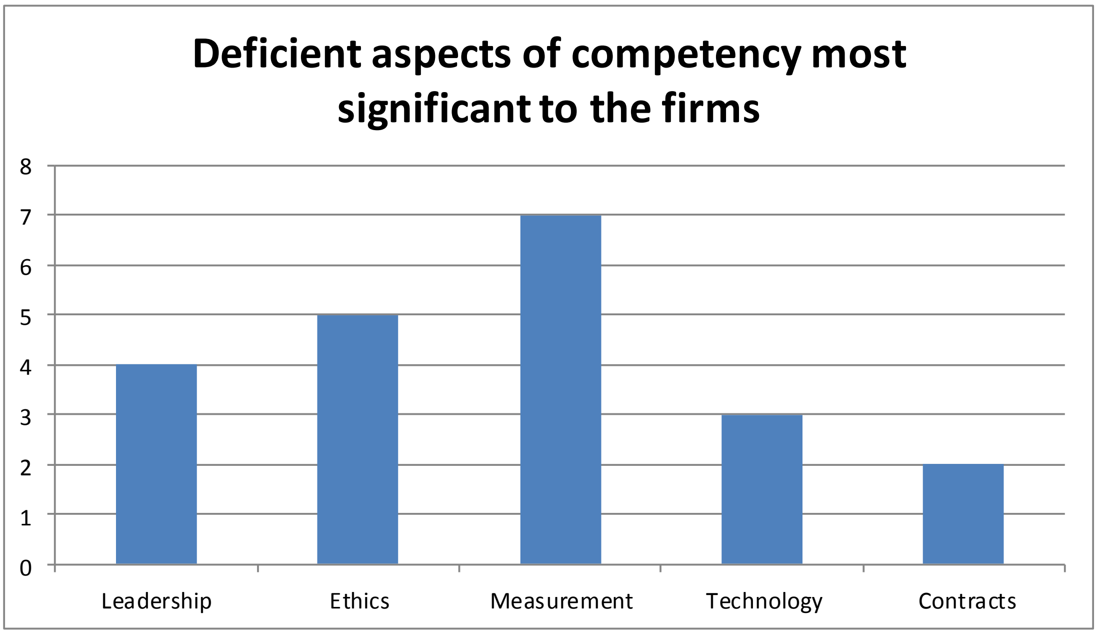
3.4.8 Question 13 – Deficient aspects of competency most significant to firms

Question 13: *Which deficient aspects of competency are most significant to your business?*

The objective of this question was to identify the priorities for which competencies should be improved from the prospective of business significance to the professional firms. The findings are recorded in Table 3.8 and presented graphically in Figure 3.6.

Table 3.8 – Data coding table – Deficient aspects of competency most significant to the firms

Category	Code	Tally	Total Occurrences
Leadership and confidence	**LEAD**	1,1,1,1	4
Application of Ethics	**ETH**	1,1,1,1,1	5
Measurement and Estimating	**MST**	1,1,1,1,1,1,1	7
Construction Technology	**TECH**	1,1,1	3
Administering Contracts	**CON**	1,1	2



<u>Figure 3.6 – Deficient aspects of competency most significant to the firms</u>

The responses showed deficiency in measurement competency was seen as the most significant when judged from a business perspective with leadership and ethics following in second and third positions. Subsequent discussions with the interviewees revealed that measurement capability was important because firms sought to optimise the use of junior staff on measurement which is seen as relatively low fee earning. Again, there was correlation with the findings from Question 6, with interviewees suggesting graduate trainees should be better prepared for measurement from their university studies.

3.4.9 Questions 14 – Participation in the controlled experiment and workshop duration

Question 14: *Would you be willing to invite your graduate trainees to participate in a simulation/accelerated learning workshops?*

The objective of this question was to ascertain the support of interviewees to participate in the application of the new learning model within a controlled experiment. Five of the firms expressed a willingness to invite volunteers from within their graduate trainee pools. The remaining three firms reaffirmed their interest in the research study but were concerned regarding time commitments of graduate trainees and possible conflict with current internal training and development programmes. The responses to this question were used to inform the design and application of the controlled experiment described in Chapter Six.

What would be your preferred duration for a learning workshop?

The responses from this discussion showed all interviewees felt an application workshop of approximately half-day (four-hour) duration would be preferred. The primary reasons given were to fit with existing structured training programmes and the flexibility of a 'four-hour' duration to be delivered as a morning, afternoon or late afternoon/evening session. As a result a ‘four-hour’ format was chosen for the controlled experiment application workshop.

3.4.10 – Conclusions and Follow-On

Conclusions and Follow-On: *Are there any further points in relation to deficient competencies and applicability of non-traditional learning workshops? Would you be willing to assist in the design of the learning workshops?*

The follow-on discussion generally reiterated and confirmed the points raised in responses provided earlier within the interviews. It is notable that interviewees repeated and reinforced a number of points about which they felt strongly, in addition several new points arose. A qualitative data analysis approach was applied which resulted in the identification of four further themes. These are shown in Table 3.9.

<u>Table 3.9 – Further themes regarding deficient competencies emanating from follow-on discussion</u>

Theme	Tally	Total Occurrences
Measurement and Estimating not seen as important by graduates and universities	1,1,1,1,1	5
There is a general issue with basic writing, grammar, spelling and maths	1,1,1,1,1	5
Large practices have resources to train graduates insufficient support for smaller firms	1,1,1	3
Simulation workshops could have real benefits for small/medium firms, regional offices and the emerging markets	1,1,1,1,1,1,1	7

The first theme is a development of concerns identified in Question 11 regarding the level of measurement teaching within university studies. Other issues raised highlighted the potential importance of the outcomes of the research study to smaller firms. This is discussed in the recommendations at conclusion of the thesis.

The interviews closed with an invitation to provide further assistance in design of the learning workshop. Representatives from two firms, F6 and F8 expressed a strong desire to assist as noted in Chapter Six.

3.5 Cross Tabulation Analysis of deficient competencies

A cross tabulation approach was applied to identify the most significant deficient competencies. Table 3.10 presents the cross tabulation analysis of the responses to Questions 10/12 – Aspects of competency most difficult to achieve and Question 13 – Deficient aspects of competency most significant to the firm. The objective was to order the aspects of competency on the basis of those that show both the greatest difficulty and the greatest potential business impact on the firms.

Table 3.10 – Cross tabulation analysis of deficient competencies

		Most difficult to achieve							
		LEAD	ETH	MST	TECH	CON	H&S	ROLE	SUST
Significance to the firms	LEAD	10							
		4							
	ETH		13						
			5						
	MST			6					
				7					
	TECH				6				
					3				
	CON					5			
						2			
	H&S						3		
							0		
	ROLE							3	
								0	
	SUST								1
									0
Column Total		14	18	13	9	7	3	3	1
Ranking		2	1	3	4	5	=6	=6	8

The analysis table reveals the Application of Ethics to be the most significant important deficiency with a total of 18 occurrences within the tally table. Ethics is followed by Leadership and Confidence with 14 occurrences, and Measurement and Estimating with 13 occurrences.

3.6 Chapter conclusion

The aim of this chapter was the identification and definition of deficient competencies challenging new entrant surveyors. The application of ethics is clearly identified as the most difficult and most important competency, it is the top priority for the firms, and for these reasons was selected as the competency to test the new learning model presented in Chapter Five.

Chapter Four – Literature Review

4.1 Introduction

Chapter Four establishes the current state of knowledge in respect of professional learning, professional competency and higher-order thinking. The data and information derived from this review is used to provide a theoretical basis for the development of the new learning model presented in Chapter Five. The objectives of this chapter are to:

(a) Review the current theory and knowledge of learning in relation to the acquisition of professional competencies

(b) Analyse and define the characteristics of professional competency with regard to learning and intellectual facets including establishing the link to higher-order thinking

(c) Identify the non-traditional learning approaches applied in other professions and disciplines with potential to develop higher-order professional learning

(d) Summarise the learning and applicational constituents to inform the design of the new learning model in Chapter Five.

The remainder of this chapter comprises seven broad sections:

Section 4.2 – Professional knowledge and experiential learning: This Section establishes the theoretical basis for learning and for knowledge as it is relevant to professional learning.

Section 4.3 – Professional competency and higher-order thinking: This section defines professional competency and establishes the link to higher-order thinking and critical thinking within professional competencies.

Sections 4.4 to 4.7 – Non-traditional learning approaches: Sections 4.4 to 4.7 then explore learning approaches applied within other professions and disciplines to the development of competencies. These include simulations, accelerated learning techniques and game-based approaches.

Section 4.8 – Conclusion: In the final section the objectives of the chapter are reviewed and the link to design of the new synergistic learning model established.

4.2 Professional knowledge and experiential learning

4.2.1 Definition

In order to explore the theory of professional learning it is necessary to establish a fundamental basis of knowledge acquired through learning. The Concise Oxford English Dictionary (2008) gives a range of meanings for the noun *knowledge*. In its broadest sense *knowledge* is described as 'knowing or familiarity gained by experience'. The dictionary definition continues to include a 'person's range of information' and an acknowledgement that *knowledge* has two components, 'theoretical and practical understanding'. The important aspect is that in its broadest sense, knowledge can be defined as the range of information that gives both theoretical and practical understanding of a subject.

This definition accords with earlier work by Oakeshott (1962) who expanded the concept of a ‘person’s range of information’ to make a clear distinction between learning comprising technical knowledge and that required for practical application. Technical knowledge being capable of written codification, whilst practical knowledge is learned only through practice. The implication of Oakeshott’s assertion being that skill and knowledge acquisition must come from practical experience in addition to theoretical study.

Polanyi (1967) further develops the distinction between formal and conceptual knowledge and is widely recognised as the originator of the term ‘tacit knowledge’ to describe that which we know but cannot tell. Polanyi’s argument is that informed guesses, hunches and imaginings are part of forming understanding and are motivated by what he describes as ‘passions’, which are aimed at discovering truth, but are not necessarily in a form that can be stated in formal terms. Polanyi suggests that with tacit knowledge people are often not aware of the knowledge they possess or how it can be valuable to others. An example of Polanyi’s categorisation in a professional context arises in the field of quantity surveying where clients require the estimation of the cost for future projects. Quantity Surveyors will use codified information in the form of historic costs and other data to compile estimates, then ‘stand-back’ and ‘sense check’ the figures. It is the judgement used for this sense checking process that falls into the category of tacit knowledge and is an essential component in ensuring robust estimates are provided to clients. The judgement required in this instance is typical of the judgements required of professionals and which is regarded as their 'professional competence' it is closely linked to higher-order thinking which is discussed later in this chapter.

Gibbons *et al* (1994) provide an alternative perspective to the categorisation of knowledge by exploring changes in the way knowledge is produced in science and technology. Gibbons categorises knowledge by describing two modes of knowledge production notated as Mode 1 and Mode 2. Mode 1 refers to a form of knowledge production that has grown up to ensure compliance with scientific practice. It is primarily academic and governed by the interests of a specific academic community; problems are solved following the constraints or codes of practice relevant to that particular community or discipline. An example of this type of knowledge related to the built environment sector is knowledge gained from defined procedures such as the testing of concrete in structures. This follows a set code of practice developed by the British Standards Institute (2009) under British Standard European Number 12504-1 and allows scientific comparison of concrete test results within a clearly defined set of criteria. A database of knowledge exists on the crushing strengths of concrete and as such the knowledge produced through the process of testing complies with acknowledged scientific practice and is therefore Mode 1 knowledge. In contrast, Mode 2 knowledge refers to trans-disciplinary knowledge and is problem focussed. It involves knowledge gained through teams cooperating on specific problems in real world situations. Gibbons *et al* suggest Mode 2 knowledge is spreading across the entire landscape of science and technology, with the multiplication of both formal and informal communication channels enabling a rapid growth in the ease and volume of communication. Such cooperation and communication is evident in the UK built environment industry, one example being the increase in knowledge sharing through collaborative or partnering procurement routes as described by the Reading Construction Forum (1995). In these routes clients, contractors and suppliers establish long term agreements resulting in an opportunity for knowledge within the supply chain to be developed and shared to the mutual benefit of all parties, such knowledge would be considered Mode 2. Mode 2 knowledge also demands a clear need for higher-order thinking to apply such knowledge to problem solving.

Compared to Gibbons' approach to knowledge types, which could be considered academically based, Eraut (1994) explored a more pragmatic approach. Eraut asserts an alternative approach to categorising knowledge can be derived from examining the personal knowledge of working practitioners. Traditionally this knowledge base is founded on a dichotomy of theoretical knowledge and practical knowledge that is acquired 'on the job'. Eraut states that when examining working practitioners in the education sector this simple model view of the professional knowledge base is seriously incomplete in that knowledge encompasses many components. He proposed a list of six knowledge categories applicable to a Head Teacher, which are summarised as follows:

(i) Knowledge of People – Knowledge gained from personal encounters that provide information about people or their behaviours

(ii) Situational Knowledge – How people read the situations in which they find themselves

(iii) Knowledge of Educational Practice – Policies and practices which surround the profession

(iv) Conceptual Knowledge – Concepts, theories and ideas that a person has consciously stored in their memory

(v) Process Knowledge – Knowledge of the processes for getting things done such as planning, organising and monitoring

(vi) Control Knowledge – Knowledge that is important for controlling your own behaviour, for example self-awareness and sensitivity

Although Eraut's work is specifically related to the education sector, it developed the earlier work of Oakeshott (1962) and Polanyi (1967) and provides and supports the finding that professional knowledge is comprised of more than two categories of knowledge. There is a clear applicability to the built environment industry, for example, a project surveyor requires knowledge of the policies and practices that surround and influence the surveying profession and the environment in which it operates. The surveyor also requires higher-order thinking to relate and apply this environmental knowledge to actual situations and produce decisions that will get things done.

4.2.2 Developing professional knowledge through learning over time

The process of acquiring knowledge over time is considered by Schon (1983) who introduced an epistemology of skill and practice based learning through the concept of reflection-in-action. Schon cites the earlier work of Schein (1973) who proposed three components of professional knowledge as follows:

(i) Underlying discipline or basic science upon which the practice rests or from which it is developed

(ii) Applied science or engineering component from which many of the day-to-day diagnostic procedures and problem solutions are derived

(iii) Skills and attitudinal component that concerns the actual performance of services to the client, using the underlying basic and applied knowledge.

Schon goes further and suggests that Schein's use of the term "skills" is of special interest, because it implies that the discipline of basic science must come first and the skills in actual application would come later i.e. there is an acknowledgement that the development of knowledge for professionals will occur over a period of time, with application skills following the basic discipline/science. Schon develops this concept, asserting that practitioners develop their application knowledge through the process of reflecting on their practice while in the midst of it, a process that he terms reflection-in-action. Schon (1983, p.79) illustrates the concept of reflection-in-action through a series of case studies that review the working practices of design professionals. In these case studies it was observed that the practitioner built up a repertoire of examples, images, understandings and actions over a period of time. The practitioner's repertoire includes the whole of his experience insofar as it is accessible to him at the time to form professional competence that enables him/her to understand the situation and formulate, select and implement appropriate actions. The implication is that professional competencies are developed in a continuing process that includes reflection on day-to-day work situations; this applies equally to other built environment professionals in their day-to-day activities.

Dreyfus and Dreyfus (1986) formalised the concept of building expertise over time by proposing a five-stage typology that recognised the process of developing skills and expertise. Dreyfus and Dreyfus describe the stages of development in their typology as follows:

Stage 1: Novice – Adherence to taught rules or plans

Stage 2: Advanced Beginner – Follows guidelines for action, but situational perception still limited

Stage 3: Competent – Carries out deliberate planning, can see longer-term goals and able to cope with "crowded" or complex situations

Stage 4: Proficient – Sees situations holistically and able to vary processes and procedures to suit particular situations

Stage 5: Expert – No longer relies on rules, has intuitive grasp and vision of what is possible

These stages recognise the development of expertise from novice level through to expert and provide a clear recognition of the progression to higher-order thinking skills, exemplified in the acknowledgement of complex situations within Stage 3, judgement on the application of processes and procedures in Stage 4 and the use of intuition in Stage 5.

4.2.3 Experiential learning

Confirmation that skill development is linked to experience provides a logical relationship to the concept of experiential learning. Cheetham (1999) asserts that the concept of experiential learning is based on the common sense view that ideas are constantly being formed and reformed by life experiences. This concept was initially formalised by Kolb (1984), who provided a model for experiential learning that has become widely recognised in the field of professional learning. Kolb describes it as the process whereby knowledge is created through a cycle where the learning from one experience is transformed to the next. Cowan (2006) develops this further and paraphrases Kolb's description to illustrate a cycle of experiential learning shown in Figure 4.1 below (for clarity Kolb's initial terminology is shown in brackets).

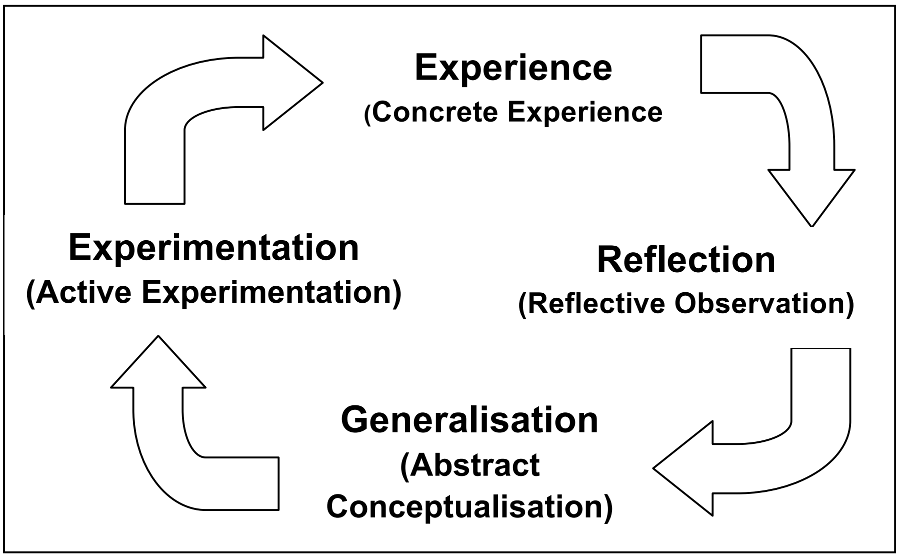


Figure 4.1 - The Kolb Experiential Learning Cycle as adapted by Cowen (2006)

In the diagram Cowen proposes that the process of experiential learning is cyclical commencing at the top with an experience or experiences. This is followed by an opportunity to reflect on these experiences and a generalisation or drawing of conclusions from what has been experienced. This is then tested through what Kolb described as 'active experimentation' when the next, similar experiences are encountered. Thus the acquisition of knowledge results from the cycle of grasping experience and transforming learning to apply to the next experience.

Race (2007) adds further to the concept of an experiential learning cycle by considering the holistic process of learning. Race established that five principal factors underpinned successful learning:

Wanting – motivation, interest, enthusiasm

Needing – necessity, survival, saving face

Doing – practice, repetition, experience, trial and error

Feedback – other people's reactions, seeing the results

Digesting – making sense of what has been learned

Race asserts that these five factors must be in place for successful learning to occur. Although the work is related to the general process of learning, it provides clear confirmation of the validity of experiential learning process through the factors of Doing (experience), Feedback (Reflecting) and Digesting (making sense of the learning for next experience).

De Weerdt *et al* (2009) confirmed that the concept of experiential learning was an essential part of the development of the competencies expected of professionals, stating that where the complexity of professional practice cannot be communicated in a set of procedures then experiential learning becomes integral to professional competence. De Weerdt *et al* argue that as professional contexts have a heuristic and self-organising character, learning (knowledge creation) and practice (knowledge use) cannot be separated.

4.2.4 Summary

The theoretical basis of professional learning has been shown to comprise two elements. Firstly recognition that there are different categories of professional knowledge beyond a simple two category model of theory versus practice and secondly an acknowledgement that the process of professional learning is time related involving periods of experience. Oakeshott (1962), Polanyi (1967) and Gibbons *et al* (1994) all confirm the division of knowledge into a range of different categories. This is taken further by Eraut (1994) who characterises knowledge into a range of personal skills and competencies required by professionals. On initial examination Eraut's model would appear fully applicable to professionals within the built environment sector; however it is contended that a potential flaw exists in the initial model proposed by Eraut in its apparent lack of distinct categories that are directly related to attributes, such as communication and leadership. For quantity surveyors and other construction professionals, such items are essential aspects in their fulfilment of day-to-day professional responsibilities. This point is reinforced by Jaegar (2012) and considered further in sub-section 4.5.6.

For learning related to the acquisition of knowledge through experience Schon (1983), Kolb (1984), Cowan (2006) and Race (2007) all confirm the assertion that there is a link between knowledge development and time; namely that learning takes time, higher-order learning takes the longest time. Schon and Kolb have shown that this is a continuing process that occurs reiteratively and is cyclical from reflection on experience. Cheetham (1999) is critical of this cyclical approach and asserts that experiential learning does not occur in a rigid process from one stage to the next. In practice, learners jump between the stages in complex ways that are often more chaotic than the cycle suggests. However, it can be argued that this criticism is not fully valid, Kolb's model envisages repeated cycling around the experiential process and therefore provides for complexity of learning. This point is also reinforced by Schuck (2010) in sub-section 4.5.3.

A further flaw is that the simple experiential learning model does not appear to acknowledge any distinct stages in the process of development or improvement. This is addressed by Dreyfus and Dreyfus (1986) whose typology of different skill levels recognises the need for different types of skill as learners progress through their development. This requirement is evident in the built environment sector and demonstrated by the hierarchical structure seen in professional roles. For example, the distinction between Junior, Intermediate and Senior Surveyor. These grades are typically achieved in a series of steps on a time-served and experiential basis, implying a requirement for differing levels of competency as surveyors progress to senior roles.

4.3 Professional competency and higher-order thinking

4.3.1 Competency

The foregoing sections have established that professional expertise extends beyond a simple two category model of theory versus practice. McClelland (1973), Boyatzis (1982) and Schroder (1989) propose that professional expertise comprises a cluster of skills which are conceptually linked and come together to form competency. Cheetham and Chivers (1998, p.276) develop this concept to provide a definition as follows:

“competency is a demonstrable ability, usually rather broader than a single skill, likely to be made up of a collection of skills”

Kennedy *et al* (2009) assert that there is wide variation in the literature regarding the interpretation and meaning of the term competency. This interpretation ranges from a description of competency in terms of performance acquired by training to a broad overarching view that encompasses knowledge, understanding, skills, abilities and attitudes. Kennedy *et al* cite Miller *et al* (1988), Wolf (1989), Adam (2004) and Winterton *et al* (2005) to illustrate the broad range of definitions and confirm that competency is not something that can be observed directly but is a construct of a number of different facets.

Attempts to produce an common definition of competency that encompasses these facets are numerous. Boak (1991), Spencer and Spencer (1993), Gonczi (1999) and Manley and Garbett (2000) all focus on a functional or performance approach to their definition. In this approach the areas or competencies are seen as functional actions capable of demonstration, observation and assessment, it implies that competencies are defined as something a person should be able to do rather than what they know. Critics of this approach argue that competency components are more complex than simple functional or performance models. McAller and Hamill (1997) and Manley and Garbett (2000) assert that competency is fragmented and needs to include the underlying attributes and complexity of performance that is present in the real world of practice. Ashworth and Morrison (1991), Le Var (1996) and Lillyman (1998) assert that knowledge and understanding must also be considered, including the underlying cognitive and effectiveness skills that are needed in practice.

In contrast to the functional or performance approach, McClelland (1973), Boyatzis (1982) and Schroder (1989) proposed the personal competence or generic model. In this model, competency comprises the individual's capabilities, job demands and the organisational environment. Boyatzis (1982) argues that effective performance will occur when all three of these critical components are consistent. Critics of the personal competence or generic model include Gonczi (1994) and Manley and Garbett (2000) who argue that the approach has a number of problems. These include the issue that the assumed balance of components does not reflect the individual's ability to excel in some competency areas. Also the model offers little capacity to transfer expertise from one organisation to another, due to the focus on personal performance in particular contexts.

To address these shortfalls, Jarvis (1985), Hodkinson (1992) and Cheetham and Chivers (1996, 1998) proposed what are later termed by McMullan *et al* (2003, p.287) as 'Holistic approaches'. Jarvis (1985) suggested that competency has three major components, knowledge and understanding of relevant academic elements, skills to perform mental processes and attitudes that result in a knowledge and commitment to professionalism. Cheetham and Chivers (1996, 1998) developed this into a model of professional competency which comprised five interrelated components:

(i) Cognitive competency including underpinning theory and concepts as well as informal tacit knowledge gained experientially

(ii) Functional competencies including skills related to individual roles

(iii) Personal competency including behavioural competencies related to the characteristics of a person

(iv) Ethical competencies comprising appropriate personal and professional values as well as the abilities to make sound judgements in work related situations

(v) Meta-competencies which transcend the other components and include communication, creativity, problem-solving, learning/self-development, mental agility, analysis and reflection.

A key feature of the Cheetham and Chivers' model (1998, p.268) is that it includes the concept of a meta-competency component, which requires cognitive processes of a higher-order. Le Deist and Winterton (2005) and Janjua *et al* (2012) further developed Cheetham and Chivers' model and confirmed the inclusion and requirement for a meta-competency. In particular Janjua *et al* (2012) argue that higher-order cognitive thinking skills are an essential component of meta-competency and set the foreground to solving all work related problems. These findings establish that competency involves higher-order thinking skill, and that it is an essential and necessary component of professional competency; and therefore the model most appropriate to this research. The analysis of the deficient quantity surveying professional competencies in Chapter Two shows that it is development of these higher-order skills that are a particular problem for employers and new entrant graduates.

4.3.2 Higher-order thinking

Lewis and Smith (1993) produced a landmark paper that defined higher-order thinking that integrated the diverse perspectives of philosophy and psychology, importantly they sought to differentiate higher-order thinking from lower-order thinking. Until this study, higher-order thinking had existed in what Cuban (1984, p.676) described as a 'conceptual swamp' with no agreed or recognised definition either theoretically or practically. Whilst the definition proposed by Lewis and Smith is couched in all-encompassing terms and lacks specificity, the basis clearly sets out the constituents of higher-order thinking, namely critical thinking, evaluation, problem-solving and analysis.

This composition is supported by a number of other writers. King *et al* (1998) observed that higher-order thinking skills include critical, logical, reflective, metacognitive and creative thinking. Sternberg (1995) produced a system to categorise the skills involved in higher-order thinking referred to as 'Higher Order Thinking Skills' (HOTS). This acknowledged three components, namely: meta-components; performance components and knowledge acquisition components. This system was further developed by Forster (2004) who offered a useful conceptualisation that distinguished two contexts in which the skills are employed; contexts where thought processes are needed to solve problems and make decisions, and contexts where mental processes including comparing, evaluating, justifying and making inferences are needed. These two contexts of thinking can be seen as two ends of a continuum. At one end is thinking that typically can be described as objective or scientific, which includes using logical analysis to draw inferences. At the other end is thinking that can be described as subjective, which includes interpretation of circumstances and holistic judgements about meaning. It is at this end of the continuum where critical thinking is at the forefront. Thomas and Thorne (2010) also argue that the definition of higher-order thinking must take thinking to a level beyond just analysing facts. For higher-order thinking facts must be understood, connected to each other, categorised, manipulated and applied to seek new solutions to problems.

Critics of higher-order thinking argue that the differentiation of thinking skills leads to misinterpretation, Crowl *et al* (1997) suggest that complex procedural knowledge is sometimes misinterpreted as a higher-order thinking skill. They argue that whilst it may be a prerequisite for higher-order thinking it is actually a type of knowledge. Similarly, the ability to apply a rule or procedure to a routine single variable is an 'application' or the ability to recite a rule or set of procedures, regardless of complexity, it is actually 'information learning'. Further, they assert that creativity itself may not necessarily involve higher-order thinking where the act of generating solutions to problems does not go beyond previously learned concepts and rules. The critical determinant is that creativity in higher-order thinking must involve divergent and convergent thinking to produce new ideas.

King et al (1998) also observed that there is some confusion amongst researchers and scholars around the terminology of higher-order thinking, with the terms 'critical thinking' and 'higher-order thinking' often used interchangeably. This is clarified by Scriven and Paul (2004) who assert that critical thinking is at the heart of higher-order thinking. Similarly, Schraw and Robinson (2011) found that by 2011 higher-order thinking skills were widely recognised to be the core skill of critical thinking, together with problem-solving, argumentation, decision-making, creativity, metacognition and self-regulation. Accordingly, this definition has logically been adopted to inform the design of the learning model presented in Chapter Five.

4.3.3 Critical thinking

Critical thinking is not new, there is evidence of its discussion in ancient Greece by Socrates over 2500 years ago and it has continued to form part of thinking and learning ever since (Paul, 1993, Paul, Elder and Bartell, 1997). To resolve the uncertainty surrounding the definition of critical thinking, the American Philosophical Association, convened an international panel of experts in 1993 to produce a consensus definition. The outcome stated the following:

"We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as

explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based"

(Facione, 1990 p.3)

Scriven and Paul (2004) went on to describe the process of critical thinking with a definition that substantially reflects the conclusions of the American Philosophical Association Report as follows:

"The intellectually disciplined process of actively and skilfully conceptualising, applying, analysing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness"

(Scriven and Paul, 2004 p.4)

Their definition provides a sufficiently inclusive and accurate definition for this research and as a point of reference for analysis and comparison of competencies and higher-order thinking. Scriven and Paul's work, together with the American Philosophical Association Report, identified the cognitive skills and sub-skills that are required for critical thinking and by extension higher-order thinking. Table 4.1 summarises the primary cognitive skills and sub-skills.

Table 4.1 - Consensus list of critical thinking cognitive skills and sub-skills (adapted from Facione, 1990 p.12)

Skills	Sub-skills
1. Interpretation	Categorisation Decoding significance Clarifying meaning
2. Analysis	Examining ideas Identifying arguments Analysing arguments
3. Evaluation	Assessing claims Assessing arguments
4. Inference	Querying evidence Conjecturing alternatives Drawing conclusions
5. Explanation	Stating results Justifying procedures Presenting arguments
6. Self-Regulation	Self-examination Self-correction

These skills and sub-skills have been used to inform the design of the learning model presented in Chapter Five.

4.3.4 Analysis of the APC professional competencies

The constituents of higher-order and critical thinking are evident in the competencies exercised by professional quantity surveyors and these are recognised within the APC Requirements and Competencies (RICS, 2014). For example, the core subject/technical competency T010 – Commercial management of construction requires ‘evaluating and advising on financial implications’ and T066 – Project evaluation requires ‘appraising overall project viability’, both clearly illustrative of critical thinking. Further, the APC also sets out broader mandatory competencies. The mandatory competencies cover nine areas shown in Table 4.2.

Table 4.2 – APC mandatory competencies

Ref.	Mandatory competencies
M001	Accounting principles and procedures
M002	Business planning
M003	Client care
M004	Communication and negotiation
M005	Conduct rules, ethics and professional practice
M006	Conflict avoidance, management and dispute resolution
M007	Data management
M008	Health and safety
M009	Sustainability

Analysis of these mandatory competencies confirms levels of higher-order thinking and actions, including decision making, judgement and critical thinking. For example, Competency M006 - Conflict Avoidance, Management and Dispute Resolution deals with the practical application of decision-making within dispute resolution situations. From the evidence presented in Chapter Three the application of ethics is the most difficult and important competency and this is covered by Mandatory Competency M005 - Conduct Rules, Ethics and Professional Practice. M0005 is directly linked to the RICS Global Professional and Ethical Standards (RICS, 2012). Analysing this mandatory competency and the ethical standards in detail confirms numerous requirements for higher-order thinking involving complex and subjective decision making as illustrated by the following:

(i) **Act with integrity** – This standard acknowledges the requirement for 'making decisions' under conditions of uncertainty and variability, particularly in relation to 'conflicts of interest'

(ii) **Always provide a high standard of service** – This requires surveyors to be 'cognisant of their competence and always act within this scope'. A clear indication of self-regulation advocated by Schraw and Robinson (2011)

(iii) **Act in a way that promotes trust in the profession** – This standard requires 'understanding how actions affect others and the environment and if appropriate questioning or amending behaviour'. Both elements aligned to the critical thinking cognitive skills of analysis and self-correction summarised by Facione (1990)

(iv) **Treat others with respect** – This standard refers to 'putting the fair and respectful treatment of clients at the centre of a firm's business culture and decision making'. A critical thinking behaviour advocated by Scriven and Paul (2004) in their definition of universal intellectual values

(v) **Take responsibility** – This standard requires surveyors to 'question and analyse things that are not right'. This questioning and analysis is clearly analogous to the questioning that is encapsulated within higher-order and critical thinking.

4.3.5 Summary

The forgoing sections have defined the characteristics of professional competencies and established the link to higher-order thinking. Higher-order thinking skills are confirmed to be the core skill of critical thinking together with problem–solving, argumentation, decision-making, creativity, metacognition and self-regulation. The requirement for these skills is clearly evident within the APC at both subject/technical level and within the broader mandatory competencies.

4.4 Non-Traditional learning techniques

4.4.1 Introduction

The research undertook an extensive literature search to identify the theories and applications of non-traditional learning techniques that have been used in the development of competencies within other professions and disciplines. The purpose of this search was twofold, firstly to determine the current state of knowledge with regard to the development of professional competencies across a wide range of disciplines and the learning approaches used. Secondly, to identify learning methods and constituent parts of learning methods that had shown success, or the potential for success, in the development of professional competencies, especially higher-order competencies, to inform the development of a new learning model.

For the purposes of this research traditional learning techniques are epitomised by lectures and presentations and other one-way techniques which consist of a monologue by the teacher (Helman and Horswill, 2002) and where students passively absorb pre-processed information (McCarthy and Anderson, 2000). In contrast, non-traditional techniques provide a pedagogy centred on active, collaborative and cooperative learning (Johnson and Dasgupta, 2005). McCarthy and Anderson (2000) suggest non-traditional techniques engage learner experiences in which they interact with the instructor and each other thereby encouraging learners to think about the subject matter and its practical application.

4.5 Simulations

4.5.1 Introduction

The first non-traditional technique reviewed was the enhancement of learning through Simulations. Simulations have been used in a number of situations to develop professional competencies with mixed success. Simulations are, as the name suggests, a safe and viable means of simulating real experiences. Cheetham (1999) argued that providing professional trainees with real work-based experience can be expensive, disruptive to normal routines and in some cases dangerous. As a result he notes that simulations are widely used as an alternative. Moule *et al* (2006) reaffirm this and state that simulations have been used in fields such as aviation since the 1930s. Cheetham (1999, p.116) acknowledges this and claims that in respect of professional training, such as pilot development, there is a real prospect of 'total training' and qualification through the use of simulation approaches. The reference to training is significant, which as will be shown in the following, does not always demand the same level of thinking as higher-order professional competencies.

4.5.2 Definition

The Oxford English Dictionary (2006) describes simulation as 'a reproduction of the conditions of a situation, for example for training purposes'. Simulations can take many different forms ranging from the use of high technology flight simulators through to skill development such as dental practice on artificial patients or "dummies".

Dowie and Phillips (2011) confirm the existence of a wide range of simulation forms and categorises these as follows:

(i) Low fidelity – Facilitator led simulations such as role plays and representations of situations within defined scenarios

(ii) Medium/intermediate fidelity – Simulations that include the use of machines that require significant input from the facilitator to operate

(iii) High fidelity – Simulation that include computer controlled machines that respond automatically to a stimulus from the trainees.

Dieckmann (2009, p.41) extends the description of simulation forms by introducing a human element. He suggests a simulation is a ‘spatiotemporal (provides space and time) and socially limited event’ during which humans interact in a goal oriented way with each other and where applicable the equipment. Dieckmann asserts that a simulation can (and should) be considered a social practice in that participation must be based on shared assumptions, values, norms and relationships within the simulated environment. In order to participate in this social practice in a meaningful way, participants need to know, understand and abide by its rules. Dieckmann uses the example of patient simulation in anaesthesiology training to illustrate this concept. Such simulations would include a patient simulator, medical equipment and role players. Typically, the patient simulator is not computer operated therefore this type of simulation would fall into the category medium/intermediate fidelity defined by Dowie and Phillips (2011). Dieckmann’s point is that success of the simulation relies on the correct balance between the three components. For example, a well-designed patient simulator is only effective if correctly operated by the simulation participants.

4.5.3 Theory of simulations

Schuck (2010) argues that learning involves acquiring and retaining new knowledge through information, concepts or skills. At the heart of Kolb's learning model referred to in sub-section 3.2.3 is the concept that learners engage in experiences to acquire and retain their new knowledge. Schuck asserts that simulations provide a mechanism for the acquisition of this experiential knowledge, they enable learners to repeatedly/reiteratively cycle through Kolb's learning model.

Keys and Wolfe (1990) assert that student motivation is critical to learning. Simulations foster greater engagement than passive education methods because they incorporate elements of practical application which enhance motivation. Keys and Wolf further noted that the inclusion of simulations within conventional education courses leads to increased levels of enthusiasm with course content and material. All critical elements in general learning theory noted by Knowles (1990), Russell (1999) and Clapper (2010). Alliger and Janak (1989) assert that simulations must be applied effectively to fully utilise the learning benefits that traditional methods of teaching do not offer. Typically, successful simulations require students to work together in groups with resulting learning benefits including collaboration and interdependence as noted by Dieckmann (2009).

Anderson and Lawton (2009) argue that Bloom's taxonomy, widely recognised in education, provides a useful framework for investigating the learning resulting from the use of simulations. Bloom's taxonomy classifies learning outcomes into three domains; cognitive (knowing), affective (feeling) and sensory (doing). Anderson and Lawton argue that simulations focus on the affective and sensory domains and provide a logical extension to the theory of problem-based learning (PBL) which reverses the order of conventional learning. In the traditional subject-based learning model, teachers tell students what they need to know and then assign problems to illustrate the concepts and embed the learning. PBL begins by presenting students with a problem, who then discover concepts and knowledge as they work to solve the problem. According to Vernon and Blake (1993) and Colliver (2000) there is evidence that a PBL approach results in longer lasting learning than a traditional lecture style. Further, it is more enjoyable for students and enhances students' attitudes and opinions of their studies. Anderson and Lawton (2009) assert that simulations provide a vehicle to link experiential learning with PBL learning in a combined pedagogy, which to some extent provides the theoretical basis justifying the success of simulations. However, they balance the learning benefits of simulations by highlighting the significant time commitment of participants required for simulation activities. They argue that simulations could be considered an inefficient pedagogy for teaching some items, such as terminology, factual knowledge and basic concepts or principles, which can be covered more quickly using traditional lecture style teaching. The authors acknowledge that it is open for debate whether students actually retain or implement basic concepts where a lecture style is the sole method of delivery. On balance, they argue that the advantages exceed the disadvantages and therefore make a strong case for inclusion of simulations within general learning theory.

4.5.4 Simulations and higher-order thinking

Weiss (2003) provided a further theoretical link to PBL and extended the theory to the design of problem scenarios for higher-order thinking and learning. She based her findings on examining previous research that addressed learning and cognition that had established well-grounded principles for the design of problems that promoted higher-order thinking. This included Jonassen (2000), who considered the design of the problem scenario to be critical to its success and White (2001) who confirmed that a poorly designed problem scenario does not achieve higher-order learning. Weiss identified a number of fundamental characteristics that must be incorporated into the design of simulation/problem scenarios in order to develop higher-order thinking. These were identified to be:

(i) Appropriateness for participants – simulation/scenario problems must have relevance to the participants and be authentic. If the problems are outside the working or daily lives of participants they may fail to engage. A point supported by Delisle (1997) and Mayer (1998). Weiss concluded that the problem should require participants to apply the content in ways indicative of professionals.

(ii) Challenging - if a problem is to serve as a stimulus for higher-order and critical thinking participants must find the problem challenging. The problem must be designed to be beyond what participants know, as a result, participants will not be able to solve the problem without extending their knowledge base and their skills. This extension will move participants beyond simply replaying what they already know; they will have to develop a deeper (or broader) understanding of the content to solve the problem (Duch, 2001). Whilst Duch postulated that the problem should be only 'slightly' beyond the participant's current knowledge, this may be conservative and reflect the educational basis for his research. With regard to professional competencies, it was noted that the extent of challenge could be greater.

(iii) Ill-Structured - problem scenarios to foster higher-order activity among participants should be ill-structured. Weiss, citing the work of Delisle (1997), Duch (2001) and Jonassen (2000) identified that ill-structured problems are messy like the problems that are faced in everyday life and in professional practice. Not all the elements of ill-structured problems are known and there are potentially several possible solutions or perhaps no solution at all. Ill-structured problems are also not confined to a single discipline and require participants to draw on a number of different fields to solve the problem (Stinson and Milter, 1996).

(iv) Collaborative - Problems designed to promote higher-order thinking should require collaboration among students (Gijselaers, 1996) but this must go beyond simple task sharing. Gijselaers illustrated this through the 'puzzle-piecing' approach, where students each complete a part of a task and then assemble the parts for submission. This puzzle-piecing approach was shown to be insufficient to foster higher-order thinking among students (Drummond-Young and Mohide, 2001 and Duch, 2001).

Weiss (2003) suggested that to be effective in the development of higher-order thinking, the scenario problem needed to encourage collaboration by being strong, which she defined as creating controversy amongst the participants. Strong problem scenarios engender synthesising ideas, decision-making and resolving controversy, which require participants to socially negotiate learning issues inherent in the problem and defend among themselves the feasibility of those solutions.

4.5.5 Simulations in Medical Fields

According to Scalese *et al* (2007) medical education and professional learning has witnessed a significant increase in the use of simulations. They identified that changes in academic environments have limited patient availability for educational purposes. There has also been a paradigm shift towards outcomes-based education that requires assessment of demonstrable competencies.

Fletcher *et al* (2002) noted the shift with respect to the training of anaesthetists. Traditionally anaesthetist training placed a strong emphasis on the acquisition of general skills under the heading of ‘human factors’ through a process of clinical practice. The ‘human factors’ included (i) cognitive or mental skills (such as decision-making, planning, situation awareness) and (ii) social or interpersonal skills (such as team-working, communication, leadership). Both sets of skills being necessary for safe and effective performance of anaesthetists in an operating theatre environment. Fletcher *et al* provided evidence to show that learning these skills, some of which could be classed as requiring higher-order thinking, can be effectively achieved through the use of simulations.

According to Moule *et al* (2006) simulations have similarly bridged the gap between theory and practice in nursing education. Ricketts (2011) confirms that the interest in simulations in nursing education derives from their use in industries such as aviation, military and nuclear power, although the focus is mainly towards practical training, predominantly addressing lower-order skills. Ricketts states the interest was in response to a shortage of clinical practice placements for pre-registration nurses and midwives, forcing medical schools to examine alternative ways to develop nursing clinical skills. Dowie and Phillips (2011) state that traditionally the nursing curriculum was practice-led, however with the advent of project 2000 in the early 1990s nursing as a subject entered higher education institutions. Practice remained an important component, but the academic part of nursing became university based, using assessments and methods more fitting to traditional higher education courses. There is a clear analogy here to the evolution of surveyor education described in Chapter One. Dowie and Phillips found that within a few years of Project 2000 being implemented, criticism of the university based model of learning emerged and many nursing practitioners expressed concern that students lacked the necessary lower-order practical skills at the point of completing their university study. The key issue related to the theory-practice balance and the result has been a move to simulations as a teaching-learning method to address this. Moule *et al* (2006) lists a significant body of knowledge supporting the use of simulations in nursing education, this includes research studies by McConville and Lane (2006), Wildman and Reeves (1997) and Goddard and Jordan (1998) all demonstrating the positive impact of simulations in developing practical (and by extension lower-order) nursing skills.

4.5.6 Simulations in Construction Management and Engineering

Jaegar (2012) provides an example of the effective use of simulations within built environment education as part of undergraduate construction management courses. Jaegar asserts that communicating effectively is one of the most important human factors in construction management. Indeed, communication is identified within the definition of meta-competencies developed by Cheetham and Chivers (1996). Jaegar argues that traditionally, students acquire this skill through conventional teaching or problem-based learning approaches; however noting that these were not always fully effective. Jaegar asserts that the limitations can be overcome by developing and applying a communication simulations approach based on the theoretical framework and learning model of Emilsson and Lilje (2008). The framework incorporates two different theoretical perspectives, "how to learn", this addresses cognitive learning through a problem-based approach and "what to learn" through the identification of subject-specific learning outcomes. Jaegar develops this model and proposes an integrated three-level framework for learning communication in construction management as follows:

(i) In the first level, cognitive learning is addressed by the use of a problem likely to be encountered in a professional situation

(ii) The second level involves interdisciplinary learning through students representing different project parties within a scenario

(iii) The third level provides an iterative social approach to communication between sender and receiver within the scenario to achieve specific results and outcomes.

Within Jaegar's study it was found that the use of simulations resulted in a statistically significant positive impact on the learning effectiveness of the meta-competency of communication for construction management students when measured against this framework.

Madhuri *et al* (2012) further developed problem-based learning for engineers and applied an inquiry-based pedagogy to develop higher-order thinking skills. Their study showed improved higher-order outcomes were produced in comparison to conventional learning approaches. The findings also confirmed those of Weiss (2003) and showed that the extent of the learning achieved was positively influenced by relevance of the material being used. The study concluded that extending a problem-based learning approach increased the motivation of participants and reduced the negative effect of lack of motivation in the acquisition of higher order knowledge.

4.5.7 Simulations use in other sectors

It is noteworthy that the use of simulations is quite extensively documented within medical and other higher education settings but it is not clear what the extent of application is in other sectors. Two cases are considered here, hospitality management and family law practitioners.

Edelheim and Ueda (2007) provide a case study to demonstrate the effective use of simulations in hospitality management education. The case study was based on groups of 30 participants at the International College of Tourism and Hotel Management (ICTHM) in Sydney, Australia.

Edelheim and Ueda found that one benefit of using simulations is in the development of decision-making and group skills. They argue that the simulation approach provides a representation of reality and therefore allows participants to make difficult decisions and develop decision-making skills (higher-order skills) without the risk of failure that could damage the business if practiced in the real world.

Edelheim and Ueda cite Fawcett and Lockwood (2000) in highlighting teamwork as another important skill that is difficult to develop in a traditional classroom situation. They argue that it is possible for lecturers to teach the principles of group work skills in a classroom situation, but to gain true understanding of group dynamics students must experience a role in a real working group. They assert that simulations can be constructed to recreate real group work situations, but for these situations to be realistic, Edelheim and Ueda cite Roberts (1999), who suggests that participants should not be allowed to choose team mates themselves but should be placed in teams randomly. Roberts points out that this may remove the opportunity for participants to form groups with someone they feel comfortable with and thereby impact on the 'fun' element of simulations. They clearly identified that working as closely as possible to reality achieves the optimum benefits from the simulations, stating that in real life situations individuals rarely get the opportunity to choose work colleagues. This is particularly true in the hospitality management sector, where work can involve a variety of different locations and teams.

Edelheim and Ueda's research also addresses the role of the simulation administrator in simulation based learning. They assert that as with lecturers in traditional classroom teaching, the simulation administrator must be fully familiar with the teaching material, this is important to guide simulations effectively and respond to participant questions/difficulties. They argue that if the administrator is also the simulation designer then understanding of the simulation environment would be sufficient for success. However, where the administrator is not the designer, it is necessary to invest sufficient time to become fully familiar with the scenario. Edelheim and Ueda also suggest that it is essential that the administrator is able to clearly communicate to participants areas within the simulation which may not be fully realistic. They suggest this can be used as an element for discussion sessions within the simulation and thereby further develop participants' understanding of the simulated environment versus real life. In the conclusion to their study, Edelheim and Ueda stated that simulation based learning has been shown to be particularly effective in the development of decision-making (higher-order) skills.

In the education of family law practitioners Apel (2011) identified that most law schools maintain a 'business as usual' attitude to traditional teaching methods. These methods rely on the study of casebooks and are primarily a passive way of learning in that they remove the students from the realities of practising law on a day-to-day basis. Apel proposed an alternative method of teaching and learning that bridges the gap between theory and practice through the use of simulations. In Apel's simulation approach, students take on the role of practicing lawyers within a law firm. As they work through simulated cases students receive information through items, such as briefing notes, memorandums from the firm's senior partner, copies of letters, rules of professional conduct and invitations to client meetings. In addition they are asked to address ethical issues such as whether or not the firm should engage in representation of both parties in a family law case. In doing so the simulations provide a blend of lower-order and higher-order skill development opportunities.

Apel also highlights the importance of the simulation administrator role in a similar way to that described by Edelheim and Ueda. Apel suggests that the simulation administrator is essential to direct discussions and provide data as simulations progress. Students learn substantive law through reading statutory and case law and other exercises which are injected into the simulations.

Again, Apel highlights a key challenge as that of establishing the balance of realism. She states that students work with a safety net, in that they can refer for guidance from senior partners and help from colleagues. This is all created within an environment where mistakes would not impact on real clients' lives. However, Apel suggests care must be taken to ensure the environment is not overly artificial thereby diminishing the benefit of the simulation approach.

A further advantage of simulation based learning identified by Apel, is that it requires students to recognise their own strengths and weaknesses. For example, the skills of communication, listening, interaction and judgement are all developed through the approach.

Considering the disadvantages, Apel highlights that simulations require a fairly small teacher to student ratio, she suggests no more than 16 students per simulation. It seems there is a divergence of views as to optimum number for simulation application, with Edelheim and Ueda (2007) suggesting a maximum of 30 participants within their case study. However, the point that Apel makes is that the number of participants must be controlled such that the activity can be effectively supervised and managed.

The second point made by Apel reinforces that made by Alliger and Janak (1989) that simulations need to be carefully prepared. Apel asserts that scenario briefing material should be drafted in detail, together with appropriately selected support materials for injection during the simulation. This supports and reinforces the requirement that preparation is a key aspect in the success of a simulation based learning approach.

In conclusion, Apel confirms that simulations provide an effective approach for improving the pedagogy of family law teaching. However, she does point out that there is a limitation, in that all participants may not adapt easily to taking on the responsibilities of active learning which is required in a simulation based methodology.

4.5.8 Other instances of simulations applied to higher-order learning

Research carried out by Tennyson *et al* (1987) provided early confirmation that a scenario/simulations approach had been explored previously. The application was limited to school level education and to solving problems that had a defined number of solutions. It did however provide some evidence that in conceptual terms the strategy of using problem-orientated simulations might provide a feasible approach to the learning and development of higher-order skills, which accords with the approach taken in this research.

Also, there is evidence of attempts to learn higher-order thinking being applied in similar learning situations to that of the professional competencies to be acquired by new entrant quantity surveyors. Research by Barker

(2011) studied the training used for US law enforcement officers, who are required to invoke reason and critical thinking skills in order to solve intricate problems in real time. However, the findings revealed that the strategies adopted to assess the effectiveness of this approach were not fully validated, but the approach did suggest the teaching technique was probably effective.

4.5.9 Application of Simulations

This section now considers the application of simulations. Dieckmann (2009, p.60) asserts that it is important to distinguish between ‘reality’ and ‘realism’. This is a similar point to that highlighted by Edelheim and Ueda (2007) and Apel (2011). Dieckmann argues that they are sometimes used synonymously but in practice are different. He states that reality concerns the ontological question of existence (does it exist) whereas realism is a comparative judgement in which a situation or scenario is compared with reality. The measure of realism is how closely a replication of a situation resembles the actual situation itself. The point that Dieckmann makes is the importance of creating realism (and therefore perceived closeness to reality) for successful simulation applications.

To apply successful simulations Jeffries (2005) proposed a framework to guide the processes of preparing, implementing and evaluating simulations comprising five main components. These were identified to be:

(i) Teacher factors – Unlike traditional classroom learning where instruction is teacher-centred, instruction for simulations is student centred, that is the teacher plays the role of facilitator leading students through the simulation. Therefore simulations should provide for the facilitating context with the simulation administrator providing learner support as needed. The application should provide for debriefing and immediate feedback to conclude the learning experience

(ii) Student factors – With simulations, students are generally expected to be responsible for their own learning, a point reinforced by Apel (2011). Jeffries states that they must be self-directed and motivated during the simulation, which therefore should set out the ground rules for the activity. Jeffries asserts that competition, although usually a motivator, should be used with care within the design of the scenario, as it could lead to anxiety and stress. Where the simulation involves role-playing, the simulation administrator should inform students about their specific roles, particularly if they are to work in groups. This is important to avoid confusion as to responsibilities within the simulation. Students have diverse learning styles, therefore simulations should allow for this so that students with varying backgrounds benefit from the experience

(iii) Collaborative factors – Simulations should provide collaborative learning opportunities, where participants work together to solve problems and share in the decision-making process. Jeffries asserts that collaborative learning in simulations increases the sense of collegiality and teamwork, and provides an environment where participants work together that is typical in professional life

(iv) Learning Outcomes and objectives – The content of simulations should be appropriate to support goals and learning outcomes. Clearly written objectives should be provided to align with the students' knowledge and experience, together with information about the activities, process, amount of time required and outcome expectations

(v) Fidelity (realism) – Simulations need to mimic reality and should therefore ensure authenticity of the simulation experience. The simulation should include as many realistic environmental factors as possible. This confirms the assertion of Dieckmann (2009) concerning the importance of realism.

Dieckmann (2000, p.49) provides a further model for the application of simulations that comprises seven stages, which they identified to be:

(i) Simulation Introduction – In the initial stage the aims and objectives of the simulation are explained

(ii) Simulation Briefing – In this stage participants are briefed on the simulation background, for example the fit with an overall course curriculum

(iii) Theory Input - In this stage participants receive information on the contents of the simulation and link to theory (Dieckmann and Manser suggest this may be integrated in small sections at different points in the simulation)

(iv) Scenario Briefing – in this stage participants receive information regarding the simulation scenario

(v) Simulation activity – The scenario should have a defined length. Dieckmann and Manser suggest that in medical training where medium/intermediate fidelity simulations are frequently used, then the scenario may take place in a designated simulation area

(vi) Debriefing – This stage includes group discussion for reflection on the experience during the scenario

(vii) Ending – In the last stage the simulation is summarised and closed.

The final framework reviewed with regard to the application of simulations was proposed by Smith (1996). The components were identified to be:

(i) Teaching Goals – The first step is defining the goals to be achieved. Smith asserts that defining goals is essential to determining the structure and methods of the simulation. Goals should be written down before commencing and used to construct the debriefing and summary

(ii) Roles – Roles within simulations should be clear. Smith proposes construction of a 'role sheet' for each player or group of players. Role statements should reflect the structure or power of relationships that exist in the real-world environment and how they may manifest themselves within the simulation

(iii) Scenario – the next component is creation of a scenario, this should interest and challenge the participants

(iv) Running the simulation – Smith recommends that the scenario and role assignments should be distributed in advance of the exercise. This allows participants time to familiarise themselves and avoids unnecessary delay within the simulation

(v) De-briefing – The final component is debriefing. Smith argues that much of the value of simulations is contained in the debriefing and summary. He asserts that if the simulation has gone well students will have become deeply involved. As a result they will be keen to hear recommended solutions and outcomes to the problems.

In conclusion, there are a several common application features in the three models which have been described above. Smith (1996), Dieckmann (2009) and Jefferies (2005) all identify the importance of clearly defined learning outcomes/objectives for simulations followed by feedback/debriefing at conclusion. Dieckmann (2009) reinforces this and asserts that simulations must be goal-oriented; this permits measurement/assessment of success.

Smith and Jefferies both highlight the need for roles within simulations to be clearly established within the design. This avoids confusion and contributes to a successful outcome. Jefferies reinforces the need for ground rules to establish behaviours within these roles.

Finally, Jeffries confirms the need for realism. He asserts that simulations need to mimic reality to ensure authenticity of the simulation experience. This is a point reinforced by several other theorists including Edelheim and Ueda (2007), Dieckmann (2009) and Apel (2011).

4.5.10 Critical review and summary

The foregoing sub-sections have considered the theory and application of simulation-based approaches applied to the general education/learning and more specifically to lower-order and higher-order thinking within professional training and development.

Schuck (2010) and others argue that primarily the use of simulations is an effective learning approach because it enables participants to adopt an experiential approach to learning, repeatedly and reiteratively cycling through the Kolb learning model.

Keys and Wolfe (1990) and Alliger and Janak (1989) highlight further benefits of simulations in that they lead to increased levels of enthusiasm and engagement. This includes a range of social benefits such as development of communication skills and the strengths of collaboration and interdependence.

A criticism levelled by Dieckmann (2009) is that participants may improve their test scores through regular use of simulations because they learn what is expected from them rather through increased knowledge/skill. In this context Dieckmann was specifically referring to medium/intermediate fidelity simulations where participants were practising tasks in a simulated environment such as medical care with a machine or dummy. However, it is contended this caution could also apply to low fidelity simulations, if the same format or scenario was repeated for a number of learning exercises.

Further, Johnson (2009) asserts that when using simulations it is important to establish the context of the exercise in respect to professional development. He suggests a flaw exists in the approach of simulation if it is not taken seriously by participants, this can be a particular issue where there is too much emphasis on exercises being fun and engaging. Johnson cites the example in medical training where simulations may simply be seen as an 'opportunity to play doctor'. To counter this he recommends that the professional context is reinforced repeatedly during simulations.

To conclude this section the main learning and applicational constituents emanating from the simulations literature review are summarised in Table 4.3.

Table 4.3 – Summary of simulation learning and applicational constituents (after Kolb, 1984 and others cited below)

Major theorists	Learning and applicational constituents	Potential contribution to learning model
Kolb (1984) Moule *et al* (2006) Schuck (2010)	**Experiential Learning** – Is based on the view that learning is formed and reformed by experiences	Simulations permit recreation of an experiential learning environment
Smith (1996) Jefferies (2005) Dieckmann (2009) Jaegar (2012)	**Engagement** - Simulations are spatiotemporal events i.e. they provide space and time for social engagement	To ensure maximum engagement rules for participation, roles, learning outcomes, objectives and feedback should be included
Jonassen (2000) Duch (2001) Weiss (2003)	**Scenarios and Problem Based Learning** - Problem based learning results in longer lasting learning than traditional lecture style	Simulations provide a theoretical link to problem based learning through use of scenarios
Jefferies (2005) Edelheim and Ueda (2007) Dieckmann (2009) Apel (2011)	**Realism** - For effective learning it is important to create realism	Simulations create realism through well-constructed scenarios
Jefferies (2005) Edelheim and Ueda (2007) Apel (2011)	**Support** – Is an important component in adult learning theory	Simulations require full preparation and provide support through active administrator/facilitator

The summary has been used to inform the conceptual learning model presented in Chapter Five.

4.6 Accelerated learning

4.6.1 Introduction

A further area of learning theory and non-traditional practice that demonstrated the potential to contribute to the development of the new learning model was that of accelerated learning. Accelerated learning techniques (ALTs) contain facets that could support, reinforce or enhance the constituents derived from simulations, they could also speed up the acquisition of professional competencies.

The review begins broadly by examining accelerated learning in a general sense and considers the history and physiological theory which underpins the concept. The review then draws a distinction between accelerated learning as applied to higher education and the use of accelerated learning techniques in a business or professional training setting. Finally the review critically reviews the theory by examining the limitations and problems put forward by several theorists and the counter responses that have emanated from proponents.

4.6.2 History and background

McKeon (1995) states that accelerated learning really began in the early 1960s when a Bulgarian psychiatrist, George Lozanov developed the theory of 'suggestology' or 'suggestopedia'. Lazonov found that by relaxing psychiatric patients with music and giving them positive suggestions about their healing many made substantial progress. Under sponsorship from the

Bulgarian government he began research into the use of his methods in the teaching of English to students. He used a variety of non-traditional learning techniques including music, meditation and other visual and auditory tools and found students were able to learn significantly faster and more effectively. Mckeon suggests that for Lozanov suggestopedia was not just a method of learning faster, but rather learning in a more holistic or complete way by employing multi-sensory, brain compatible approaches to teaching and learning.

Meier (2000) reported that in the 1970s Don Schuster of Iowa State University and educators Ray Bordon and Charles Gritton began applying these methods to higher education teaching with positive results. This led, in 1975, to the establishment of The Society for Accelerative Learning and Teaching (SALT) in the USA, similar groups followed in England and Germany. Meier (2000) asserts that this led to the steady and sustained growth of accelerated learning philosophies and methods applied to adult learning and education.

4.6.3 Definition and theory

Ganiron (2013) argued that the term accelerated learning is broadly used to indicate theoretical based approaches to learning, drawn from a wide range of fields such as neuro-science, psychology and learning theory. The technique is grounded in an understanding of how learning takes place, rather than what is to be learned. The principle is that with correct teaching

approaches, motivation and learning environments, learners are able to achieve faster and more effective results. The work of McKeon (1995, p.65) confirms this overview with a definition that states:
"accelerated learning is a multisensory, brain-compatible teaching and learning methodology which speeds the learning process"

Bancroft (1985) asserts that when properly applied by a competent teacher accelerated learning methods have been claimed to speed up learning and improve retention by 2.5 to 3 times.

Accelerated learning theory is built on the findings of research into the structure and processes of the human brain. Hughes (1991) asserts that our brains are divided into two hemispheres and that different areas of the brain have a dominant responsibility for different functions and actions:
Right hemisphere – deals with images, colour, music, creativity and intuition
Left hemisphere – deals with reading, writing, listening, logic and sequence.

Hughes argued that learning will be accelerated if we can help our brains develop a filing system for new information which maximises use of the differing hemispheres and areas therein. Hughes recommends that teaching should recognise this and include strategies for utilising the differing areas of the brain; this will have a positive impact on learning and memory recall.

Smith (1998) titles this concept as ‘whole brain learning’ and further develops Hughes’ description of hemispheres by describing a model of the brain’s architecture initially proposed in the 1960s by Paul Maclean. This model comprises three areas:

(i) Brain stem or reptilian brain - which controls the basic bodily functions such as heart rate and breathing

(ii) Limbic system or mammalian brain - which controls emotions, desires and long term memory

(iii) Neocortex or thinking brain - which handles the higher cognitive functions such as seeing, hearing, thinking and talking

Meier (2000) asserts that these different brain areas are interlinked and serve as clearing houses for specialised functions in the brain’s overall operation. Smith and Meier both argue that the key to effective accelerated learning is to maximise all areas of the brain in the learning process.

Ganiron (2013) cites Rose and Nicholl (1997) and Meier (2000) and argues that there are two further major theories which underpin accelerated learning. The first of these is the theory of multiple intelligences. Ganiron (2013, p.31) draws on the work of Gardner (1983) and describes multiple intelligence theory as ‘a recognition that all humans have different types of intelligences and different intelligence profiles’. Gardner argues that individual’s profiles are based on genetics and experiences, and it is this which makes each person unique. Ganiron lists ten intelligence types and these are summarised as follows:

(i) Linguistic intelligence - This is the ability to use spoken and written language effectively

(ii) Logical/mathematical intelligence – This is the ability to analyse problems and investigate issues scientifically

(iii) Musical intelligence – This is showing sensitivity to rhythm and sound

(iv) Bodily/kinaesthetic intelligence – This is the ability to use the body for expression

(v) Spatial intelligence – This is the ability to recognise, use and interpret images in three dimensions

(vi) Interpersonal intelligence – This is the ability to understand people's intentions, motivations and desires

(vii) Intrapersonal intelligences – This is the ability to understand oneself and to interpret and appreciate your own feelings and motivations

(viii) Naturalist intelligence – This is the ability to recognise and appreciate our relationship with the natural environment

(ix) Emotional intelligence - This is the ability to be able to recognise an emotion as we are experiencing it

(x) Existential intelligence – The is the ability to know the reason for one's existence and purpose

Ganiron states that although these intelligences are anatomically separated they very rarely operate independently. Rather, the intelligences are used concurrently and typically complement each other as individuals develop skills or solve problems. Ganiron argues that in accelerated learning the intelligences should be considered as equally important, thus teachers should structure material in a style or format that engages most or all of the intelligences. This is in contrast to traditional education and teaching systems which have typically placed emphasis on the development of linguistic and mathematical intelligences. This point is reinforced by Rose and Nichol (1997) who confirm that for effective accelerated learning teaching should be designed to recognise all the areas of intelligence of learners.

The second theory is that of preferred learning styles or modes of learning. Coffield *et al* (2004) state that they have identified 71 different learning style theories dating back to the 1960s, from this they considered 13 to be the most influential and 3 the most well-known. Coffield *et al* imply that all the theories address the basic concepts of categorising learning style preferences and structuring teaching to recognise these. The approach applied in this literature review is to examine the three most well-known theories.

The first of these is Kolb's Learning Style Inventory (LSI). Kolb and Kolb (2005) state that the LSI was created in 1969 as part of a curriculum development project at Massachusetts Institute of Technology. It was originally developed as an experiential education exercise designed to help learners understand the process of experiential learning (referred to in sub-section 2.2.1) and their individual style of learning from experience. The LSI is designed to measure the degree to which individuals display different learning styles derived from the stages of Kolb's experiential learning model. The resulting styles of learner applicable to different stages of this model are summarised in Table 4.4.

Table 4.4– Summary of Learning Styles: Kolb's Learning Style Inventory (adapted from Kolb, 1984 and Kolb and Kolb, 2005)

Style	Stage	Preferences
Accommodator	Concrete Experience Active Experiment	• want to be "hands-on" • Carry out plans
Converger	Abstract Conceptualisation Active Experiment	• test hypotheses • solve problems
Diverger	Concrete Experience Reflective Observation	• imaginative • generate ideas
Assimilator	Abstract Conceptualisation Reflective Observation	• bring together information • put into concise form

According to Kolb's model, the ideal learning process engages all four of these styles at appropriate points. Kolb argues that in practice as individuals attempt to use all four styles they develop strengths in one experience-grasping approach and one experience-transforming approach. Their resulting preferred learning style is then a combination of these strengths.

The second theory is based on a Learning Styles Questionnaire (LSQ) developed by Honey and Mumford (1986). Honey and Mumford adapted Kolb's earlier learning styles work and developed their own model based on research into managers' behavioural tendencies. The model uses a similar four stage experiential learning cycle and identifies four distinct learning styles or preferences directly associated with each stage. Table 4.5 is adapted from Honey and Mumford's original definitions together with the work of Rogers (2001).

Table 4.5 - Adaptation of Honey and Mumford Learning Styles (adapted from Honey and Mumford, 1986 and Rogers, 2001)

Learning Style	Attributes	Preferences
Activist	Activists learn by doing. They need to get involved and have an open-minded approach to learning, involving themselves fully and without bias in new experiences	• Brainstorming • Problem solving • Group discussion • Puzzles/competitions • Role-play
Theorist	Theorists like to understand the theory behind actions. They require models, concepts and facts in order to engage in the learning process. They prefer to analyse and synthesise in a systematic way	• Models • Statistics • Stories/Quotations • Background information
Pragmatist	Pragmatists need to be able to see how learning is to be applied to the real world. Abstract concepts and games are of limited value unless they can see practical application	• Time to think about how to apply learning • Case studies • Problem solving • Trying out new ideas
Reflector	Reflectors learn by observing and reviewing what has happened. They prefer to stand back and view experiences from a number of different perspectives. This includes collecting data and taking time to review and develop an appropriate conclusion	• Paired discussions • Observing activities • Feedback from others • Coaching and interviews

According to Honey and Mumford individuals have preferred learning approaches and to maximise personal learning each learner should understand their preferred style and seek out opportunities to learn using that style. However, Honey and Mumford note that to be an effective learner it is important to develop ability to learn in all four styles. The point they are making is that all four learning styles may not always be available in particular learning settings. As a result it is important to develop the ability to learn across all styles and therefore maximise learning opportunities.

The third learning style theory examined was launched by Neil Fleming in 1987 through work carried out at Lincoln University, USA and is termed the VARK model (Fleming and Baume, 2006). VARK is an acronym for Visual, Aural, Read/Write and Kinesthetic learning styles. The assertion being that visual learners learn best through pictures, diagrams and other forms of visual stimulation. Auditory learners receive information best via avenues such as lectures and discussions. Read/Write learners prefer the written word and Kinesthetic learners prefer learning through physical activity such as movement and direct involvement. Fleming acknowledges that VAK (Visual, Aural and Kenesthic) models existed for a considerable time ahead of his work. However, from his research it was noted that some students had a distinct preference for the written word and as a result this recognition is incorporated into his model. Fleming asserts that this distinction is now widely accepted in the field of learning theory.

Table 4.6 considers learning strategies applicable to the four VARK learning styles and has been developed based on the work of Jester (2000) and Fleming and Baume (2006).

Table 4.6 – Summary of VARK Learning Styles and Strategies (after Jester, 2000 and Fleming and Baume, 2006)

Learning Style	Attributes	Strategies
Visual	Visual learners think in pictures and learn best from graphical displays including diagrams, illustrations, photographs and other visual formats	• Teaching material should highlight key points in colour • Convert notes into symbols, diagrams and pictures • Create visual reminders of information • Use charts, diagrams and mindmaps
Auditory	Auditory learners learn best through verbal teaching, discussions and listening. They interpret the underlying meaning of speech through voice tone, pitch and speed	• Teaching should provide opportunities for discussions, listening and talking • Work in groups or pairs to encourage conversation • Present notes and instructions verbally

Read/Write	Individuals with this preference prefer information displayed as words. Emphasis is on text-based input and output i.e. reading and writing in all forms	• Teaching should provide for written notes • Notes should be read and reviewed • Arrange learning material in lists and hierarchies • Provide written summaries and conclusions • Allow time for reading and assimilation
Kinesthetic	Kinesthetic learners learn best through hands-on approaches. They can become distracted by their need for movement and activity	• Teaching should include practical exercises • Create hands-on learning when possible, this could include models, visits and laboratory time • Allow for frequent breaks • Stay actively engaged with participants

In conclusion, authors such as Greenfield (1997), Stahl (2002) and Henry (2007) all question the validity of learning style preferences from a neuroscientific viewpoint. The argument being that humans have evolved to the point that senses work in unison exploiting the interconnectivity of the brain and therefore cannot be viewed as a simple preferences model. Kolb and Kolb (2005) and Fleming and Baume (2006) counter such criticism my citing empirical evidence for the effectiveness of their LSI and VARK models. The conclusion drawn by Meier (2000) is that the balance of evidence suggests activities should be designed to appeal to as many learning styles as possible, this will ensure that each learner benefits and contribute to accelerated learning.

4.6.4 Accelerated Learning in higher education

Ganiron (2013) argues that when accelerated learning began in the 1970s it was considered revolutionary in that the starting point was completely different from anything on offer at that time. Educationalists still thought in terms of traditional learning based around curriculums, terms, courses and examinations. Trainers dealt in lectures, demonstrations, classes and workshops. According to Meier (2000) traditional learners were seen as students suited to learn within the boundaries of a physical classroom using a predefined curriculum. Teaching approaches were generally teacher-directed and followed the “cookbook” approach of steps and demonstrations. In an attempt to differentiate traditional learning in higher education from accelerated learning Russell (1999) provides a comparative analysis of the characteristics. This is summarised in Table 4.7.

Table 4.7 – Comparison of traditional learning versus accelerated learning (adapted from Russell, 1999)

Characteristics of Traditional Learning	Characteristics of Accelerated Learning
Traditional learning is Linear	Accelerated learning is non-linear, systemic
Teaching is directed towards 'Knowing about'	Teaching is directed towards 'Knowing how'
Format is formal, structured	Format is informal, flexible
Style focuses on conscious mind	Style focuses on the unconscious mind
Learners memorise facts	Learning is intuitive and focuses on application knowledge
Learners are incentivised through having to learning	Learners are incentivised through wanting to learn
Learning is seen as hard work	Learning is fun, effortless
Teaching style is emotion-free and passive	Teaching style is emotional and active

Ganiron (2013) asserts that learning in a traditional sense was seen as a two-step process involving the reception and processing of information. The reception stage involves transfer and receipt of information, the processing step may simply involve memorisation. Felder and Silverman (1988) argue that the outcome of traditional learning is seen as the material being either 'learned' in one sense or 'not learned'. Ganiron argues that it is the recognition of the shortfalls in the traditional learning approach which has inspired the interest in the application of accelerated techniques in education.

In the case of higher education Imel (2002) suggests that the terms accelerated learning and accelerated programmes are often confused. She states that accelerated programs generally refer to duration and intensity rather than methodology. However, many accelerated programs do contain features advocated by accelerated learning. Wlodkowski (2003) suggests accelerated learning programs commenced approximately twenty-five years ago and are now one of the fastest growing transformations in higher education in the USA. Accelerated courses being presented in less time than the conventional number of contact hours through the use of intensive teaching platforms and methods. Ganiron (2013) reports that in teaching environmental control systems in Qassim University, Saudi Arabia the adoption of accelerated learning principles benefitted students in that they learned more, faster and better. They were able to apply what they learned in the working environment and became more creative innovators. In contrast to the work of Wlodkowski and Ganiron, Imel (2002) asserts that the straightforward inclusion of accelerated learning techniques into higher education practice is not as widespread as claimed. However, she concludes by recommending wider application to exploit the obvious benefits demonstrated by proponents such as Greenbaum (1999), McKeon (1995) and Meier (2000).

4.6.5 Accelerated learning in business and professional sectors

Boyd (2004) suggests that In the 1970s corporate training specialists in the United States adopted the ideas of suggestopedia and started to incorporate accelerated learning approaches into their training courses. He argues that initially this was seen as a way of saving time and money on training but subsequently developed into an approach for realising more positive results. Boyd states that Lozanov's early suggestopedia work also caught the attention of David Meier, a specialist in applying instructional methods to business training. As a result in 1981 he founded the Centre for Accelerated Learning at Lake Geneva, Wisconsin, USA. Meier (2000) argues that since establishment of the centre accelerated learning has survived and thrived in many training and development settings. However, in line with Imel's observation above, he does acknowledge that there is still a long way to go and argues that the approaches remain far from mainstream.

In the UK Smith *et al* (2003) assert that there is widespread use of accelerated learning approaches within business training and argue that the benefits can be significant, particularly if activities are designed to appeal to as many learning styles as possible. Simon and Price (2010) provide a case study to illustrate use within the built environment sector as part of the development of project managers. Simon and Price (2010, p.9) argue that traditional training approaches such as "Death by PowerPoint, lectures and tangential war stories" are not effective for developing project managers' human and organisational competencies. They draw on the work of Malcolm

Knowles (1990) and suggest training should recognise the characteristics of adult learners which they summarise as needing to:

- Be autonomous and self-directed
- Connect with life experiences
- Goal and relevancy orientated
- Practical and practice orientated

Based on these characteristics Simon and Price propose three principles to be incorporated into accelerated learning. Firstly, the learning needs to be embedded within a ‘real case’ project example that is immediate and relevant. The case project should be designed to present challenges enabling participants to discover new ways to deal with these challenges. Secondly, the learning needs to be truly facilitated by trainers who are experienced facilitators and project managers. This ensures the participants make appropriate links to practice. Thirdly participants need to be provided with a learning environment where they have autonomy to direct their own learning, witness and assess the behaviours of others and reflect on their experiences. These principles have been adopted to inform the new learning model in Chapter Five.

In conclusion, Simon and Price claim that applied correctly an accelerated learning approach can impart two years of on-the-job experience in two days spent in a learning event. This serves to support claims made by others as to the power of accelerated learning such as Bancroft (1985) discussed earlier in this section.

4.6.6 Application of Accelerated Learning

This section now considers the application of effective accelerated learning. Meier (2000) asserts that in order to encourage collaborative learning it is necessary to build positive and trusting relationships within the learning group. He recommends that small group activities should be used that encourage people to share their goals and experiences. These activities should be designed to build a sense of connectedness between members of a group.

Boyd (2004) asserts that the key to application is to involve students in active learning so as to avoid monotony and engage all aspects of the brain-mind-body connection. He suggests encouraging participants to engage in proactive reading whereby they skim information to a get a general sense and then identify specific areas or questions. Finally, he argues that it is essential to encourage learners to engage regularly in reflection on what they are learning and how it may be applied.

McKeon (1995) asserts that in accelerated learning, the trainer must get involved with the trainees in the learning activities. This reinforces the point made by Simon and Price (2010) and provides a link to the theory on effective application of simulations. For example, Apel (2011) advocated the active involvement of the simulation administrator.

To incorporate effective accelerated learning into corporate development programs Rose and Nicholl (1997) proposed a six-point framework which must be addressed. The framework is termed ‘MASTER’, the components are summarised and explained below:

(i) Mind - It is necessary to establish the right state of mind. For example, establishing the benefits of the learning, a physical environment conducive to learning and novelty/excitement in activities

(ii) Acquire the information – This includes establishing facts and provision of basic data

(iii) Search out the meaning – Establishing the gaps, this includes analysis and visual frameworks

(iv) Trigger the memory – Build in a review cycle

(v) Exhibit what you know – provide an environment for sharing information

(vii) Reflect – Provide for feedback and learning summary

Meier (2000) asserts that in applying accelerated learning the key factor is to allow learners to work with each other in ‘as a real world setting as possible’. This allows learners to create their own personal meaning, knowledge and skill. Meier proposed ‘7 Principles of Rapid Design’ which are summarised below:

(i) Apply the four-phase learning cycle – Application should be built on the four phases of learning, preparation, presentation, practice, application. All four phases must be present and in proper balance

(ii) Appeal to all learning styles – This develops earlier work reviewed on learning styles, but emphasises the need to provide an 'option rich' environment that appeals to all learning styles

(iii) Make application activity based – Learning should include activities that participants can engage in

(iv) Create a learning community – Meier asserts that effective learning has a social base, therefore should allow for sharing knowledge and experiences

(v) Alternate between active and passive learning activities – Application should include physical (doing) activities and passive learning activities such as thinking and reflecting

(vi) Follow 30/70 rule – This means avoiding domination by the trainer. Meier advocates the balance to be 30% facilitator time and 70% learner participation time

(vii) Create flexible, open-ended sessions – Accelerated learning application should be open-ended and responsive to change. Feedback from one session should be incorporated into the next.

The final framework reviewed for the application of accelerated learning is proposed by Smith et al (2003) who advocate a four-stage accelerated learning cycle. This cycle is summarised as follows:

(i) Connect – Allow for connecting the learning to overall objectives and outcomes

(ii) Activate – Application sessions should include for input information followed by opportunities for learners to participate in activities

(iii) Demonstrate – This stage provides opportunity for leaners to demonstrate their learning through meaningful evaluation

(iv) Consolidate – The final stage addresses consolidation of learning through review of outcomes.

In conclusion, there are several common features in the three models which have been described. Rose and Nicholl, Meier and Smith *et al* all include aspects related to creating an effective and inclusive learning environment. This includes the use of activities which recognise learning styles. Boyd (2004) supports this and asserts that the key to effective design is to involve students in active learning. Rose and Nicholl and Meier highlight the need to provide an environment that permits sharing knowledge and experiences. Rose and Nicholl and Smith *et al* all confirm the need for review sessions to trigger memory and consolidate learning.

Finally, Rose and Nicholl and Meier highlight the important role of the facilitator in learner support. This point is reinforced by McKeon (1995) who asserts that the teacher must be fully involved with the trainees in learning activities. However, Rose and Nicholl add a caution in that trainers should avoid dominating the session.

4.6.7 Critical review and summary

The foregoing sections have examined accelerated learning theory and application. It is evident that accelerated learning approaches can deliver significant benefits as highlighted by Bancroft (1985), Smith and Price (2010) and Ganiron (2013). However, there remains some doubt around the full integration into adult learning settings (Imel, 2002).

Wlodkowski (2003) suggests accelerated learning techniques are criticised by conventional academics because they focus on convenience i.e. speed rather than substance and rigor. Wlodkowski states that the criticism is because there remains a view in higher education that learning is less effective when less time is devoted to it. To counter this criticism Wlodkowski cites Walberg's synthesis (1998) that states time is necessary but not a sufficient condition for learning in itself. The point being made is that focussing on duration is irrelevant without also considering learning effectiveness. Other factors that influence learning include elements such as student capability and personal motivation. Although Wlodkowski's observations relate primarily to accelerated learning programmes in higher education he asserts that the format can be effective across all adult learning. As an example to support the effectiveness he cites a survey conducted in 2003 which provided empirical evidence to confirm that a higher percentage of students graduate sooner from courses following an accelerated format. In conclusion, Wlodkowski claims that accelerated learning is effective but acknowledges that the extent of evidence is limited and suggests more research is required towards accelerated learning in programme areas such as sciences, medicine and engineering. It is not clear that evidence exists connecting the benefits of accelerated learning specifically to higher-order thinking skills.

Swenson (2003) also critiques accelerated learning and suggests the term accelerated implies that there is a normal method or pace for teaching and learning. He states that this assumption is flawed because all learning is individual, the epistemology of learning is social and it is situated in the context of individual's social lives. Thus it is not valid to argue accelerated learning on the basis of time alone. Swenson asserts that the actual issue in education relates to teaching systems in that they have been constructed to codify learning and therefore protect the traditional approach. He argues that the goal should be to create conditions under which the greatest amount of learning can take place within the shortest time, if this can be shown to be achieved this would silence sceptics of the accelerated approach.

To conclude this review the main learning and applicational constituents are summarised in Table 4.8. These are incorporated into the learning model presented in Chapter Five.

Table 4.8 – Summary of accelerated learning theory and application constituents (after Lozanov, 1978 and others cited below)

Major theorists	Learning and applicational constituents	Potential contribution to learning model
Lozanov (1978) Bancroft (1985) McKeon (1995)	**Learning Environment** – Should be relaxed and suggestive	For effective accelerated learning environment is important
Gardner (1983) Hughes (1991) Smith (1998) Meier (2000) Ganiron (2013)	**Intelligences** - Teaching should maximise all areas of the brain	Presentation style should be varied to engage most or all of the intelligences identified by Ganiron (2013) and others
Kolb (1984) Honey and Mumford (1986) Fleming and Baume (2006) Meier (2000) Coffield *et al* (2004)	**Learning Styles** - Accelerated learning is effective through appealing to preferred learning styles of learners	Presentation style should be varied to provide for the preferred learning styles advocated by Kolb (1984) and others
Knowles (1990) Simon and Price (2010)	**Engagement** - Accelerated Learning achieves engagement by recognising the components of adult learning	To support engagement learning model should provide for self-direction, connection with experiences and be goal orientated

4.7 Game based learning

4.7.1 Introduction

The third area of theories and knowledge that demonstrated the potential to contribute to the development of the new learning model was that of game-based learning (GBL). There are several aspects within the theories and literature relating to learning, simulations and accelerated learning that suggest a positive association with the theories and principles of games and gaming. Jefferies (2005) and Dieckmann (2009) both refer to the need for rules in the successful application of simulations, whilst Keys and Wolfe (1990) highlight the need for enthusiasm as a component for effective learning. This is reinforced by Knowles (1990) who identified the desire to participate as being an important aspect in adult learning theory. Honey and Mumford (1986) identify the preference for puzzles and competitions within the Activist Style of their learning styles model. Finally, Russell (1999) differentiates accelerated learning from traditional learning through the need for learning to be fun and effortless. The contention of this thesis is that game based approaches may contribute to the new learning model and enhance the acquisition of professional competencies.

The section begins by examining the history and background to games as applied to learning and education. The section then explores the differing definitions of game based approaches and uses this as the basis for reviewing the supporting theory. The section then moves on to examine the critical factors contained in the application of game based learning approaches. Finally the section concludes by critically reviewing the theory and presenting a summary of the main theoretical and applicational aspects which have been identified.

4.7.2 History and Background

Shelton *et al* (2013) state that most researchers who study games and education recognise that close ties have existed for centuries. Several theorists support this, such as Ginsburg (2007), who asserts that educationalists recognise play is an important element for learning development. Bedrova and Leong (2003) and others state that children have traditionally learned through imaginative play and Ke (2009) argues that the opportunity to play is not necessarily a distraction from learning but rather an integral part of learning and intellectual development. However, Shelton *et al* (2013) point out that the acceptance of games in a traditional class room based education setting was frowned upon through the early and middle parts of the twentieth century, possibly they suggest, because the term "game" was associated with leisure and therefore not widely welcome by serious educationalists. They argue this perception has changed in the latter part of the twentieth century, driven primarily by the rapid advances in computer based technology. Garris *et al* (2002), Squire (2003), Prensky (2005) and others all reaffirm this point and note that there has been a fundamental shift in the field of learning brought about by developments in computer and video games, resulting in games traditionally thought of as pure entertainment now being recognised as powerful tools to support learning. In conclusion, Shelton *et al* argue that technology development has now reached such a point that it can support many aspects of classic learning and development theory.

4.7.3 Definition and theory

It is evident from reviewing the theory of game-based approaches that several definitions are used by theorists, some of which cross-over. As a result it is helpful to review the theory based on these definitions and therefore provide clarity.

(i) Game and Gaming – A basic definition provided by the Oxford English Dictionary (2008) defines a game as "an activity or sport with rules in which people or teams compete against each other". This is differentiated from Gaming through the action of doing. Gaming is defined as "the action or practice of playing a game". McClarty *et al* (2012, p.2) extend this and specifically apply the term "Gaming in Education" to the playing of digital games in education (defined below as digital game based learning).

(ii) Game Based Learning – Trybus (2015) defines game based learning as the borrowing of gaming principles and applying them to education settings, to engage users. Bainbridge (2007) earlier proposed a similar definition for game based learning, it being the use of game play to provide defined learning outcomes. Bainbridge expanded this to explain that game based learning is designed to balance subject matter with gameplay and thereby enhance the ability of the participants to retain and apply the subject matter in the real world. He asserts that in a successful game based learning environment, choosing actions, experiencing consequences and working towards goals allows participants to make mistakes through experimentation in a risk-free environment. There is a strong link to simulation, Edelheim and Eueda (2007) highlight that participants in simulations can make difficult decisions without the risks that may be associated with failure.

Charles *et al* (2011) assert that game based learning has gathered momentum due to the view that the approach helps to make learning more fun and allows the introduction of competition. They state that for effective game based learning the primary goal of participants should be to understand the rules and thereby compete to 'win the game'. They recommend that points should be allocated to the achievement of tasks in relation to the rules and scores used as feedback to students. Charles *et al* go on to develop this in the context of digital game based learning which is considered further below.

Ebner and Holzinger (2007) asserted that game-based learning provided a logical link to problem based learning, in that specific problem based scenarios can be placed within a game framework. This provides a further link to the simulation theory put forward by Anderson and Lawton (2009) and others who advocated the use of simulations as a means of enhancing problem based approaches.

(iii) Digital Game Based Learning - Prensky (2005) differentiates digital game based learning from the learning dimensions of basic game approaches, in that digital game based learning introduces the use of computer based games. A concept that combines computer games and learning theory in a structured format.

Charles *et al* (2011) support this concept and highlight that in a computer game approach many of the components defined within learning theory can be delivered in a digital game format. For example, achievements within games can be acknowledged by pop-up messages and points can be awarded to acknowledge player's successes. These points can be added to the player's overall game scores, therefore providing immediate feedback.

Charles *et al* provide a case study to illustrate the application of one of these concepts within a computing degree course. In the case study an experiment was conducted at the University of Ulster in 2008. A digital gaming feedback approach was applied to provide 4th year computing students with individual feedback on their engagement with aspects of the course. Points were awarded to students based on their level of participation for areas not formally assessed, such as completing extra tasks in laboratory work, using discussion boards and asking questions in class. Seven hundred points were made available to students over a period of six weeks. The rules on how to obtain these points were provided to students and the points scores were fed back digitally in graphical format. Anonymous tables of scores were published regularly, which allowed students to see their position in the overall class. Charles *et al* observed that students were more motivated, participated better and attendance improved. Thus Charles *et al* cite this as evidence that the digital feedback aspect of game based learning can significantly enhance educational feedback and student engagement.

Kirriemuir and McFarlane (2004) ascertained that computer games are a growing part of our culture, finding that 75% of young people regularly play computer based games, however they claim there is little research evidence for the theoretical and actual implications for learning. They reason that the theory cannot be mapped onto one traditional research discipline with the epistemology spanning computer science, education, psychology, media and cultural studies.

Neville and Shelton (2010, p.612) also acknowledge that this is a rapidly emerging area and suggest the learning aspects of three-dimensional games are the next avenue for further development. They state this technology offers the potential to entirely immerse the learner in what they term "the otherness of the game world". The point they are making is that technology development will enable learners to be completely engaged in a virtual world and as such, three-dimensional game technology will require an entirely new typology or genre for learning categorisation. This is clearly an important and fast-moving area of development, but one that is far from decided at this point in time. In view of this and to keep this research within a manageable boundary of knowledge, the application of digital formats to learning and their future development has not been included within the scope of the study. It is however, an area of research that will emerge and become an important part of digital learning in the future.

(vi) Gamification – Deterding *et al* (2011) define gamification as the use of game thinking and game mechanics in a non-game context to engage users and define problems. Sutter (2010) agrees, stating that gamification takes some game elements and applies them to non-game settings. A number of organisations are developing these concepts, including professional bodies, such as The Association for Project Management (2014) who have adopted these concepts as a means to develop professionals. The APM state that there are four main game elements falling under the gamification banner. These are:

- Points – something for participants to earn
- Rewards – something for participants to spend their earned points on
- Badges – something to show peers the achievements of participants
- Leader boards – a method of showing real-time feedback that is visible to all participants

Deterding *et al* (2011) state that the enthusiasm for gamification among its proponents has met with some critical responses from portions of the games community, as it can create an artificial sense of achievement. Deterding *et al* also assert that that gamification can encourage unintended behaviours. An example of this might be where participants focus exclusively on a desire to 'be top of the leader board' rather than the content or learning aspects of a game.

The review of literature suggests gamification is an emerging area with potential for use within a game based learning methodology, including the built environment sector. This is supported by Briggs and Giffin (2013) who assert that gamification offers the potential to develop project managers through increased motivation and enhanced engagement within the project process.

(v) Game Theory and Competition Based Learning – Myerson (1991) defined game theory as a study of strategic decision making. More specifically, it is the study of mathematical models of conflict and cooperation between intelligent rational decision makers. Binmore (1994) considers that game theory provides useful mathematical tools to understand possible strategies that individuals may follow when competing or collaborating in games. He argues that this is a branch of applied mathematics, which is used in social sciences (mainly economics), biology, engineering, political science, international relations, computer science and philosophy to predict the outcomes from problems or scenarios. Initially it was developed to analyse competitions in which one individual does better at another's expense, termed zero sum games. The classic case cited is that of the prisoner's dilemma.

Burguillo (2010) also notes that game theory is well established in applied mathematics, he suggests that there is a significant body of knowledge surrounding its use in areas such as, economic behaviour including predicting the behaviour of companies, markets and consumers, however, he states that the approach is not widely applied as a tool to support educational learning theory. To develop this application Burguillo proposes the concept of combining game-based learning and problem-based learning with game theory in an approach he terms competition based learning (CnBL). CnBL is a methodology where learning is achieved through competition, but the learning result is independent of the participant's score, thus the learning results from competing rather than the final score that is achieved. Burguillo applied this concept to a number of undergraduate courses in Telecommunications Engineering, over a five year period. Students were divided into pairs and worked one against the other in a series of practical tasks. As in the prisoner's dilemma they had the option of working together or against each other in different elements of the tasks. Burguillo found that the percentage of students passing the course was higher in the five years where the CnBL approach was used (96.56%), compared to 90% in years without use of CnBL. From the study Burguillo concludes that the use of CnBL enhances the learning experience and stimulates the students' motivation. He deduced that the prime element is cooperative competition and it is this that provides the motivation and thereby helps increase student performance. This links to the work of Jeffries (2005) with regard to simulation theory, Jeffries also acknowledged that competition is usually a motivator, however he counselled against its use if it is likely to cause anxiety and stress to learners. The point Burguillo is making is that cooperative competition is the key element in this context and does not exceed the threshold where it become negative and is unlikely to result in anxiety and stress.

Pivec and Dziabenko (2004) assert that most researchers conceptualise learning as a multidimensional construct of learning skills, cognitive learning outcomes, such as procedural, declarative and strategic knowledge and attitudes. They consider that the game based learning model addresses all of these concepts and is used in formal education very successfully, in particular in military, medical and physical skills training. The main characteristic being that instructional content is blurred with game characteristics. They assert that games address learning theory through motivation, so that learners are encouraged to repeat traditional learning cycles within a game context. The effect is that enjoyment is related to the learning activity with the result that learning becomes viewed as a desirable outcome by participants.

Prensky (2005) asserts that the main reason people play games is because the process of game playing is engaging. Games address the attitude element of learning theory, wanting to learn (see Race, 2007 in Section 4.2.3) by bringing together a combination of motivating elements. Examples adapted from Prensky's list being:

- They are fun
- They provide play
- They have competition/challenge

- They have characters/stories

Van der Meij *et al* (2011) argue that an important aspect of learning theory which game based approaches can provide is the incorporation of collaboration. In this sense they define collaboration as a situation in which two or more people share and construct knowledge to solve a problem. There is a link to earlier simulation learning theory in which Anderson and Lawton (2009) advocated working in groups to solve problems and Alliger and Jank (1989) highlighted the learning benefits of working together. Van der Meij *et al* assert that the advantage of collaboration over solitary work is the stimulating effect from verbalisation, they point out however that not all verbalisation contributes equally to the learning development. As an example, general social 'chit-chat' can be disruptive to learning tasks. Van der Meij *et al* state that they tested the collaboration theory of gameplay using a controlled test, in which the test participants in the experimental condition played a game in pairs, whilst those in the control condition played the game in solitary mode. Van der Meij *et al* expected the results would show that the paired learning outcomes would be higher, due to the fact that paired participants articulate and explain their thoughts. However, they found that this collaborative gameplay did not always positively influence the scores, because partners tended to be side-tracked into discussing superficial game features, rather than collaborating to solve the game problems. To address this issue, Van der Meij *et al* recommended scripted collaboration as a possible solution, where learning partners are assigned different roles/tasks and provided with prompt questions in the form of a script. In conclusion, Van der Meij *et al* showed that the balance of evidence supported collaborative learning through games, provided that the issues of non-contributory discussion are fully considered.

4.7.4 Game based learning in civil engineering higher education

Ebner and Holzinger (2007) tested a game based learning approach with students attending a civil engineering higher education course. The content of the game was based on the theory of structures. They state that before starting any project civil engineers must calculate the internal forces of the component or structure being considered. These calculations are a necessary prerequisite to the design of for example, a structural concrete beam. Traditionally these calculations were conducted manually but this task has now largely been undertaken by computers, with the role of the engineer being limited to ensuring correct inputs and assessing the validity of outputs. The effect of this is that students do not practice traditional calculations and lose the tacit knowledge and understanding gained through the manual calculations. Ebner and Holzinger advocate the use of a game based approach to practice these calculations which introduces a high level of fun and motivation. In their case study, results showed an improvement of 25% in the number of correct forces students were able to calculate. Ebner and Holzinger concluded that the results demonstrated the effectiveness of a game based approach when compared to a traditional method. However, the example is a lower to middle order learning task that had fixed and certain outcomes. There was no possibility for objective decisions and as such would not demonstrate higher-order learning.

4.7.5 Application of game based approaches

Kiili (2005) describes a three component model for effective application of educational games, these he considers should allow for:

(i) Storytelling – The use of stories in games is a fundamental part of game application. Games should have some sort of story embedded in them that generally integrates the challenges set within the game into a larger task or problem. Stories lead to enhanced learner engagement and motivation.

(ii) Game balance – The main objective of balancing is to provide a game that is internally consistent and fair, without allowing participants to exploit flaws to gain advantages as well as to make sure that the game is fun and engaging. Typically progress in a game is rewarded by positive feedback and rewards, this can lead to a situation where the player or partners are ahead, they gain advantage from their increased level of understanding and being 'in the lead'. Kiili (2005, p.20) describes this scenario as a situation where "the rich get richer and the poor get poorer", the effect is that other participants can become demotivated by the game. Thus it is important to ensure that positive feedback loops are incorporated, which balance scores and keep the game fun and engaging. Although good performance should be rewarded, Kiili advocates that the progress of not so good players should be supported in order to ensure that they can catch up and retain the possibility of ultimately winning the game

(iii) Optimising cognitive load – The third component is to ensure that the instructional learning element within games remains within the working memory capacity of learners. Although this point applies primarily to computer based games with complex multimedia elements, the principle can be applied to all game composition. The objective is to ensure the knowledge required to 'play the game' remains within working memory limits, Kiili suggests this can be achieved by cutting down on irrelevant elements or unnecessary complications.

The second model proposed by Garris et al (2002, p.445) provides a theoretical framework for the application of games, which is founded on experiential learning theory. The model proposes that games should follow an "input-process-outcome" framework and include the following:

(i) Input – In the first stage instructional content and game characteristics are described. Examples would include time limits, rules and participant roles

(ii) Game Cycle – The second stage is described by Garris *et al* as the 'trigger cycle', this stage includes user judgements or reactions such as enjoyment or interest and user behaviours such as persistence and feedback to improve performance. The point that Garris *et al* make, is that the game should allow for recycling around the 'game cycle' loop in a similar manner to that advocated by classic experiential learning theory

(iii) Debriefing – In the final stage, the game should allow for debriefing, which should be linked to learning outcomes and reinforce the learning emanating from the game.

Another model for effective game application is proposed by McClarty *et al* (2012), who advocate a five-point model. This framework is summarised as follows:

1. Games should be built on sound learning principles; these include clear goals and immediate feedback

2. Games should provide personalised learning settings; the main point is that game composition should be based on students' needs

3. Games need to provide engagement for the learner; this includes stories, challenge and personal attachment

4. Games should teach 21st century skills; these include collaboration, problem solving and procedural thinking

5. Games should provide authentic and relevant assessment; which includes a means for quantifying progress and achievement.

In conclusion, there are several common features in the three application models, all highlight the need for feedback and debriefing, which is seen as a key element linking game based approaches to conventional learning theory. There is also a link here to simulation theory, for example Keys and Wolfe

(1990) assert that simulations also foster greater engagement/motivation and this is critical to the learning process. Finally, Garris *et al* and McClarty *et al* highlight the need for goals and rules providing a logical link between the fundamental definition of a game and learning theory.

4.7.6 Critical review and summary

Whilst the literature clearly shows that there are a number of benefits of using game-based learning strategies, it is evident there are also some potential disadvantages. Pho and Dinscore (2015) assert that it is important to consider whether the technology or game is being used for its own sake, or if it actually improves learning. McClarty *et al* raise a similar point and claim that despite the strong debate on how games improve learning, very little empirical research has been carried out to demonstrate the relationship between games and academic performance. However, this criticism is countered by theorists such as Ebner and Holzinger (2007) and Burguillo (2010), who provide clear evidence of learning improvement from game based settings. Finally, Pho and Dinscore (2015) highlight the importance of considering the student's proficiency with technology when applying digital game based approaches. The point they make is that it is important to ensure a lack of proficiency in technology itself doesn't become a barrier to learning.

To conclude this section the main theories emanating from the game based learning literature reviewed are summarised in Table 4.9. These are incorporated into the learning model presented in Chapter Five.

Table 4.9 – Summary of game based learning theory and application constituents (after Pivec and Dziabenko, 2004 and others cited below)

Major theorists	**Learning and application constituents**	**Potential contribution to learning model**
Pivec and Dziabenko (2004) Kiili (2005) Charles *et al* (2011) McClarty *et al* (2012) Trybus (2015)	**Engagement** – Games enhance engagement through a blurring of instructional content with game characteristics	To support engagement games should be fun, have rules, characters and stories
Garris *et al* (2002) Kiili (2005) Bainbridge (2007) McClarty *et al* (2012)	**Gameplay** - Game based learning should balance subject matter with gameplay	Designs should include choices, goals, consequences and feedback
Sutter (2010) Deterding *et al* (2011) Charles *et al* (2011) McClarty *et al* (2012)	**Game Elements** - Gamification applies game elements to a non-game setting	Learning settings should include points, rewards, tables of scores and leader boards
Prensky (2005) Kiili (2005) Burguillo (2010) Charles *et al* (2011) Van der Meij *et al* (2011) McClarty *et al* (2012)	**Competition and Collaboration** – Are important elements in supporting adult learning	Games allow the introduction of competition to learning. Positive feedback loops should be included and participants should work in pairs/teams to solve problems

4.8 Chapter conclusion

4.8.1 Review of chapter objectives

This chapter has built on the identification and definition of deficient competencies described in Chapter Two by reviewing the current state of knowledge in respect of professional learning, higher-order thinking and competency development. The main objectives are revisited below:

(a) Review current theory and knowledge of learning in relation to the acquisition of professional competencies – The review has confirmed that professional knowledge comprises a number of essential competencies beyond core theoretical and practical elements. Traditionally these competencies are acquired through a process of experiential learning, conventional wisdom suggests this necessarily takes time to achieve; higher-order elements take the longest time.

(b) Analyse and define the characteristics of professional competency including establishing the link to higher-order thinking – Professional expertise comprises a cluster of competencies which are conceptually linked and come together to form competency. Higher-order thinking is an essential and necessary component of professional competency. Higher-order thinking skills are confirmed to be the core skill of critical thinking together with problem-solving, argumentation, decision-making, creativity, metacognition and self-regulation. The requirement for these skills is clearly demonstrated within the APC.

(c) Identify the non-traditional learning approaches applied in other professions and disciplines with potential to develop higher-order professional learning – It has been found that simulations are widely used both in general education/learning settings and in professional training/development. Schuck (2010) and others suggest the use of simulations is an effective learning approach because they create an experiential learning environment. The review also shows accelerated learning theory provides a basis for speeding-up learning through a whole brain approach. This is achieved by addressing, for example, the learning style preferences of participants. Finally game-based approaches provide an opportunity to enhance learning through motivation and engagement deriving from gaming aspects such as fun, game-play and storytelling.

The review has shown that some cross-over is evident between the theories of simulations, accelerated learning and game based approaches. For example both simulation theory (Anderson and Lawton, 2009) and game based learning theory (Ebner and Holzinger, 2007) emphasise the link to problem based learning. **However there is no evidence to show that applying these three approaches in a combined pedagogy has been considered.** The contention of this research study is that the key theoretical and applicational aspects of the three approaches can be combined in a new learning model which is described in Chapter Five.

Chapter Five – New learning model

5.1 Introduction

The new learning model was developed to meet the learning characteristics of higher-order professional competencies determined in Chapter Four and to integrate specific constituent learning and applicational components to address these characteristics, drawing on previous learning theories and applications identified and discussed in the literature review. These theories and applications have been analysed to identify possible aspects and features that have shown potential to enhance learning in other contexts, situations and levels of competency. Chapter Five describes the design approach which has taken these fundamental constituents and adopted, adapted and modified them to form a new synergistic learning model.

It is hypothesised that the synergy resulting from the operation and interaction of the combination of features and aspects that comprise the new learning model will produce enhanced learning acquisition of higher-order professional competencies.

5.2 Approach to design of the synergistic model

There is limited evidence in the literature to show that any of the contributory theories or applications has successfully developed higher-order professional competencies. It is not clear from the literature review that the recognised theories of learning or schemes of learning successfully address the needs of higher-order professional competencies. There are various examples of schemes of learning that have been applied to competencies, but these were generally limited to the lower-order/middle-order that had fixed outcomes or structured situations with limited uncertainty. Applications such as pilot simulator training, emergency medicine protocols and the like have successfully used these methods, but the focus is generally on training or practice, no successful applications to specifically develop higher-order competencies in these professions have been reported.

Research carried out by Tennyson *et al* (1987) provided early confirmation that non-traditional learning techniques could be used to develop problem-solving skills. The application was limited to school level and solving problems that had a defined number of solutions. However, it did provide some evidence that in conceptual terms the strategy of using problem-orientated simulations might provide a foundation for the development of a learning model to develop higher-order skills. This potential was confirmed by the research of Barker (2011), Madhuri *et al* (2012) and others. Whilst the results were not always reliable, it is probable that the approach of non-traditional learning was at least partially effective and as such could contribute to a new learning model.

Thus, the characteristics of higher-order professional competencies together with the features and aspects of non-traditional learning techniques provided potential source material with which to build the new learning model and this is reflected in the structure of the remainder of this Chapter. The research brings together the characteristics into five primary strands as follows:

1. Realism and relevance
2. Experiential

3. Higher-order
4. Critical thinking
5. Engagement

The essence of the new learning model is that it has a simulation basis, with a problem-based learning scenario that uses an accelerated and game-based structure as the platform for its operation and delivery. The outline framework for the model is shown in Figure 5.1.

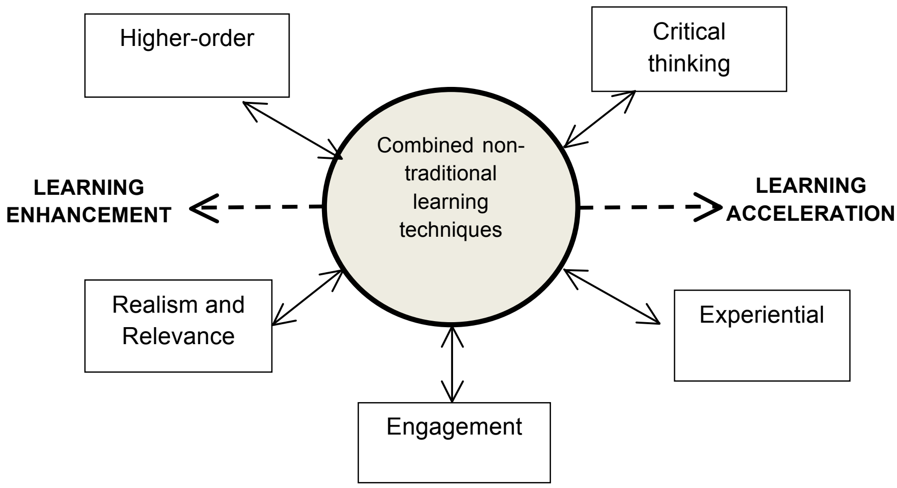


Figure 5.1 – Outline framework for New Learning Model

The discussion of the design of the new learning model follows the structure of the characteristics identified, but a number of the constituent features of the non-traditional techniques that have been incorporated address more than one of the characteristics. It is this cross-over which contributes to the synergistic effect of the model.

5.3 Realism and relevance

The use of simulations provided the basis for the learning model because they permit the use of work-based learning scenarios that can be designed to replicate and/or reflect the realism of the professional situation in which the competence will be exercised. There are numerous examples of simulations being used in this way, some for professional competencies, but generally only to develop structured lower-order/medium-order competencies.

Schon (1983) showed that simulation provides a learning platform for examples, images, understandings and actions within a work-based scenario, which is exactly what is required. Realism is also supported by applying the results of decision-making to a recognisable work-related situation or problem. Participants utilising the learning model perceive a direct and immediate value to the learning, irrespective of whether the perception is conscious, sub-conscious or a mix of the two. This aspect also addressed the requirement of relevance.

The characteristics identified by Weiss (2003) were incorporated into the design of the scenario, the characteristics included appropriateness, challenge, ill-structured (messy) and collaboration. These features address a number of the other characteristics of higher-order professional competencies such as complexity, uncertainty and relevance.

Relevance of the learning model was an over-arching consideration in the design to overcome the potential of professional participants failing to engage if the learning is perceived to be outside of their working lives. Authenticity is a necessary characteristic of the new learning model, particularly with respect to ensuring that the learning is relevant to the participants' future plans and career. The new leaning model maximises the perception that it is what is expected of emerging professionals. (Mayer 1998, Stinson and Milter, 1996 and Weiss 2003).

5.4 Experiential

Professional competence by its very nature involves the development of an informed body of knowledge and decision-making processes that allow the professional to make valid decisions in the interests of their clients. The work of Kolb (1984), Cheetham (1999), Cowan (2006), De Weerdt *et al* (2009) and others showed that experience and experiential learning is an essential part of acquiring higher-order competencies. The opportunity to accumulate professional experience must be a constituent of the new learning model, the use of work-based scenarios within a simulation platform facilitates this.

The experiential learning can be reinforced and enhanced by incorporating reflection into the learning process. Schon (1983, p.79) promulgated a theory of reflection-in-action. Within the model the facility to undertake reflection was operationalised through the use of game-based learning and other gamification features. Introducing a game-based constituent that obliged participants to make decisions, but with a forced feedback loop where the decision was incorrect would oblige participants to seek and engage with guided support and reinforcement. Schon also considered that reflection-in-action was an important constituent of experiential learning, as it allowed practitioners to build up a repertoire of professional examples, images, understandings and actions over a period of time. Schon had identified this as an important part in the development of the applicational knowledge required of competent professionals.

The development of a body of experiential, tacit, situational-relevant experiences directly supports the acquisition of professional competencies, which replicate and/or reinforce their development in professional practice through day-to-day work situations. Further, the generation of professional solutions/decisions using experience and reflection forms a key constituent of critical thinking, so it is important that experience and reflection form part of the new learning model.

5.5 Higher-order

Developing higher-order thinking underpins the entire learning process required for professional competencies; it therefore provides the guiding principles in the design of the new learning model and forms an omnipresent constituent of it. The cognitive skills and sub-skills identified in the Delphi Report (Facione, 1990) required for critical thinking and by extension higher-order thinking formed a checklist in the design of the new learning model. The new model was designed to incorporate features to develop as many of the cognitive skills that were relevant to professional competencies as practicable. These included interpretation, analysis, evaluation, inference, explanation and self-regulation. All of these cognitive skills are addressed through the combined use of the non-traditional learning techniques envisaged in the model.

Further, collaboration was shown to enhance the development of higher-order thinking skills (Gijselaers, 1996, Drummond-Young and Mohide, 2001, Duch, 2001). The new learning model envisages a paired approach to application thus incorporating collaboration within the model.

5.6 Critical thinking

Scriven and Paul (2004) identified the process of critical thinking as actively and skilfully conceptualizing, applying, analysing, synthesizing, and/or evaluating information. Actively participating in the process is an important contributor to critical thinking and would therefore be an important contributor to learning critical thinking skills; consequently the new learning model was designed to ensure that the learning process involves active participation and minimises or avoids passive learning. This was achieved through the design and operation of a game-based learning methodology which obliged participants to engage in active learning in order to proceed with the 'game'. Accessing the competitive instincts of the participants maintains engagement through continued enjoyment; it also enhances their continued use of skill to satisfy their continued pursuit of success.

The design of the model incorporated features to ensure that the other aspects of critical thinking identified by Scriven and Paul (2004), namely conceptualizing, applying, analysing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication. These form key activities of the new learning model.

5.7 Engagement

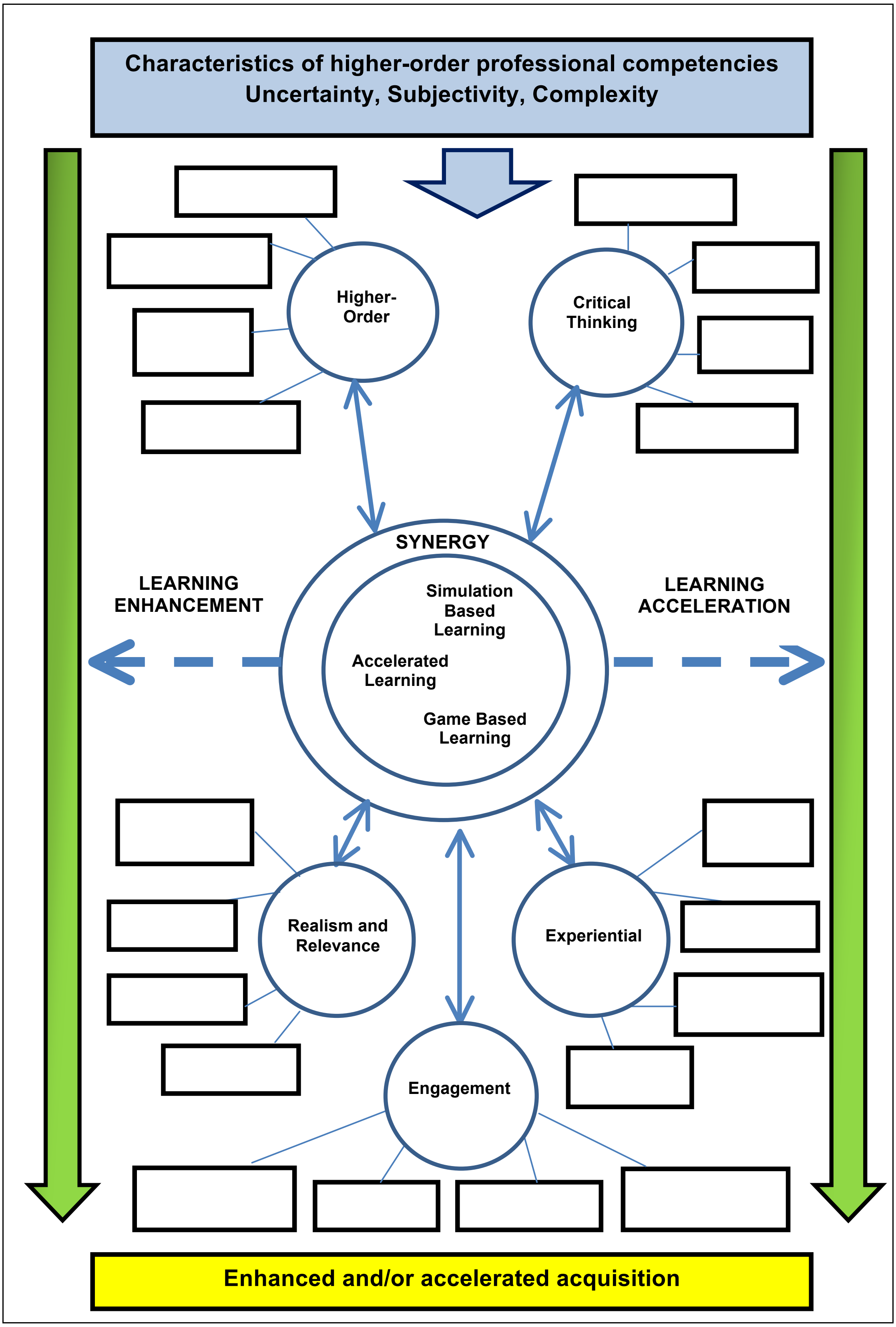
Engagement and the need for it to produce effective learning is widely recognised in educational theory, it has been shown to be a major contributory factor in the acquisition of knowledge, and especially so with regard to higher-order knowledge (Knowles, 1990, Dieckmann, 2009 and others). Engagement is considered to be a key factor in the performance of the new learning model. To enhance the acquisition of higher-order professional competencies the participants must be engaged to the maximum. The theories of gaming and gamification provided evidence of the capability to do this (Pivec and Dziabenko, 2004, Kiili, 2005), which together with the widespread evidence witnessed of the engagement of game players, indicated that gaming principles would provide an essential part of the new learning model.

5.8 The new synergistic learning model

The analysis of professional competencies identified a number of characteristics that collectively contributed to the difficulty of acquiring these competencies. These characteristics related to uncertainty and the consequent complexity involved in exercising these professional competencies. Dreyfus and Dreyfus (1986) had identified that higher-order professional competencies require the ability to be able to cope with "crowded" or complex situations, which reflect the multiple variables that influence and exist in professional competence situations. The new learning model incorporated these variables within the design of the work-based learning scenario and the decision-making outcomes of the simulation. These had to be deliberate constituents of the model, as to some extent they would differentiate its performance from other work-based simulations, which whilst achieving acceptable success in definable structured learning situations had been shown not to do so in more complex situations.

The design of the new learning model incorporated game-based features that recognised not all the elements of the problems are known and that there are potentially several possible solutions or perhaps no solution at all. These features encapsulate the complexity of the PBL so that it met the requirements for an ill-structured problem, which require participants to draw on a number of different fields to solve the problem and foster higher-order activity among participants. (Weiss 2003, Stinson and Milter, 1996 Delisle, 1997, Duch, 2001, Jonassen, 2000).

The characteristics and constituents described above are combined to provide the new learning model illustrated in Figure 5.2.



<u>Figure 5.2 – New Synergistic Learning Model</u>

The learning model is a dynamic model that shows a composition of theoretical and applicational parts which have originated from a number of learning settings, brought together in a unique combination within the model. The effect is to create synergy from the interaction of all the individual constituents, each facilitating the application of and enhancing the others. The combined constituents include those of higher-order and critical thinking all of which recognise the complexity of professional competency development. It is the synergy achieved by the operation and interaction of all the features and aspects of the new learning model that when applied to the characteristics of higher-order competencies produces learning enhancement and acceleration.

5.9 Chapter conclusion

This chapter has described and explained the design approach of the new learning model and the synergistic application of the learning approaches in a combined pedagogy. The next research stage seeks to test the application and efficacy of the model through a controlled experiment described in Chapter Six.

Chapter Six – Controlled Experiment

6.1 Introduction

Stage Five of the research was concerned with the major fieldwork within the study, which comprised a controlled experiment to empirically test the new learning model. The objectives of this chapter are to:

(a) Explain and justify the sampling strategy applied to the controlled experiment

(b) Describe the design and application of the controlled experiment including development of the application workbook

(c) Critically review links from the workbook to the underlying theoretical and applicational constituents within the learning model.

6.2 Sampling Strategy

The controlled experiment was conducted with a sample of new entrant quantity surveyors. The population for the research comprised graduates registered for the Assessment of Professional Competence (APC) with the Royal Institution of Chartered Surveyors (RICS) following the Quantity Surveying and Construction Pathway. This population was selected because the RICS is the main professional body representing surveyors in the United Kingdom (RICS, 2011) and is the professional body graduates aspire to join to achieve Chartered status.

As at December 2012 there were 3,873 UK based trainee quantity surveyors registered with the RICS following the Quantity Surveying and Construction

Pathway. This was established from analysis of data provided by the RICS in April 2013. Contacting, obtaining information and testing the learning model on this relatively large population was beyond the time frame available for the research, as a result a sampling approach was adopted and a sampling group or frame established.

6.2.1 Composition of the sampling frame

Trainees registered for the Quantity Surveying and Construction Pathway are employed by 1221 companies or organisations with defined training schemes approved by the RICS. These companies and organisations comprise three main groups, private practice firms or consultancies, construction companies/developers and public sector organisations. The distribution of trainees in the individual firms and organisations is shown in Table 6.1.

Table 6.1 - Distribution of APC trainees in firms/organisations

Number of APC Trainees in each Firm/Construction Company/Public Organisation	Total number of APC Trainees
26 and above	534
10 to 25	612
2 to 9	1283
1	775
Total in Consultancies/Construction Companies/Organisations	**3204**
Not in employment or unallocated	669
Total number of APC Trainees registered in Quantity Surveying and Construction Pathway at December 2012	**3873**

For selection of the experiment sampling frame large private practice firms with over 25 (26 and above) trainees on approved RICS training schemes were used. This approach was adopted because the large firms have consistent structured graduate training programmes. These provided a comparable basis for the experimental and control groups within the controlled experiment. Additionally graduates within the larger firms experience a range of structured learning methods as part of their development programmes; this enabled the learning model to be applied without a significant change to current learning practice. A significant change to learning practice might have an undesired effect on the experiment results.

A further consideration is that larger firms are able to provide consistency to the experience of new entrants through the exposure to differing work types for defined periods. This is achieved through rotation within structured training plans. Trainees from the large firms will have been exposed to broadly similar ranges of work types therefore providing experience comparability within the selected sampling frame. It is recognised that the sampling frame approach may not produce absolute representativeness of the population, but it is argued that the level provided by characterisation of participants discussed on section 6.2.4 is adequate for the aims of this research.

As at December 2012 there were 404 trainees located within 8 large private practice firms with 26 trainees and above. Each large private practice firm has been given a designation reference to ensure anonymity. The composition of the sampling frame is shown in Table 6.2.

Table 6.2 - Composition of sampling frame

Type	Designation Reference	Number of APC Trainees
Large Private Practice Firms	F1	131
	F2	68
	F3	58
	F4	38
	F5	31
	F6	26
	F7	26
	F8	26
Total Sampling Frame		**404**
Other construction companies and organisations		130
Total of APC Trainees in Firms/Construction Companies/Organisations with 26 and above		**534**

6.2.2 Sampling technique adopted

The sampling technique adopted for the controlled experiment was Non-Random Natural Sampling. Collis and Hussey (2009) assert that this is fairly common in business research where the researcher does not know the chance of including the exact individual in the sample. In the controlled experiment participants were selected by invitation from their companies and as such the researcher had little influence over the actual composition and so could not bias the sample. To add rigour to the study an element of randomisation was introduced through the separate invitation of experimental and control group participants, thus invitees were able to choose, as a matter of personal preference, if they wished to be included in one or the other of the groups.

6.2.3 Determination of Sample Size

Collis and Hussey (2009) assert that determination of suitable sample size is based on desired statistical validity. The larger the sample size the lower the likely error if seeking to generalise to the population, sampling is therefore a compromise between required accuracy of findings and amount of effort invested in collecting, checking and analysing data. Fellows and Liu (2008) cite Cochran's formula (Cochran, 1977) as the common measure for calculating sample size. The formula is given as:

$$n_s = \frac{(t)^2 \times (s)^2}{(e)^2}$$

Where: n_s is the sample size

t is the value of alpha (usually 0.05)

s is the estimated standard deviation of the population

e is the acceptable level of error

For convenience within this research a sample size calculator was used to apply the appropriate formula and determine the target sample size (Creative

Research Systems, 2012). For the controlled experiment the determining factors which have been applied are:

(i) Confidence Level – This is the level of certainty that the results represent the characteristics of the sample frame. Saunders *et al* (2009) suggest that researchers normally adopt a 95% confidence level and this has been applied for the controlled experiment

(ii) Confidence Interval – This is the acceptable margin of error and intervals of 10, 15 and 20 have been applied.

Table 6.3 shows the target sample size applying the parameters stated above.

Table 6.3 - Sample size for controlled experiment at given confidence levels

Confidence Level	**Confidence Interval (Margin of Error)**	**Sample Size**
95%	10	78
95%	15	39
95%	20	23

The table shows that for a sample size ranging from 23 to 78 the results from the controlled experiment can be claimed to represent the sample frame with 95% certainty at a margin of error of plus or minus 10 to 20. Based on the assertions of Saunders *et al* (2009) this was considered an acceptable margin of error for a social research study of this nature and the target size for the sample group and control group was set at 50, being the mid-point of the sample size range.

6.2.4 Characteristics of the Population

Saunders *et al* (2009) assert that in order to make comparisons between data obtained from a sample group and the entire population it is necessary to understand the profile or characteristics of the population. For the controlled experiment five main characteristics have been taken as significant in the population, these are:

- Gender (Male/Female)
- Age
- Type of first degree held (Cognate or Non Cognate)
- Time since graduation
- Progress through APC

These characteristics were considered significant because they influence the extent of experience and learning style of trainees. For example, non-cognate degree holders will have been exposed to a broader range of knowledge having studied a subject or discipline outside core surveying topics, but may have a lower level of relevant sector knowledge and experience. For age, time since graduation and progress through the APC are important aspects because they affect the amount of time trainees have been involved in the industry therefore exposed to relevant learning situations. Those with lesser numbers of years may have had less relevant experience. For gender, Wehrwein *et al* (2006) and Lau and Yuen (2010) have demonstrated empirically that learning styles are sensitive to gender, with males and females having different learning style preferences. The implications of these characteristics are that they may affect the reliability of the experiment results; this has been examined in the presentation and analysis of results discussed in Chapter Seven.

Based upon the RICS APC Trainee Intake Survey (RICS, 2010) the academic background of trainees comprised 91% with cognate degrees and 9% with non-cognate degrees who have completed an approved conversion or development course. The gender mix of trainees and age profile of the population was established by analysis of data provided by the RICS which showed the ratio of female to male graduate trainees to be approximately 1:5. The average age of graduate trainees in the post-university groups up to age 39 years was shown to be 29.60 years. Mature APC candidates aged 40 years and upwards were not included in the data analysis because the focus of this study was on graduate trainees following APC Graduate Route 1.

It is argued that the characteristics considered are the primary ones which may affect the acquisition of post graduation surveying competencies. This has implications for the reliability of results in that any changes to graduates' competencies observed following the experiment may not result exclusively from the application of the learning model. To test this implication the experiment has been designed to determine if any relationship is evident between the differing characteristics and competency acquisition results. The findings from the analysis are presented in Chapter Seven of the thesis.

6.2.5 Critical review of sampling approach

Creswell (2009) asserts that the reasonableness of a sampling approach can be proved if there is no sampling bias evident. A sampling bias occurs when the sample of trainees could have been collected in such a way that some trainees of the sampling frame were less likely to be included than the other trainees. Ideally, the individuals would have been randomly chosen from the sample frame such that each person had a known chance of being selected. For the controlled experiment it was not possible to directly influence the actual participants identified for the experimental and control groups and it is recognised this technique may not produce an absolute probabilistic sample. This limitation is acknowledged and has been considered through the use of characterisation of the population and sample group. The controlled experiment aimed to provide a sample group that equated with the main characteristics identified for the population. The effect of this, if any, on the reliability of the results is analysed and reviewed in Chapter Seven.

6.3 Design of the controlled experiment

Cresswell (2009) asserts that the basic intent of experimental design is to test the impact of an intervention on an outcome, whilst controlling all other factors that might influence the outcome. As one form of control researchers randomly assign individuals to groups where one group receives a treatment and the other group does not. The researcher can then isolate whether it is the treatment and not other factors that influence the outcome. Cresswell describes this as a true experiment design and this approach has logically been applied to this study. The steps which formed the controlled experiment are as follows:

(i) Design of intervention

(ii) Expose the experimental group to the intervention and administer no treatment to the control group

(iii) Compare the performance of the experimental and control groups through use of an assessment instrument.

6.3.1 Design and administration of the intervention

As referred to in Chapter Three the application of ethics was clearly identified as the most difficult and most important competency challenging new entrant graduates. Consequently this was selected as the competency for the controlled experiment to test the new learning model. The experiment comprised a learning workshop of half-day (four-hour) duration applied to five groups. This was the preferred format identified in the interviews conducted with employers in research stage 2 as it logically fitted within the structured experiential learning process undertaken by new entrant surveyors.

Representatives from two firms, F6 and F8, expressed a strong desire to assist in the design of the learning workshop. Accordingly, follow-up sessions were held with the training managers to identify the detailed issues and dilemmas likely to be encountered in the practical application of ethical standards. The outcome of these meetings resulted in the identification of seven main issues and challenges as follows:

(i) Practical interpretation of RICS Professional and Ethical Standards
(ii) How to advise clients about poor performance of other consultants
(iii) Conflicts of interest, in particular mixed loyalties to organisations
(iv) Understanding what constitutes bribery and how to respond
(v) The implications of money laundering for surveyors
(vi) How to deal with advance payments and client's funds
(vii) Understanding professional liability and dealing with errors/defects

These items were considered to frequently involve requirements for subjective decision making under conditions that are often uncertain and variable; and as a result require surveyors to apply higher-order and critical thinking. Addressing the issues and challenges provided the learning objectives for the workshop which are shown within Appendix D.

6.4 Application of the learning model and critical reflection of workshop facilitation

6.4.1 Design of the application workshop

Application of the learning model is through a facilitated workshop. Design of the workshop followed a game-based design approach as advocated by

Pardew (2005). The design was based on a series of thirteen primary storyboards, each describing a scene and establishing the issues and challenges identified in section 6.3.1. The primary storyboards were as follows:

Scene 1 – The Scenario

Scene 2 – The Players

Scene 3 – The Client

Scene 4 – Planning Advisor performance

Scene 5 – Professional and Ethical Standards

Scene 6 – Money Laundering

Scene 7 – Decision Making Scenarios

Scene 8 – Advance Payment and Client Funds

Scene 9 – Accelerating Planning Approval

Scene 10 – Tender Lists Dilemma

Scene 11 – Conflicts of Interest

Scene 12 - Bribery

Scene 13 – Errors and professional Liability

Pardew (2005) asserts that typically games are not linear in nature, they are broken into different levels and participants determine the route through the game. One of the pivotal games illustrating this concept was first developed in 1984 by Livingstone (2009) and entitled 'Deathtrap Dungeon'. Within this game participants were invited to determine their journey through the game scenario. The introduction stated:

"You are about to embark upon a thrilling adventure in which you decide which route to take. Success is by no means certain you may well fail at your first attempt…."
(Livingstone, 2009 p.10)

Consequently, to provide a game based format to the learning workshop a journey determination approach was applied, ordering of the storyboards shown above was randomised and participants established their route through the scenario by addressing dilemmas and determining decisions. The storyboards were linked by activities, answers and review points to provide 22 workbook sheets. Sample pages from the workbook are provided in Appendix D.
A full example of the workbook has not been included as part of this thesis to protect the intellectual property arising from the unique combination of alternative learning techniques in the workshop. A full example of the workbook has been provided to the examiners to permit examination.

6.4.2 Facilitation of the workshop and critical reflection

The randomised 'Journey' through the learning workshop is illustrated by the flowchart shown in Figure 6.1.

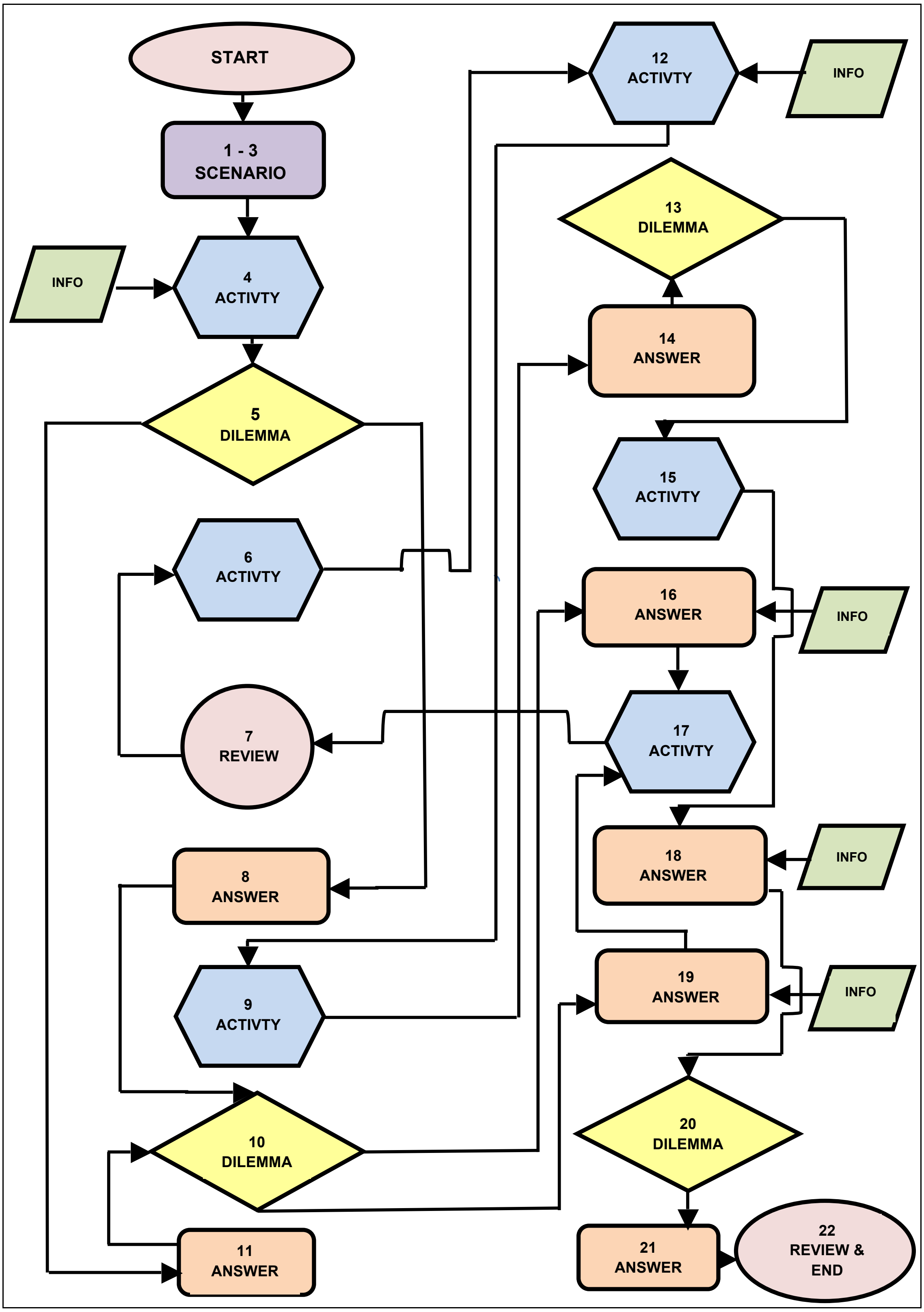
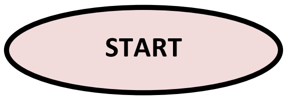


Figure 6.1 – Flowchart showing route through learning workshop

The flowchart illustrates how participants progress through the workshop undertaking activities and making decisions the outcomes of which determine their route to the next activity or dilemma. The step-by-step approach through the workshop and critical reflection is described in the sections below.

(i)



The workshop commences with an outline of the learning objectives (shown within Appendix D). This is followed by a description of the format of the exercise, roles of participants and rules. A copy of the workbook is provided to each participant. Pairs were chosen as the collaborative group size. Each pair is allocated a deposit of 500 points in the form of reward tokens and informed of the potential prizes at completion. The final prizes were deliberately tangible to provide a gameplay incentive as advocated by Sutter (2010) and others.

Critical reflection - It was noted that most participants scanned through the workbook on receipt to see ‘what is coming’. However the randomisation of the sheets was found to be effective in preventing participants progressing directly to the end of the exercise. The provision of reward tokens immediately was found to establish a game-based environment, encouraging the competition advocated by Ebner and Holzinger (2007) and others, with participants keen to engage in the learning. Allocation of participants to their respective pairs was carried out by the facilitator, this was to create realism and avoid participants working with friends as noted by Roberts (1999). There were no objections raised to this approach and repositioning within the room further enhanced the learning environment (McKeon, 1995 and others).

(ii) **1 - 3 SCENARIO**

Workbook Sheets 1-3 describe the work-based project scenario, the players and the client. The scenario is designed to provide an authentic work situation for new entrant surveyors taking on their first role as a project surveyor, as advocated by the realism and relevance theme of the learning model.

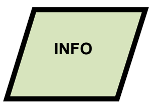
Critical reflection – Most participants recognised and related to the type of project scenario described in worksheets 1 to 3, which was a large office/warehouse development. However, more photographs and a video or three-dimensional walk-through of the site would further enhance realism. For application of the model it would be important to validate in advance that the scenario project type selected was familiar to participants to ensure realism.

(iii)

Workbook Sheet 4 provides an activity addressing RICS Professional and Ethical Standards. Participants are required to analyse the scenario and discuss possible responses regarding applicability of the standards. The activity provided the first opportunity for exploration as advocated by De Jong (2006) and others.

Critical reflection – This initial activity worked well and introduced participants to the RICS Professional and Ethical Standards. However, it was found several participants wanted to discuss the standards with the facilitator. This was controlled by capturing the points to a flip-chart for discussion at the review point. An important learning point was that the facilitator can quickly become overly involved in discussion and disrupt the game flow, a warning highlighted by Meier (2000) in terms of desirable extent of facilitator involvement.

(iv)



At this point additional data on professional and ethical standards is provided in the form of an Information Sheet. Use of information sheets was aimed at participants with a reading style learning preference advocated in the VARK learning style model (Fleming and Baume, 2006).

Critical reflection - It was observed that some participants required support and reassurance from the facilitator in the form of clarity of understanding. This was dealt with by one-to-one discussion with individual participants to avoid disruption of the group. The requirement for facilitator support is an element noted within the learning model as important to establish and maintain engagement in the learning process.

(v)

Workbook Sheet 5 provides the first ethical issue or dilemma, in this instance concerning the poor performance of the client's planning advisor. Participants are required to make a decision and response i.e. whether to act or not, this can be correct (YES) or incorrect (No). The decision selected then determines the route to the next workbook sheet.

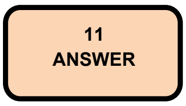
Critical reflection – For this dilemma participants are required to apply higher-order thinking and metacognition to solve a problem which is complex/uncertain and provides an opportunity for option exploration advocated by De Jong (2006) and others. It was found the facilitator's role is important at this point to ensure participants do make a decision and move-on with the game. Participants were not familiar with this type of decision-making workshop game, which added to the excitement and enthusiasm within the learning environment and ultimately to enjoyment and engagement in the learning.

(vi) **8 ANSWER**

Workbook Sheet 8 provides confirmation of the correct answer and reinforces the learning. Participants making the correct decision are awarded 100 reward tokens that they collect from the facilitator. From this point participants move to Worksheet 10 which presents the next issue and dilemma.

Critical reflection – It was observed that this contributed positively to an active and competitive environment with participants keen to collect their tokens. Distribution of the tokens was carried out publically, deliberately encouraging the competition advocated by Burguillo (2010) and others. It also increased the bonding and cohesiveness of the pairs in their learning.

(vii)



Workshop pairs that made an incorrect decision are routed to Workbook Sheet 11. This provides guidance on the correct answer and therefore supports learning. At this point those making an incorrect decision were requested to surrender 100 reward tokens to the facilitator. From this point participants move to Worksheet 11 which provides the next issue and dilemma.

Critical reflection - It was found this required careful facilitation to avoid demotivation and additional support was provided through direct interaction and discussion with individual pairs. The facilitator plays an important role here in the operation of the model to ensure participants remain engaged.

(viii)

The process of activities, dilemmas and decisions is repeated through to Workbook Sheet 7 which provides a review point. The objective of the review point is to reinforce reflective learning and provide support to participants. A further game element is introduced in the form of a quiz based on ten “decision-making scenarios”. This provided an opportunity to earn further reward points and a league table was established to enhance the element of competition.

Critical reflection - It was found that this required careful management as some participants could move significantly into the lead with a series of correct answers. Those with lower scores becoming anxious and concerned about their ability to catch-up in the remainder of the workshop; a point noted by Jefferies (2005) with regard to competition in simulation theory. In practice this was addressed by 'skilful' facilitation using such measures as ensuring the balancing of respondents permitted to answer quiz questions.

(ix) Following the review point the learning workshop continues with further activities and dilemmas of increasing complexity and subjectivity, a feature of higher-order activity advocated by Robinson (2011). For example, Workbook Sheet 20 requires participants to consider the dilemma of errors and professional liability. The outcome of which could have profound effect on professional indemnity liabilities. The learning workshop concludes with a final review point and feedback session primarily aimed at summarising and reinforcing learning. Reward points are totalled, 'winners' declared on the league table and prizes awarded.

Critical reflection - At this point it was observed that energy within the workshop was very high with participants commenting on the enjoyment emanating from the session, an important element of the learning model. This was evidenced in workshop sessions 2 and 5 which concluded with spontaneous applause from the participants. An important learning point throughout the workshops was the need for the facilitator to monitor and nurture commitment, energy and engagement. To achieve this it is essential the facilitator is confident and experienced with the material. A point noted by Jeffries (2005) and others as critical in the successful facilitation of simulations.

6.5 Validation of the application workshops against the learning model

The purpose of this section is to summarise and confirm how each characteristic of the learning model has been incorporated into the learning workshops. The analysis below provides examples based the five primary strands of the learning model.

1. Realism and relevance

The learning workshops are based on a simulation comprising a series of realistic and authentic issues and dilemmas that surveyors would probably encounter in their workplace environment. The scenario project is carefully formulated to reflect reality as advocated by Dieckmann (2009) and others. The relevance of the simulation is further assured by establishing the link to relevant APC professional competency requirements. This is reinforced in the introduction to the workshops.

2. Experiential

Participants experience typical work-based issues and dilemmas. This was assured through the involvement of experienced practitioners in identification of the issues and challenges as described in Chapter Six, Section 6.3. The workbook follows an experiential game-based structure; this includes opportunities to reflect at review points, collaboration within participant pairs, opportunities to accumulate reward points and competition to 'win' the game.

3. Higher-order

The basis of the application workshops is problem solving and decision making. Participants progress through the scenario based on collaborative decisions made with their partners. The design of the model required participants to display metacognition to determine decisions. This is evidenced by the complexity of the issues and dilemmas, for example the application of bribery legislation which is particularly complex when considering firms operating outside the United Kingdom.

4. Critical thinking

Throughout the workshop participants are required to analyse the scenarios presented to them in order to determine appropriate decisions. Central to the decisions is judgement and self-regulation, evidenced by the example of ethical behaviour in respect of professional errors forming part of workbook sheet 20. Participants must display careful self-regulation in the dilemma which is placed before them in relation to errors and the implications on professional liability.

5. Engagement

The workbook is designed to accommodate differing intelligences and learning styles. For example, differing aspects of the workbook provide for all the learning style preferences advocated by Honey and Mumford (1986) and Rogers (2001). A supportive learning environment is provided through the workshop facilitator who assumes the roles of simulation administrator envisaged by Edelheim and Ueda (2007) and Apel (2011). Roles and rules are clarified at the commencement of the learning workshop.

6.6 Assessment of performance

Following the workshops a questionnaire was used as the assessment instrument for the experimental and control groups. To ensure learning was long-term the questionnaires were completed a minimum of two weeks after the learning workshops. The full questionnaire process and content is discussed further in Chapter Seven.

6.7 Chapter summary and conclusion

Chapter Six has explained and justified the approach adopted to selection and characterisation of the sample group for the controlled experiment. The design and application of the controlled experiment conducted to test the new learning model has been described including validating the links between the application workshops and components of the learning model. Analysis of the results emanating from the controlled experiment is described in the next chapter.

Chapter Seven – Presentation and analysis of results

7.1 Introduction

Chapter Seven of this thesis provides an in depth analysis of the empirical data emanating from the controlled experiment. The objectives of this chapter are:

(a) To present the empirical data obtained from assessment of experimental and control groups

(b) To review reliability of data in terms of sample size and profiles of participants

(c) To analyse the results and draw conclusions as to the effectiveness of the learning model

(d) To determine if there is any correlation of results between variables within the empirical data set.

7.2 Chapter layout and content

The remainder of this chapter comprises eight broad sections:

Section 7.3 – Validity and reliability of the data: This section shows that the composition of the experimental group sample and the control group sample are equivalent, unbiased and that the data is valid and reliable.

Section 7.4 – Equivalence and representativeness of participants' characteristics (variables): This section establishes that the characteristics (variables) of the experimental group and the control group are representative of the characteristics of the population as a whole.

Section 7.5 – Presentation of results: This section presents and analyses the results for each question from the assessment instrument used for the experiment.

Section 7.6 – Analysis of the performance of the new learning model: This section considers an analysis of the aggregated experiment results with respect to performance of the new learning model.

Section 7.7 – Cross tabulation of results from individual questions: This section presents a cross tabulation analysis of the results from each question to identify any correlation of findings.

Section 7.8 – Acceleration in the rate of learning: This section considers the extent that accelerated learning is shown by the results.

Section 7.9 and 7.10 – Critical review and chapter conclusion: The final sections include a critical review of aspects of the application approach and a conclusion of the chapter objectives.

7.3 Validity and reliability of the data

The data from the controlled experiment was collected between November 2014 and January 2015 through five application workshops held at the offices of the participating firms.

Following the application workshops, the same data was collected from the control group who undertook ethics learning as part of their structured training programmes; this was completed on 11th March 2015. A total of 90 graduate trainees (n=90) participated in the controlled experiment, this comprised experimental group (n=44) and control group (n=46). The reliability of the actual sample sizes achieved for the experimental and control groups were recalculated using the sample size calculator described in Chapter Six and the outcome is shown in the Table 7.1.

Table 7.1 - Reliability of sample size at given Confidence Levels

	Sample Size	Confidence Level	Margin of Error	Confidence Level	Margin of Error
Experimental Group	44	95%	14 (13.96)	99%	19 (18.38)
Control Group	46	95%	14 (13.62)	99%	18 (17.93)

The results show that at a 95% confidence level, the actual sample size of the experimental group and control group is representative of the entire sampling frame of 404 graduate trainees plus or minus 14. A margin of error of 14 graduate trainees is considered very small when compared with the sample frame and to be within the target range for margin of error set in the sampling strategy for the study. This confirms that results from the experimental and control groups can be reliably inferred to the population of trainees registered for the APC Quantity Surveying and Construction Pathway as described in Chapter Six.

The reliability of the sample size has been further tested by computation of the margin of error at an increased confidence level of 99%. This showed a margin of error of 19 for the experimental group and 18 for the control group. These are very close to the margins of error at 95% confidence level and remain within the target range for margin of error set by the sampling strategy, thus further supporting the validity of the sample sizes. The size of the experimental group, 44 participants and the control group, 46 participants are similar, providing further assurance of the comparability of the results produced.

7.4 Equivalence and representativeness of participant characteristics (variables)

The next section analyses the characteristics of graduate trainees who participated in the experiment. Each participant completed an assessment questionnaire which contained a set of contextual questions to determine the following five characteristics of the participants:

(i) Gender

(ii) Age

(iii) Type of first degree held

(iv) Time since graduation

(v) Progress point in the APC

The findings are shown in sections 7.4.1 to 7.4.5 below.

7.4.1 Characteristic: Gender

The gender composition of the experimental and control groups is shown in Table 7.2.

Table 7.2 - Gender composition of experimental and control groups

Characteristic: Gender	**Experimental Group**	**Control Group**
Male	No. of Participants: 37 (84%)	No. of Participants: 40 (87%)
Female	No. of Participants: 7 (16%)	No. of Participants: 6 (13%)
Total	n= 44	n=46

The table shows that the ratio of female to male graduate trainees was approximately 1:5 for the experimental group and 1:6 for the control group. This aligns closely to the overall ratio for the population of 1:5 as at April 2013, established by analysis of data provided by the RICS and confirms the gender mix of the sample was representative and would not bias the results.

7.4.2 Characteristic: Age of participants

The age profile of the experimental and control groups are shown in Table 7.3.

Table 7.3 - Age profile of experimental and control groups

Characteristic: Age	Experimental Group	Control Group
20 – 29 years	No. of Participants: 32 (73%)	No. of Participants: 38 (83%)
30 – 39 years	No. of Participants: 12 (27%)	No. of Participants: 8 (17%)
Average age	27.73 years	26.74 years

Based on the mid-point for each category, the estimated average age for participants in the experimental group was 27.73 years and 26.74 years for participants in the control group. These align closely to the average age of graduate trainees within the population in the age groups 20 to 29 years and 30 to 39 years of 29.60 years as at April 2013, established by analysis of data provided by the RICS. Consequently the average age mix of the experimental and control groups are consistent with the overall population and would have no significant effect on the results.

7.4.3 Characteristic: Type of first degree held

This characteristic considered the distinction between the cognate and non-cognate first degrees held by participants. Cognate degrees were taken as those directly related to the surveying profession and accredited by RICS for entry to the profession following Graduate Route 1 (RICS, 2014). The results showed cognate degrees held by the experimental and control group participants fell into four main groups, Bachelor of Science (BSc) degrees in Quantity Surveying, Commercial Management, Construction Economics and various combinations with Construction/Project Management. Non-cognate degrees were taken as other first degrees not accredited by the RICS where graduates take a postgraduate conversion course (such as Post Graduate Diploma or MSc in Surveying) to be eligible for professional membership (Birch *et al*, 2005). The results showed Non-cognate first degrees held by experimental and control group participants covered twelve different specialisations comprising BSc or BA degrees in History, Psychology, Economics, Media and Cultural Studies, Modern Languages, Business Studies, Politics, Geography, Mathematics, Accountancy with Law, Business Information Technology and Biological Sciences. The comparison of experimental and control group composition with the population is shown in Table 7.4.

Table 7.4 - First degrees held by experimental group, control group and population

Characteristic: Type of First Degree	Experimental Group	Control Group	Population from APC Intake Survey
Cognate	No. of Participants: 40 (91%)	No. of Participants: 32 (70%)	91%
Non Cognate	No. of Participants: 4 (9%)	No. of Participants: 14 (30%)	9%

Comparing the composition percentages it can be seen that the cognate versus non-cognate split for the experimental group aligned exactly with percentages for the population derived from APC Trainee Intake Survey

(RICS, 2010) and therefore confirm comparability with the population. The composition for the control group is weighted towards non-cognate first degree holders. The effect of this could be to bias the results based on the presumption that non cognate trainees have a lower level of relevant sector knowledge and experience. To test this, the results of cognate and non-cognate participants have been compared in Section 7.6.4 (ii). It was found that results differ by 1.13%., which can be considered insignificant and certainly not proportional to the 20% difference that could be expected if the difference between the groups was biasing the results Thus it is contended that the effect is insignificant and therefore the difference between the first degrees of these groups can be safely ignored.

7.4.4 Characteristic: Time since graduation

The next characteristic considered for experimental and control group composition was time since graduation with a first degree. The analysis categories used were 0-1 years, over 1-2 years, over 2-3 years and over 3 years. The composition of the experimental and control groups is shown in Table 7.5.

Table 7.5 - Composition of experimental and control groups based on time since graduation

Characteristic: Time since graduation	0-1	1-2	2-3	Over 3
Experimental Group	No. of Participants: 9 (20.5%)	No. of Participants: 9 (20.5%)	No. of Participants: 11 (25%)	No. of Participants: 15 (34%)
Control Group	No. of Participants: 15 (32.6%)	No. of Participants: 12 (26%)	No. of Participants: 5 (11%)	No. of Participants: 14 (30.4%)
Mean composition of groups	No. of Participants: 12 (26.55%)	No. of Participants: 10.5 (23.25%)	No. of Participants: 8 (18%)	No. of Participants: 14.5 (32.2%)

Composition data for the population in relation to time since graduation was not available from the RICS as at April 2013. The significance of composition has been considered in terms of what would be expected as a normal profile of graduate trainees entering the profession. Candidates following the Graduate Route 1 are required to complete two years structured training prior to the APC final assessment. Consequently the expected profile would show the largest number of candidates in the period 1-2 years and 2-3 years as they prepare for assessment with a tail-off of numbers in the over 3 years category following completion. This profile is reflected in the composition shown in the table above with a mean of 18.5 participants falling in the 1-2 years and 2-3 years categories. However, a fall in the number of participants in the over 3 years category is not evident. The likely reason for this is that participation in the controlled experiment was by invitation and candidates in the over 3 year category, who may have already been referred at their first

APC Assessment, would have seen the application workshop as being particularly helpful in their training and development. To determine whether weighting of the sample towards the over 3 year category impacted on reliability of the results this has been specifically examined in Section 7.6.4 (iii). It was found that the improvement in mean score for the Over 3 years category was 35.63%, this was very similar to the 0-1 year category at 35.90%, thus it can be concluded that the effect of differing group compositions on the experiment results would be insignificant and therefore safely ignored.

7.4.5 Characteristic: Progress through APC

The final characteristic considered for experimental and control group composition was progress through the structured training period of the APC. The analysis categories used were 0-1 years, over 1-2 years, over 2-3 years and over 3 years. The composition of the experimental and control groups is shown in Table 7.6.

Table 7.6 - Composition of experimental and control groups based on progress though APC

Characteristic: Progress through APC	0-1	1-2	2-3	Over 3
Experimental Group	No. of Participants: 18 (41%)	No. of Participants: 14 (32%)	No. of Participants: 11 (25%)	No. of Participants: 1 (2%)
Control Group	No. of Participants: 22 (48%)	No. of Participants: 13 (28%)	No. of Participants: 6 (13%)	No. of Participants: 5 (11%)
Mean composition of groups	No. of Participants: 20 (44.5%)	No. of Participants: 13.5 (30%)	No. of Participants: 8.5 (19%)	No. of Participants: 3 (6.5%)

Composition data for the population in relation to progress through APC was not available from the RICS as at April 2013. However, a comparison of the data in the table above shows that the group compositions follow the expected profile where the largest number of candidates would be in the periods 1-2 years and 2-3 years as they prepare for assessment with a tail-off of numbers in the over 3 years category following completion. This profile is reflected in the composition shown in the table above with a mean of 22 participants (13.5 + 8.5) falling in the 1-2 years and 2-3 years categories and a clear tailing-off in the over 3 years category with a mean of 3 participants. The data suggests candidates within the sample may not have immediately embarked on the APC process following graduation. To determine whether composition of the groups based on progress through the APC affects overall validity of the results from the experiment this has been specifically examined in Section 7.6.4 (iv). It was found that the improvement in mean score for the Over 3 years category was 39.48%, this was within 4.50% of the mean score for the 0-1 year category at 34.98%%, thus it can be concluded that the effect of differing group compositions on the experiment results would be insignificant and the two groups can be considered as effectively equal in composition.

7.5 Presentation of results

Testing the new learning model delivered in the application workshops was measured by comparison of the results achieved by experimental group participants with those of non-participants in the control group who had received ethics training through conventional structured training programmes. A questionnaire was used as the assessment instrument to test their acquisition of the professional competence. For consistency a marking scheme was developed assigning thirty-nine marks to the eleven questions within the questionnaire. Each assessment questionnaire was then marked by the researcher in mixed batches to ensure a spread across participant firms and to reduce the possibility of marking bias in relation to a particular workshop. Scores for each participant were expressed as a percentage against the maximum mark of thirty-nine.

To ensure objectivity and reliability of the marking process moderation was applied. A 10% random sample was moderated by a second marker (a professional associate of the researcher, independent of the research project). Thuraisingam *et al* (2009) asserts that moderation is an essential quality assurance process for ensuring that marks or grades are awarded appropriately and consistently. Knight (1995) suggests that an effective way to check objectivity of assessment is through double-marking of samples by colleagues and this process was applied. Scores from the moderation sample were found on average to be within 5% i.e. +/- 2 marks, which was considered to be acceptable and no adjustment was made as a result of the moderation.

The details of each question and results achieved are presented in the Sections 7.5.1 to 7.5.11 which follow.

7.5.1 Results: Question 1

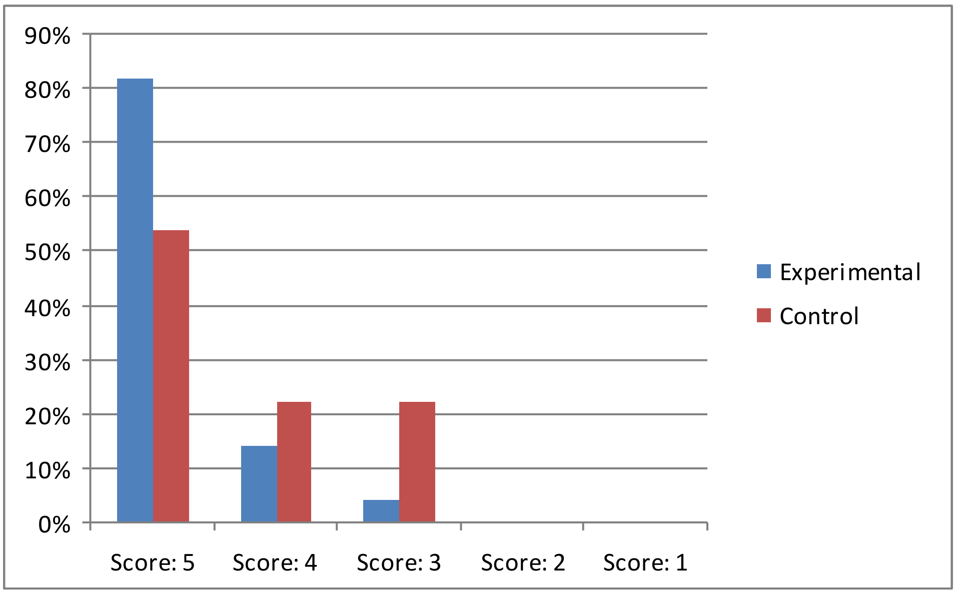
Question 1: *Which of the items shown are main professional and ethical standards of the RICS?*

Participants were required to identify up to five professional and ethical standards from a multiple choice list of ten items. One mark was awarded for each correct professional and ethical standard identified. The results are shown in Table 7.7.

Table 7.7 - Results from Assessment Questionnaire Question 1: Identifying professional and ethical standards

Experimental Group		**Control Group**	
No. of Participants	**Score**	**No. of Participants**	**Score**
36 (82%)	5	25 (54%)	5
6 (14%)	4	10 (22%)	4
2 (4%)	3	10 (22%)	3
0	2	0	2
0	1	1 (2%)	1
0	0	0	0
Total: 44		**Total: 46**	
Mean Score: 4.78		**Mean Score: 4.26**	

The results show a clear improvement in the acquisition of this aspect of professional knowledge, 28% more participants achieved the highest score in the experimental group than the control group. The results show a distinct shift in attainment towards the higher scores for the experimental group in comparison to those for the control group, who generally had a higher proportion scoring lower scores. A comparison of the scores across the range of marks is illustrated in Figure 7.1.



<u>Figure 7.1 - Comparison of scores from Assessment Questionnaire Question 1: Identifying professional and ethical standards</u>

The figure illustrates the lower level of performance by the control group participants with a higher proportion achieving lower end scores in the range. The mean scores for the groups reflected the shift towards the higher attainment scores for the experimental group, with results of 4.78 and 4.28 respectively. Thus it can be concluded from the above that participants in the experimental workshops achieved discernibly higher attainment scores. The statistical significance of the results is shown in Table 7.19.

7.5.2 Results: Question 2

Question 2: *You have heard rumours about the poor performance of a project advisor employed by your client. How would you respond to the rumours?*

Participants were required to identify appropriate professional responses to rumours regarding the performance of a project advisor. Two marks were awarded to participants who identified firstly, the need to respond as being a professional responsibility to the client and secondly, the need to corroborate the rumours so that any response is evidence based. The results are shown in Table 7.8.

<u>Table 7.8 - Results from Assessment Questionnaire Question 2: Professional response to rumours about poor performance of advisors</u>

Experimental Group		**Control Group**	
No. of Participants	**Score**	**No. of Participants**	**Score**
37 (84%)	2	6 (13%)	2
7 (16%)	1	13 (28%)	1
0	0	27 (59%)	0
Total: 44		**Total: 46**	
Mean Score: 1.84		**Mean Score: 1.13**	

The results show that the experimental group participants have a higher attainment score, with 84% achieving the highest score compared to 13% of control group participants. The results show a distinct shift in attainment towards the higher scores for the experimental group in comparison to those for the control group, who generally had a higher proportion scoring lower scores. The shift in the results is illustrated in Figure 7.2.

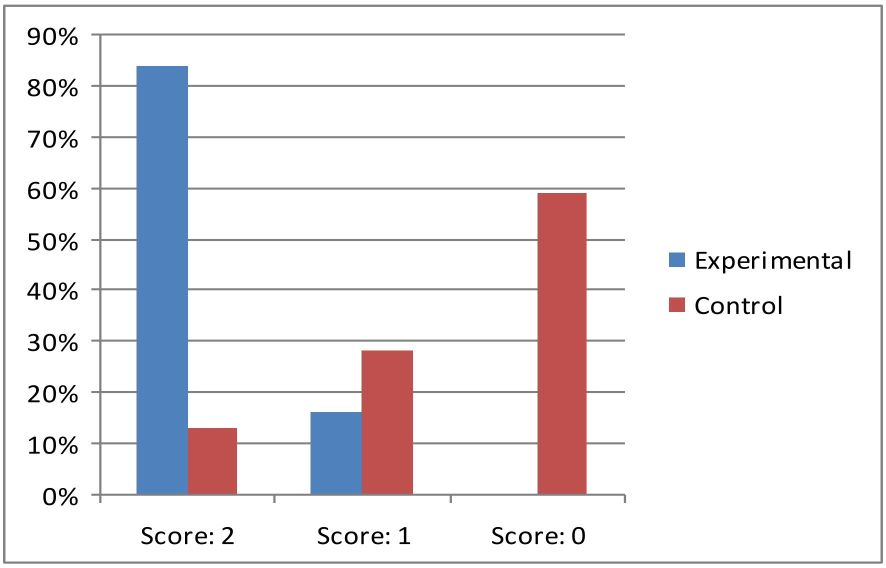


Figure 7.2 - Comparison of scores from Assessment Questionnaire Question 2: Professional response to rumours about poor performance of advisors

It is significant that the figure illustrates a high proportion of the control group participants, 27 participants (59%), were not able to identify any appropriate responses, which supports the underlying premise that the acquisition of these competences present difficulties to new entrant graduates. From the results it can be deduced that participants in the experimental group achieved an enhanced acquisition of this aspect of the professional competence. The statistical significance of the results is shown in Table 7.19.

7.5.3 Results: Question 3

Question 3: *During your university studies you heard that the UK has some of the toughest anti-corruption legislation in the world and you are unsure how this will impact on your role as a project surveyor. What is the name of the principal legislation that applies in the UK and what are the main offences outlined by this legislation?*

This question sought to test whether the participants could identify the principal legislation affecting their professional work, particularly the UK Bribery Act, 2010 and the main offences described within the legislation. One mark was awarded for correct identification of the current Act applicable in the UK and up to five marks for identifying the offences addressed by the Act. The results are shown in Table 7.9.

Table 7.9 - Results from Assessment Questionnaire Question 3: Identifying bribery legislation

Experimental Group		Control Group	
No. of Participants	**Score**	**No. of Participants**	**Score**
6 (14%)	6	0	6
14 (32%)	5	1 (2%)	5
11 (25%)	4	3 (7%)	4
11 (25%)	3	9 (19%)	3
1 (2%)	2	3 (7%)	2
0	1	10 (22%)	1
1 (2%)	0	20 (43%)	0
Total: 44		**Total: 46**	
Mean Score: 4.20		**Mean Score: 1.74**	

The results showed an enhancement in the acquisition of the knowledge achieved by the experimental group compared to the control group. The results showed that the number of participants able to correctly identify the appropriate legislation together with all five offences was low in both experimental and control groups, with numbers of 6 (14%) and zero respectively. This situation changed significantly for sores in the range of 0-5 marks and a comparison of the full results is shown Figure 7.3.

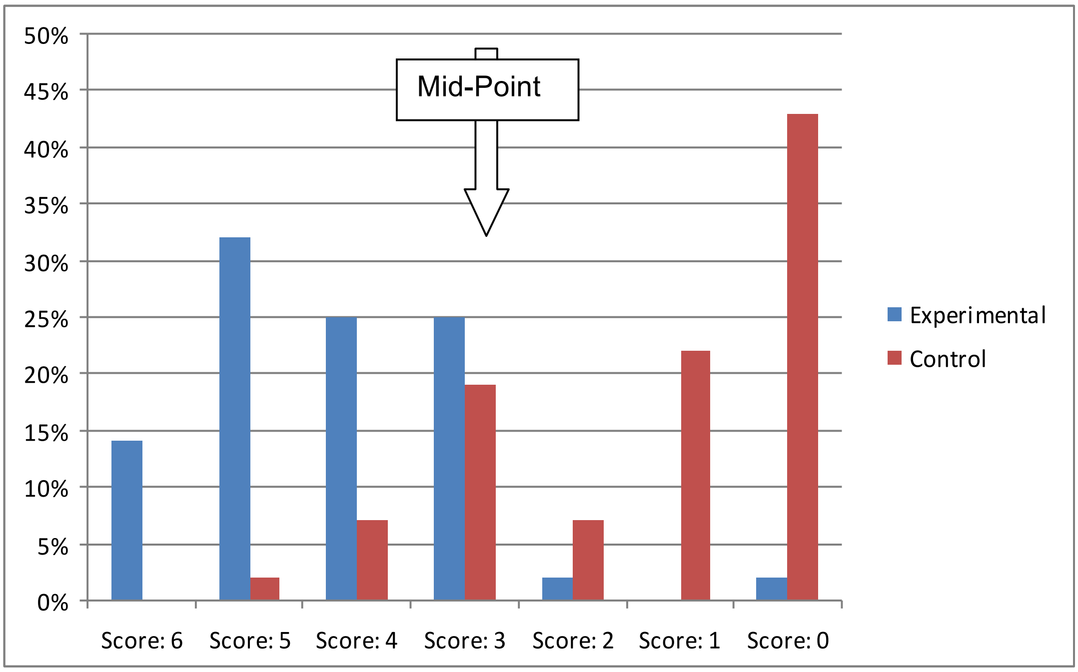


Figure 7.3 - Comparison of scores from Assessment Questionnaire Question 3: Identifying bribery legislation

As with previous questions, the results showed a distinct shift towards the higher scores in the experimental group compared to the control group, which is reflected in the mean score for the groups. The figure illustrates a clear division of results above and below the mid-point shown. For the experimental group 40 participants (96%) were able to identify the legislation scoring 3 marks and above. For the control group 42 participants (91%) achieved scores of up to and including 3 marks, with 20 participants (43%) scoring zero, unable to identify the legislation or any applicable offences. From this analysis it can be deduced that the application workshop was effective for this particular question generating a distinct shift in scoring profiles. The statistical significance of the results is shown in Table 7.19.

7.5.4 Results: Question 4

Question 4: *In your role as a project surveyor you have become aware of the following situations; would they be covered by the current UK anti-corruption legislation?*

(a) *A payment offered by your client to an individual in the planning authority to speed up the planning approval process*

(b) *A compensation payment made by your client to an adjoining landowner*

(c) *A payment made by a sub-contractor to the buying manager within the main contractor to secure a place on the tender list for the groundwork package*

(d) *A discount as part of the tender process for the combined award of a bundle of five similar contracts*

(e) *An end of year discount to the main contractor paid by the groundwork subcontractor based on the number of contracts awarded throughout the year*

(f) *An invitation to attend Rugby at Twickenham on the main contractors annual outing as a guest of the Contractor's Surveyor*

(g) *An offer to use the Contractor's villa in France free of charge for your next family holiday*

(h) *At the December project team meeting the Contractor's Surveyor passes out a bottle to members of the team.*

Question 4 was designed to examine participants' knowledge regarding the practical application of anti-corruption legislation to scenarios that may occur in the work of surveyors. The scenarios were deliberately designed to represent the realism of situations that the participants would encounter in their work. Participants were required to identify whether they would be covered by the legislation applicable in the UK with one mark awarded for each correct answer to items (a) to (h) above. A further additional mark was allocated to item (e) where participants were able to identify both sides of the argument (yes and no) which could apply to the scenario described in the question. The results are shown in Table 7.10.

Table 7.10 - Results from Assessment Questionnaire Question 4: Applicability of anti-corruption legislation

Experimental Group		Control Group	
No. of Participants	**Score**	**No. of Participants**	**Score**
2 (5%)	9	0	9
26 (59%)	8	3 (7%)	8
11 (25%)	7	9 (19%)	7
4 (9%)	6	12 (26%	6
1 (2%)	5	10 (22%)	5
0	4	7 (15%)	4
0	3	3 (7%)	3
0	2	0	2
0	1	0	1
0	0	2 (4%)	0
Total: 44	**44**	**Total: 46**	**46**
Mean Score: 7.55		**Mean Score: 5.35**	

The results showed 100% of experimental group achieving scores which exceeded the mid-point of available marks i.e. 5 marks and above. For the control group 34 participants (74%) achieved scores which exceeded the mid-point. The distribution of results across the range of possible scores is illustrated in Figure 7.4.

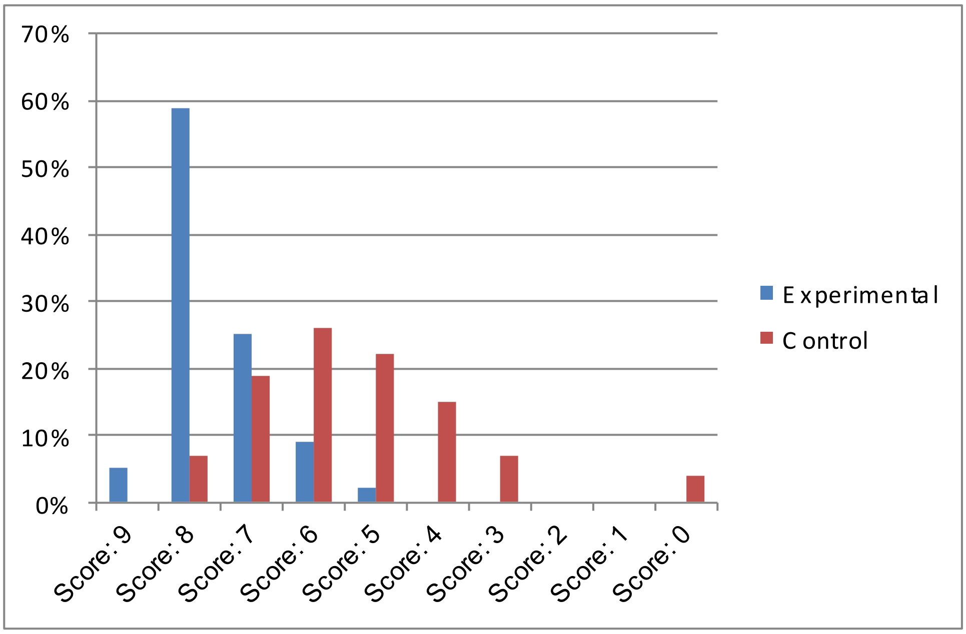


Figure 7.4 - Comparison of scores from Assessment Questionnaire Question 4: Applicability of anti-corruption legislation

The figure illustrates a clear shift of scores towards the higher level of attainment for experimental group participants, 84% of experimental group participants scored 7 or 8 marks, compared to 26% of control group participants. The results provide evidence to show that the new learning model enhances the acquisition of understanding of the application of anti-corruption legislation to the scenarios covered by this question. The statistical significance of the results is shown in Table 7.19.

7.5.5 Results: Question 5

Question 5: *You work in the London Head Office of a surveying firm. A colleague who has just returned from your overseas office tells you the firm has to arrange facilitation payments to foreign officials in order to be included* *on tender lists. Apparently this is normal practice. What would be your response in this situation?*

Question 5 required participants to make a decision as to the applicability of the Bribery Act 2010 to a scenario requiring facilitation payments occurring outside the United Kingdom. Two marks were awarded for participants able to identify the extent of Bribery Act applicability to UK based firms and facilitation payments together with the need to escalate critical issues such as this within the business. The results are shown in Table 7.1.

Table 7.11 - Results from Assessment Questionnaire Question 5: Applicability of bribery legislation outside the UK

Experimental Group		**Control Group**	
No. of Participants:	**Score**	**No. of Participants:**	**Score**
20 (45%)	2	2 (4%)	2
24 (55%)	1	9 (20%)	1
0	0	35 (76%)	0
Total: 44		**Total: 46**	
Mean Score: 1.45		**Mean Score: 1.04**	

The results show a better performance by the experimental group compared to the control group. All the experimental group participants were able to provide a correct score, whilst 76% of the control group were unable to provide a correct score. Whilst 45% of experimental group participants were able to achieve the highest score, only 4% of control group participants were able to achieve the highest score. A similar result is produced by the second highest score, 55% versus 20% for the experimental and control groups respectively. Comparison of the full results is illustrated in Figure 7.5.

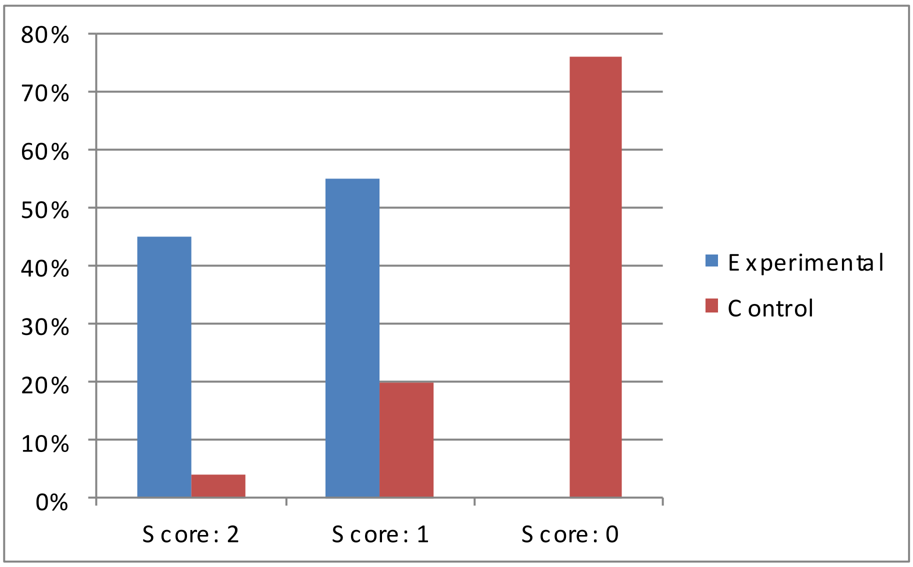


Figure 7.5 - Comparison of scores from Assessment Questionnaire Question 5: Applicability of bribery legislation outside the UK

The figure illustrates the shift in the performance of the experimental group compared to the control group, which has an almost opposite profile of scores. This demonstrates that the new learning model has enhanced the acquisition of this aspect of the professional competence. The statistical significance of the results is shown in Table 7.19.

7.5.6 Results: Question 6

Question 6: *A director of your surveying firm is also a Non Executive director of a Design & Build Contractor on the list of tenderers for the project you are currently working on. Is there an issue here and how would you respond?*

For Question 6 participants were required to identify that a potential conflict of interest might exist in respect of the Non Executive Director's position. One mark was awarded for identification of the conflict together with two further marks for proposing appropriate responses, such as removal of the firm from the tender list, full disclosure to all parties, clear separation of the director from the tender process and third party verification of the probity. The results are shown in Table 7.12.

Table 7.12 - Results from Assessment Questionnaire Question 6: Identifying and responding to a conflict of interest

Experimental Group		Control Group	
No. of Participants	**Score**	**No. of Participants**	**Score**
12 (27%)	3	0	3
27 (62%)	2	6 (13%)	2
5 (11%)	1	25 (54%)	1
0	0	15 (33%)	0
Total: 44	**44**	**Total 46**	**46**
Mean Score: 2.15		**Mean Score: 1.13**	

The results show that the performance of the experimental group was better than that of the control group. All the participants in the experimental group were able to score at least one mark in comparison to 33% of control group participants who were unable to score any mark. At the opposite end of the table the situation is repeated, whilst the number of participants in both experimental and control groups able to score full marks for this question was low, 27% of the experimental group did score maximum marks compared to 0% of the control group. This showed a clear shift towards higher scores for the experimental group, which is illustrated in the full comparison of the results shown in Figure 7.6.

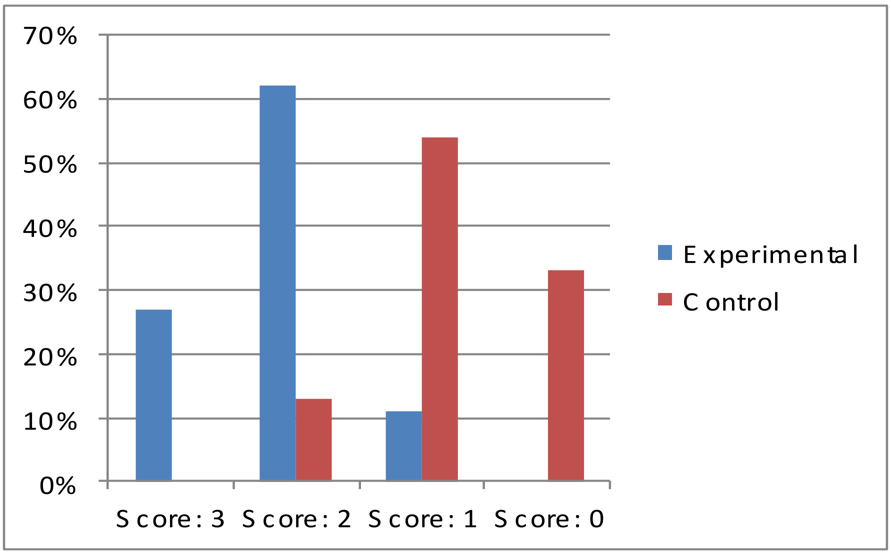


Figure 7.6 - Comparison of scores from Assessment Questionnaire Question 6: Identifying and responding to a conflict of interest

Similar to the results for previous questions, a clear division exists above and below the mid-point score, with experimental group scores lying to the left (upper) side of the score range. These results show that the new learning model clearly enhances the acquisition of this facet of professional competence. The statistical significance of the results is shown in Table 7.19.

7.5.7 Results: Question 7

Question 7: *If you are looking for guidance on money laundering what regulations currently apply in the UK?*

Question 7 examined participant's knowledge of the regulations applying to money laundering in the UK. One mark was awarded for correct identification of the Money Laundering Regulations 2007. The results are shown in Table 7.13.

Table 7.13 - Results from Assessment Questionnaire Question 7: Knowledge of the Money Laundering Regulations

Experimental Group		Control Group	
No. of Participants	**Score**	**No. of Participants**	**Score**
28 (64%)	1	8 (17%)	1
16 (36%)	0	38 (83%)	0
Total: 44		**Total: 46**	
Mean Score: 0.64		**Mean Score: 0.17**	

The performance of the experimental group was significantly better than the control group, with 64% correctly answering compared to 17% for the control group. The mean score reflects this with a threefold difference in the scores. Comparison of the results is illustrated in Figure 7.7.

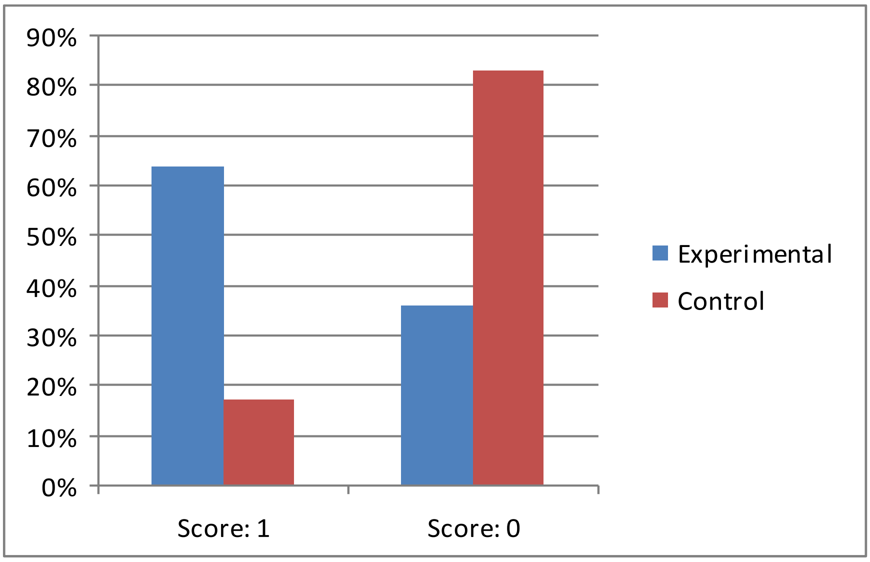


Figure 7.7 - Comparison of scores from Assessment Questionnaire Question 7: Knowledge of the Money Laundering Regulations

Concerningly, the results show that 83% of control group participants were unable to identify the current regulations applicable to money laundering. It can be deduced that there is a clear deficiency in this knowledge area, an area that is seen as significant to the role of Chartered Surveyors (RICS, 2012a). The profile of the results shown in Figure 7.7 indicate a clear improvement for the experimental group compared to the control group, which strongly suggests the new learning model is effective in enhancing the acquisition of professional competence in this area. However, the fact that 16 experimental group participants (36%) remained unable to correctly identify the regulations indicates that the importance of the regulations may not be fully appreciated and that a residual problem in their acquisition remains. The statistical significance of the results is shown in Table 7.19.

7.5.8 Results: Question 8

Question 8: *In your role of project surveyor you become aware of the items listed below. Make a decision as to whether they could be taken as money laundering and how to address the issue with your client:*

(a) *Your client makes an interim payment to the contractor from a third party bank account?*

(b) *Your client sold properties at other sites in the UK and is using the money to fund the project you are working on?*

Question 8 was designed to examine applicability of the money laundering regulations to scenarios surveyors may encounter in their day to day roles. As with previous questions, realism was an important factor in the question scenario. One mark was awarded for each correct answer to items (a) and (b) above. An additional mark was allocated to participants able to identify the sensitivity of the issue and therefore the need to ensure legislative responsibilities of surveyors are clear to clients prior to entering into commissions. The results are shown in Table 7.14.

Table 7.14 - Results from Assessment Questionnaire Question 8: Applicability of the Money Laundering Regulations

Experimental Group		**Control Group**	
No. of Participants	**Score**	**No. of Participants**	**Score**
0	3	0	3
32 (73%)	2	25 (54%)	2
9 (20%)	1	11 (24%)	1
3 (7%)	0	10 (22%)	0
Total: 44		**Total: 46**	
Mean Score: 1.66		**Mean Score: 1.33**	

The results show no participants in the experimental or control groups scored full marks for this question. Analysis of the questionnaire responses found there is a very low appreciation of the potential impact on client relationships from this issue, however participants from both groups were able to correctly identify the potential for money laundering or otherwise within the scenarios and a comparison of the scores illustrates this in Figure 7.8.

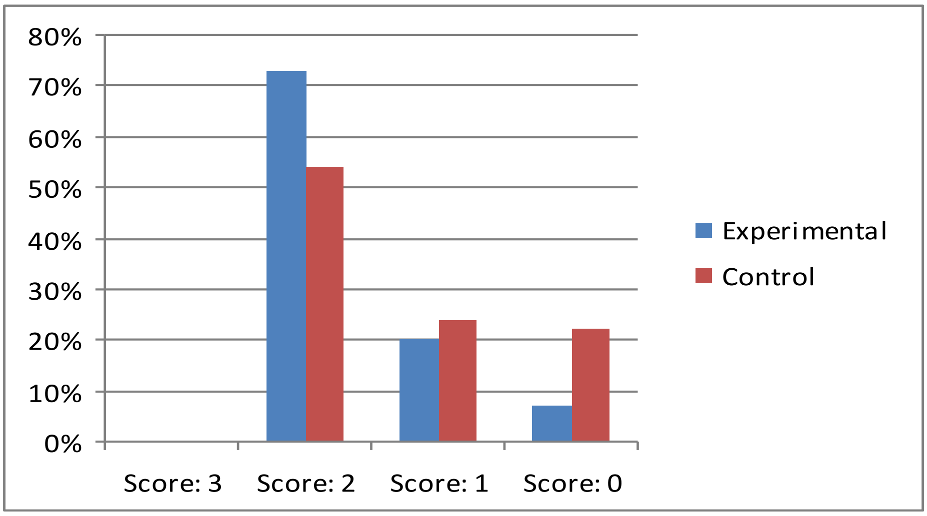


Figure 7.8 - Comparison of scores from Assessment Questionnaire Question 8: Applicability of the Money Laundering Regulations

The figure illustrates that whilst over 50% of experimental and control group participants recognised that scenario (a) provided potential for money laundering in contrast to scenario (b) which is common practice in the funding of real estate developments, there still exists an enhanced performance by the experimental group 73% versus 54%. As with previous questions, there is a demonstrable shift in the performance of the experimental group towards higher scores compared to the control group, which indicates that the new learning model is effective, even though this is an aspect that is not properly understood. Comparing this score with the score for Question 7, it can be deduced that although a large number of control group participants were not aware of the precise regulations applicable in the UK; they did appear to understand the concept and potential for money laundering. The statistical significance of the results is shown in Table 7.19.

7.5.9 Results: Question 9

Question 9: *Your client is going to be away for six months and wishes to make an advance payment to the contractor. He suggests you hold the funds in your firm's account to meet advance payment when it becomes due. How would you respond and what advice would you give on advance payments?*

Question 9 was designed to examine participants' knowledge of the RICS regulatory requirements for the protection of client funds, together with risks associated with advance payments. One mark was awarded for identifying the need to keep client's funds separate and up to three marks for identification and mitigation of advance payment risks. The results are shown in Table 7.15.

Table 7.15 - Results from Assessment Questionnaire Question 9: Awareness of regulatory requirements for protection of client funds

Experimental Group		**Control Group**	
No. of Participants	**Score**	**No. of Participants**	**Score**
0	4	0	4
6 (14%)	3	0	3
11 (25%)	2	3 (6%)	2
24 (54%)	1	10 (22%)	1
3 (7%)	0	33 (72%)	0
Total: 44		**Total: 46**	
Mean Score: 1.45		**Mean Score: 0.35**	

The results show no participants in the experimental or control groups scored full marks for this question. Analysis of the questionnaire responses found there is a very low understanding of the RICS regulatory requirements relating to protection of client funds. However, the results show higher scores and a higher level of knowledge in the experimental group, this is illustrated in Figure 7.9.

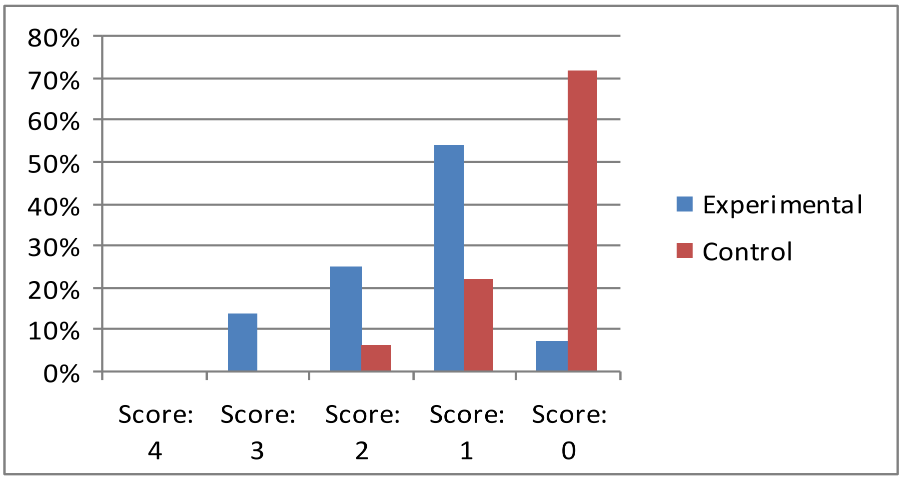


Figure 7.9 - Comparison of scores from Assessment Questionnaire Question 9: Awareness of regulatory requirements for protection of client funds

The results show a clear improvement of scores for the experimental group compared to the control group, which is reflected in the mean score for the experimental group, which is nearly four times that of the control group. The results indicate that the new model of learning has produced a definite enhancement in the learning and acquisition of this aspect of professional competence. The results show that the level of understanding of advance payment issues for participants in the control group was worryingly low with

33 participants (72%) scoring a zero score. However, overall scores are low for both groups with the diagram skewed to the right (low end) of the marking profile. The statistical significance of the results is shown in Table 7.19.

7.5.10 Results: Question 10

Question 10: *You have included a payment in an interim valuation for work which subsequently looks to be defective. The contractor's surveyor suggests to leave it for the moment and it will be sorted out later. How would you respond?*

This question was designed to examine appropriate professional responses to issues associated with interim payments to contractors relating to defective work. Two marks were awarded to participants who identified firstly the need to refer the defective work to an appropriate expert (quantity surveyors are not qualified to make decisions on defective work or the rectification process) and secondly to adjust the interim payment as soon as the issue is identified. The results are shown in Table 7.16.

Table 7.16 - Results from Assessment Questionnaire Question 10: Professional responses related to defective work

Experimental Group		Control Group	
No. of Participants	**Score**	**No. of Participants**	**Score**
20 (45%)	2	2 (4%)	2
22 (50%)	1	22 (48%)	1
2 (5%)	0	22 (48%)	0
Total: 44		**Total: 46**	
Mean Score: 1.41		**Mean Score: 0.57**	

The results showed that 45% of experimental group participants were able to identify two appropriate responses compared to 2% of control group participants. This is conversely reflected at the opposite end of the results, where 48% of the control group scored zero compared to 5% for the experimental group. Comparison of the results is illustrated in Figure 7.10.

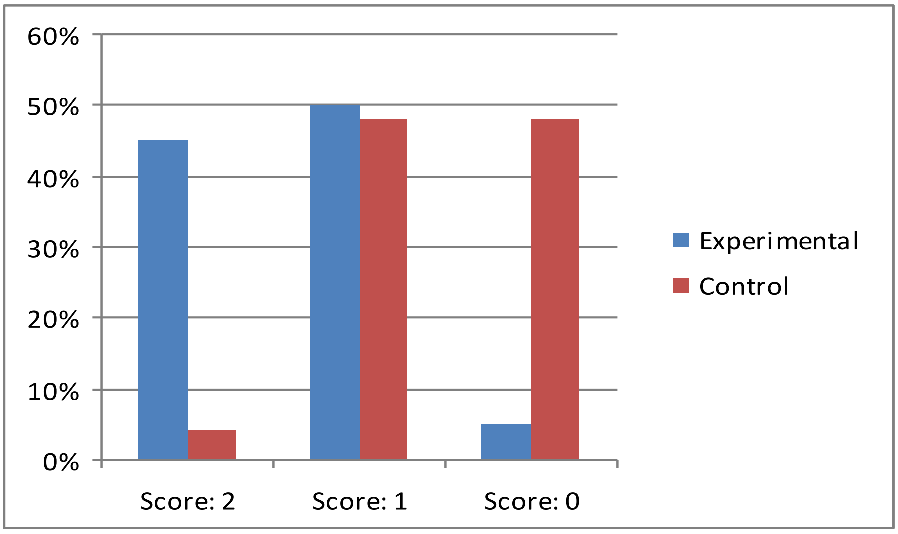


Figure 7.10 - Comparison of scores from Assessment Questionnaire Question 10: Professional responses related to defective work

The figure illustrates a similar pattern on results produced for previous questions, with a clear shift towards higher scores for the experimental group compared to those for the control group. The figure also shows a clear division of results either side of the mid-point, with experimental group results lying to the left (upper) side and control group scores to the right (lower) side of the score range. Again, the results indicate that the new learning model does produce a significant improvement in the participants' acquisition of professional competence. The statistical significance of the results is shown in Table 7.19.

7.5.11 Results: Question 11

Question 11: *Your client believes you have made an error in your work and suggests that he will seek financial recompense from your firm. What actions should you take?*

This question was designed to examine participants' understanding of responsibilities for errors and professional indemnity. One mark was awarded for the need to report the error immediately upon becoming aware, including escalating the issue within the business (i.e. do not cover-up/avoid the error). A second mark was awarded for notification of Professional Indemnity Insurers. The results are shown in Table 7.17.

Table 7.17 - Results from Assessment Questionnaire Question 11: Responsibilities for errors and professional indemnity

Experimental Group		**Control Group**	
No. of Participants	**Score**	**No. of Participants**	**Score**
19 (43%)	2	8 (17%)	2
22 (50%	1	23 (50%)	1
3 (7%)	0	15 (33%)	0
Total: 44		**Total: 46**	
Mean Score: 1.36		**Mean Score: 0.85**	

The results show that the experimental group performed better than the control group. The results show only 8 control group participants (17%) were able to identify two appropriate responses, compared to the experimental group participants where 19 (43%) were able to identify two appropriate responses. Comparison of the results is illustrated in Figure 7.11.

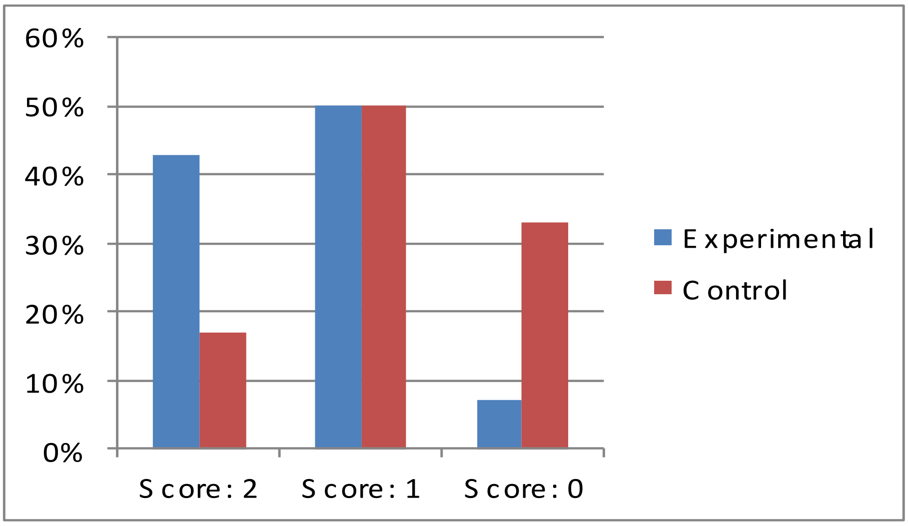


Figure 7.11 - Comparison of scores from Assessment Questionnaire Question 11: Responsibilities for errors and professional indemnity

A similar shift in the performance of the experimental group towards the higher scores produced in previous questions is shown for this question. Again, the figure illustrates a clear division of results either side of the mid-point, with experimental group results lying to the left (upper) side and control group scores to the right (lower) side of the score range. The results reveal that the performance of participants engaged with the new model of learning was clearly enhanced compared to those participants who were not. The statistical significance of the results is shown in Table 7.19.

7.6 Analysis of the performance of the new learning model

This section of the chapter considers the analysis of the aggregated results with respect to the performance of the new learning model. The analysis is based on two components, firstly descriptive statistics are used to describe and interpret the empirical data, secondly inferential statistics are used to draw inferences from the results regarding their applicability and generalisability to the larger population. The analysis strategy applied was structured into six elements as follows:

(i) Determining the nature of the data sets obtained. This was used to inform the statistical tests to be applied as advocated by Salkind (2008) and Bryman and Cramer (2011)

(ii) Establishing if experimental group results showed a statistically significant mean difference over results from the control group

(iii) Analysing the results categorised against learning objectives/learning outcomes set for the application workshops

(iv) Determining if there is any effect on the results from the differing characteristics (variables) of the experimental and control groups

(v) Establishing if there is any cross-tabulation correlation between variables and questions within the data sets

(vi) Establishing if the results show enhancement in the rate of learning between the experimental group who participated in the application workshops and control group following a conventional structured training approach.

Each of the elements (i) to (vi) above are now reviewed in Sections 7.6.1 to 7.6.6 which follow.

7.6.1 Distribution of results of the experimental and control groups

The first analysis of the results was to evaluate how they related to a normal distribution; these are shown in Figures 7.12 and 7.13.

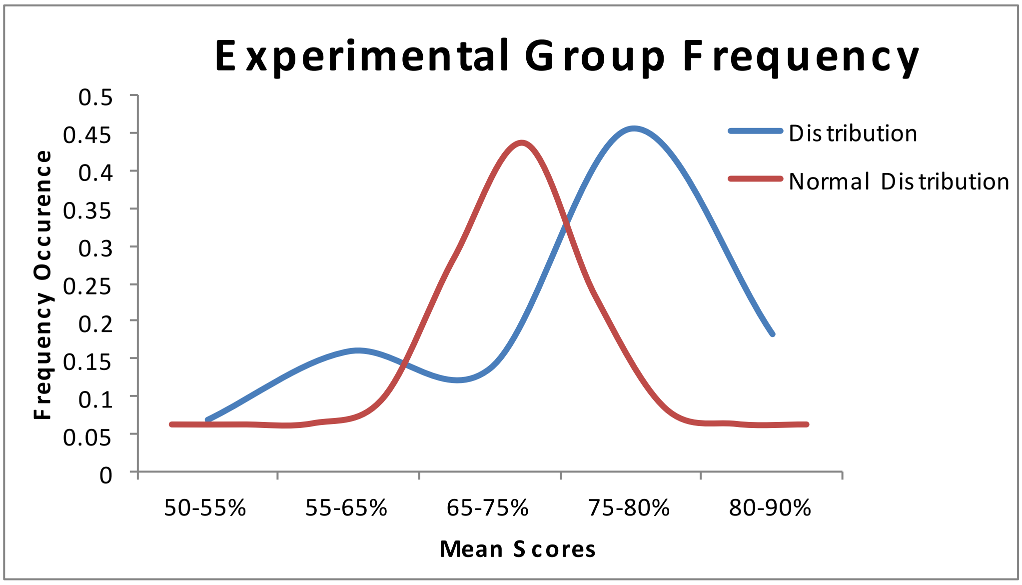


Figure 7.12 - Frequency distribution of aggregated results from experimental group

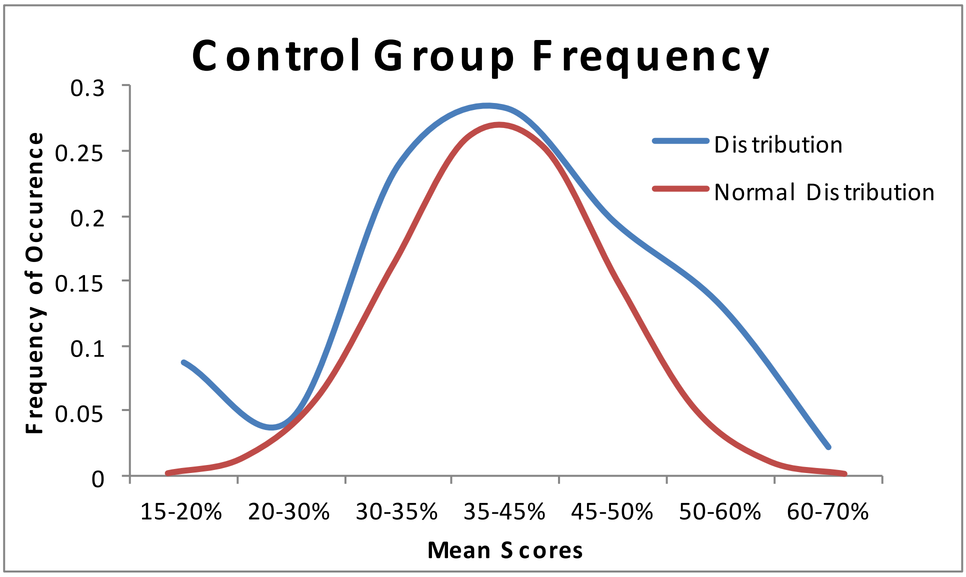


Figure 7.13 - Frequency distribution of aggregated results from control group

From the graphs it can be seen that the results curves show profiles which align with normal distributions. The curve for the experimental group distribution is shifted to the right, which shows that the proportion of participants in the experimental group achieving a score higher than the mean was greater than that which would be expected for a normal distribution. It is contended that this shift demonstrates effectiveness of the new learning model as the results achieved by the experimental group are clearly shifted towards higher scores. The results for each individual question also show that this shift is consistent for all questions.

The appropriate statistical test to apply was determined utilising Salkind's flow chart for selecting test statistics (Salkind, 2010, p.173). The flow chart indicates that when examining the differences between two groups on one or more variables where participants are not tested more than once then t-test for independent means or samples would be correct. This statistical test has been applied in the analysis sections which follow.

7.6.2 Improvement in overall mean aggregated results and individual questions

The overall mean aggregated results for all questions for the experimental and control groups are shown in the Table 7.18.

Table 7.18 - Overall mean results for experimental and control groups

	Mean Score	**Standard Deviation**
Experimental Group	73.14%	3.30
Control Group	40.50%	4.38
Difference	**+32.64%**	

This indicates that the mean aggregated assessment scores for participants who learned using the new learning model (Experimental group) was increased by 32.64% compared to the non-participants (Control group). The contention is that this result shows a significant improvement in the knowledge level of graduate trainees who participated in the application workshops. The overall mean aggregated experimental group score shows a result that is nearly twice that of the control group.

To verify the statistical validity of this result, a null hypothesis was set as "participation in the new learning model had no effect on the scores of graduate trainees". A t-test was then computed to establish if there was a statistically significant improvement in graduate trainee scores following application. The result achieved was t-stat 15.16 i.e. greater than 3.41 with 87 degrees of freedom and 0.001 confidence level which suggested the results showed a highly significant improvement in participants' knowledge following application. Accordingly, the results can reliably be inferred to the population.

The statistical validity was also verified for the results from individual assessment questions. The resulting t-test statistics are shown in Table 7.19.

<u>Table 7.19 – Statistical analysis of results from assessment questions</u>

Assessment Question	t-stat
1	3.105 > 2.63, Significant at 0.01
2	10.544 > 3.41, Highly significant at 0.001
3	3.530 >.3.41, Highly significant at 0.001
4	6.244 >.3.41, Highly significant at 0.001
5	10.472 >.3.41, Highly significant at 0.001
6	10.055 >.3.41, Highly significant at 0.001
7	4.964 >.3.41, Highly significant at 0.001
8	3.459 >.3.41, Highly significant at 0.001
9	7.230 >.3.41, Highly significant at 0.001
10	6.784 >.3.41, Highly significant at 0.001
11	3.675 >.3.41, Highly significant at 0.001

Thus, all results from individual questions are shown to be either statistically significant or highly significant.

7.6.3 Analysis of mean results against learning objectives

The next element of analysis categorises the results against the learning objectives for the application workshops using the new learning model. Six learning objectives were defined in Chapter Six, Section 6.3.2. Questions in the assessment questionnaire were categorised against each learning objective as shown in Table 7.20.

Table 7.20 - Assessment questions categorised to learning objectives

After completing the exercise participants should, at an appropriate level, be able to:		Assessment Questions applicable
1	Identify the five RICS Professional and Ethical Standards	1
2	Understand the requirements of the Bribery Act 2010 and determine appropriate responses	3, 4, 5
3	Recognise a conflict of interest and determine appropriate actions	6
4	Identify the requirements of the law related to money laundering and the Money Laundering Regulations 2007	7, 8
5	Understand responsibilities for errors and professional indemnity	11
6	Recognise the implications of failing to apply professional and ethical standards to responses and decisions that may occur in the work of surveyors	2, 9,10

The results for experimental and control group participants against each question were sub-analysed to reveal the mean scores for each of the learning objectives, these are shown in Table 7.21. To determine if the scores are statistically significant, t-tests were computed.

Table 7.21 - Analysis of mean scores categorised to learning objectives

Learning Outcome	Experimental Group Mean Score	Control Group Mean Score	Difference	t-stat
1	96.00%	86.00%	+10.00%	3.105 > 2.63, Significant at 0.01
2	77.65%	40.59%	+37.06%	12.926 > 3.41, Highly significant at 0.001
3	73.33%	26.67%	+46.66%	10.055 > 3.41, Highly significant at 0.001
4	57.50%	37.50%	+20.00%	4.492 > 3.41, Highly significant at 0.001
5	70.00%	40.00%	+30.00%	3.675 > 3.41, Highly significant at 0.001
6	58.75%	18.75%	+40.00%	13.466 > 3.41, Highly significant at 0.001

The sub-analysis shows a range of differences between the experimental group and the control group, with means of minimum 10.00% to maximum 46.66%. T-test results showed these all to be highly significant at 0.001. Table 7.22 shows the sub-analysis ranked on the size of the difference, ranked high to low.

Table 7.22 - Ranked difference in mean scores against learning objectives

Learning Outcome	Experimental Group Mean Score	Control Group Mean Score	Difference
3	73.33%	26.67%	46.66%
6	58.75%	18.75%	40.00%
2	77.65%	40.59%	37.06%
5	70.00%	40.00%	30.00%
4	57.50%	37.50%	20.00%
1	96.00%	86.00%	10.00%

The results indicate that highest differences occurred against learning objectives 3, 6 and 2. For clarity the results are presented in graphical format in Figure 7.14.

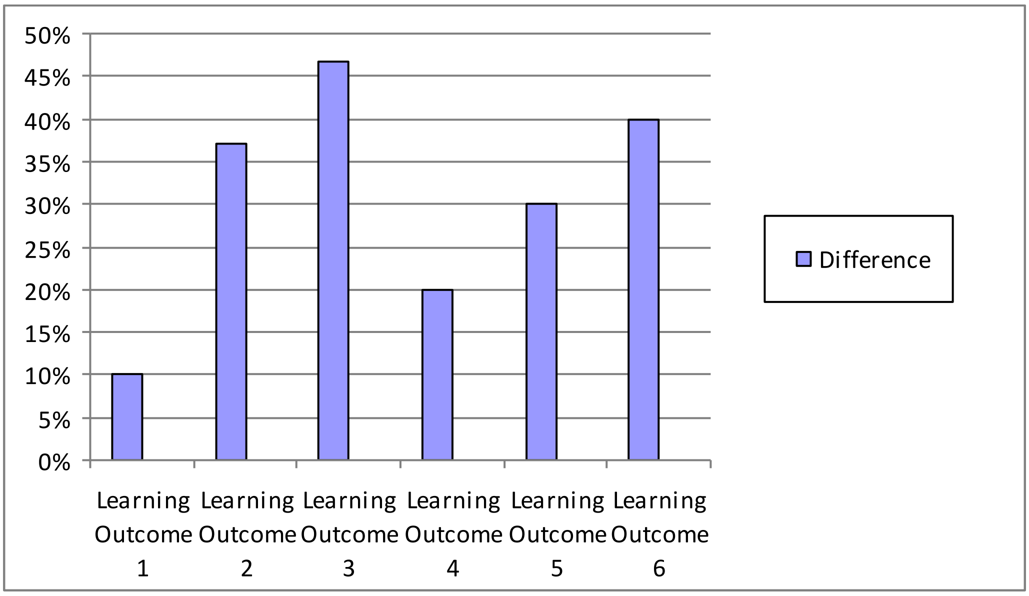


Figure 7.14 - Difference in mean scores against learning objectives

The main finding derived from this analysis is that learning objectives with the greatest difference (3, 6 and 2) are those competencies that require higher-order thinking in the form of subject decision-making in a context of uncertainty to determine appropriates actions in practical situations. They require what might be termed ‘application of professional judgement’, traditionally acquired through the process of experiential learning as advocated by the theories of Kolb (1984), Honey and Mumford (1986), Cowen (2006) and others. Thus it is contended the results show that the new learning model used in the application workshops is effective in enhancing the acquisition of this type of knowledge.

The lowest differences occurred in respect of the results for learning objectives 5, 4 and 1 which all relate to awareness of legislation, regulations and procedures; what might be termed codified knowledge. The results suggest that the application of the new learning model was less effective to enhance the acquisition of this type of knowledge. The lowest improvement score was for learning objective 1, which required the identification of the five RICS Professional and Ethical Standards. This suggests that participants had either already acquired an awareness of the RICS Professional and Ethical Standards through their conventional structured learning programmes, or that the acquisition was simple knowledge and therefore did not require the new learning model. Consequently, question 1 did not provide sufficient evidence to conclusively demonstrate enhanced learning for this category of knowledge.

7.6.4 Effect of Contextual Variables

The analysis now turns to a two-way comparison of experimental and control group composition against mean results achieved. The purpose of this analysis is to determine if the variables in the group composition had any effect on the results and the validity of the overall mean aggregated improvement scores produced by the new learning model. The results from the five main contextual variables examined are shown below.

(i) Gender composition

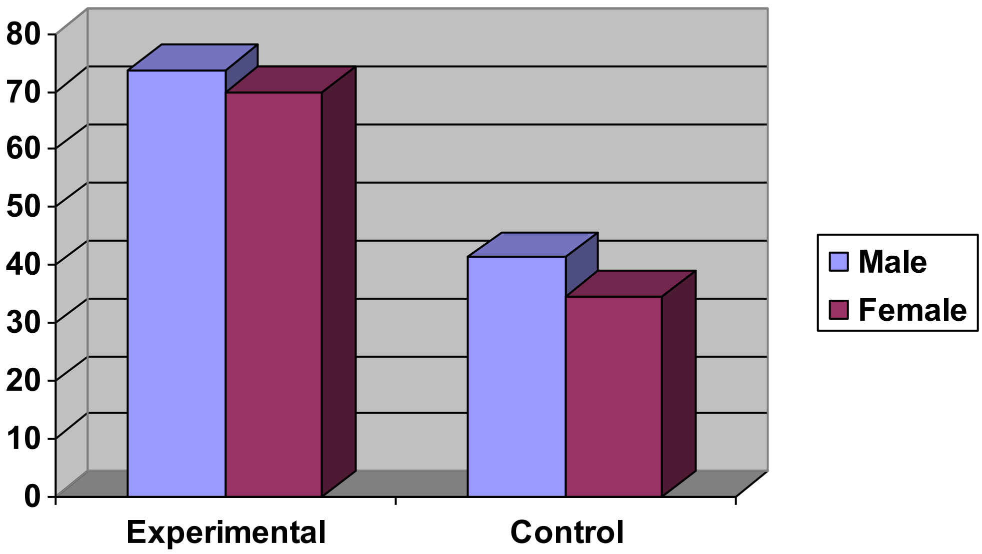


Figure 7.15 - Comparison of mean scores by gender

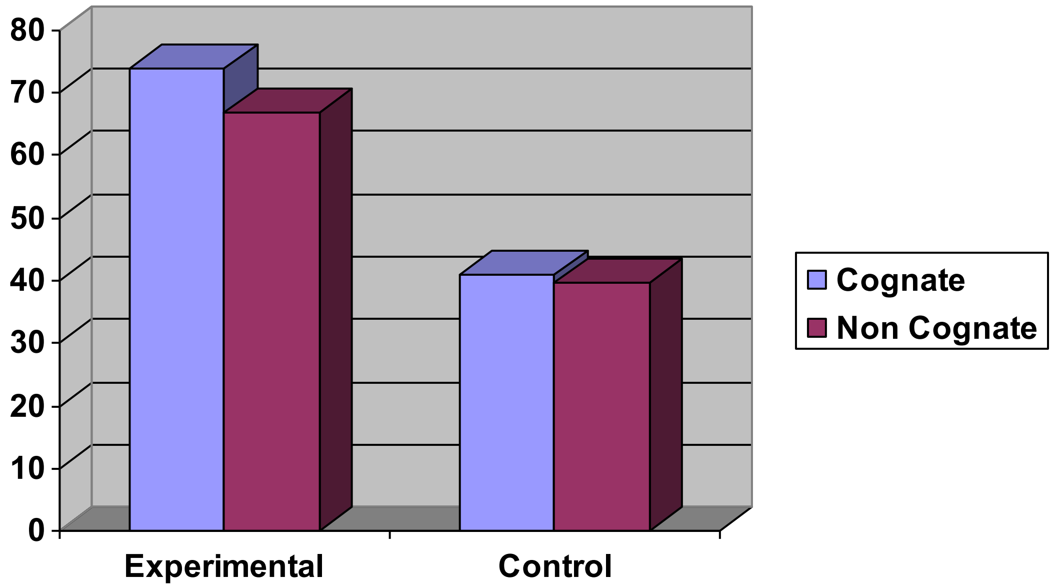
Figure 7.15 shows that the mean scores for male participants was higher than for females in both the experimental and control groups. However, when examining the difference between the experimental and control group means, it shows that the greater improvement occurred for female participants. Table 7.23 shows the comparison of experimental and control group improvements and differences from overall mean score.

Table 7.23 - Comparison of experimental and control group differences based on gender

Variable: Gender	**Experimental Group mean score**	**Control Group mean score**	**Improvement in mean score**	**Overall mean improvement score from Table 7.18**	**Difference from overall score**
Male	73.74%	41.41%	+ 32.33%	32.64%	+ 0.31%
Female	69.96%	34.62%	+ 35.34%	32.64%	+ 2.70%

From the table it can be seen that improvement for male and female participants is minimal, which is the same when the scores are compared with the overall mean improvement score showing a difference of + 0.31%. The improvement in female participant scores is higher with a difference of + 2.70%. Thus it can be deduced that gender composition of the experimental and control groups has some effect, but it is negligible and can be safely ignored as an intervening variable in the results. The analysis shows that an increase in the proportion of female participants within the application workshops would actually produce a greater overall mean improvement score.

(ii) First degree held by participants



<u>Figure 7.16 - Comparison of mean scores by first degree</u>

Figure 7.16 shows that the mean scores for cognate degree holders was marginally higher in both the experimental and control groups, the difference being 7.11% and 1.13% respectively. The difference between experimental and control group mean scores when compared with the overall mean score was also greater for cognate degree holders. Table 7.24 shows a comparison of the experimental and control group differences.

Table 7.24 - Comparison of experimental and control group differences based on first degree held

Variable: Type of First Degree	Experimental Group mean score	Control Group mean score	Improvement in mean score	Overall mean improvement score from Table 7.18	Difference from overall mean score
Cognate	73.78%	40.87%	+ 32.91%	32.64%	+ 0.27%
Non Cognate	66.67%	39.74%	+ 26.93%	32.64%	(-) 5.71%

The table shows that the new learning model is less effective for non-cognate degrees holders with a difference of (-)5.71% when compared with the overall mean improvement score for the experiment.

(iii) Time since graduation

Table 7.25 shows a detailed analysis of the improvement in mean scores for time since graduation.

Table 7.25 - Comparison of results based on time since graduation

Variable: Time since graduation	0-1 years	1-2 years	2-3 years	Over 3 years
Experimental Group	74.36%	70.37%	71.10%	75.56%
Control Group	38.46%	43.38%	41.54%	39.93%
Improvement in mean score	+35.90%	+26.99%	+29.56%	+35.63%

The analysis indicates that the application workshops are most effective for participants in the 0-1 years and over 3 years categories for time since graduation. This is shown by improvements in mean score of +35.90% and +35.63% respectively. For the 1-2 years and 2-3 years categories the improvements in mean score are slightly lower at +26.99% and +29.56% respectively. From the results of the research it has not been possible to identify any reasons for these minor differences. They are more likely to be associated with progress through the APC considered in the next analysis section. However, this does not affect the effectiveness of the new learning model in enhancing the acquisition of professional competences because of length of time since graduation. The analysis shows that even the lowest improvement score, in the 1-2 years category, produces a significant improvement of +26.99%.

(iv) Progress through APC

The analysis considered the effect on the results of the participants' point of progress through the APC. Table 7.26 shows a detailed analysis of the mean scores against each time category.

Table 7.26 - Comparison of results based on progress through APC

Variable: Progress through APC	0-1 years	1-2 years	2-3 years	Over 3 years
Experimental Group	71.23%	71.61%	77.86%	76.92%
Control Group	36.25%	47.14%	44.44%	37.44%
Improvement in mean score	+34.98%	+24.47%	+33.42%	+39.48%

The analysis indicates that the application workshops are most effective for participants in the 0-1 years and over 3 years categories for progress through the APC. This is shown by improvements in overall mean score of +34.98% and +39.48% respectively. For the 1-2 years and 2-3 years categories the improvements are slightly lower at +24.27% and 33.42% respectively. A reason for this may be that the normal period of structured training in preparation for the final APC assessment is two years; hence participants in the 1-2 years and 2-3 years categories would be preparing themselves for interview with revision and mock assessment exercises. Consequently their awareness of issues and knowledge levels may be heightened. The analysis still shows that even the lowest improvement score in the 1-2 years category for progress through APC remains a significant improvement at +24.47%.

However, the improvement in mean score is consistently significant for all years and does not show any pattern of change, such as tailing-off with time, which indicates that progress through the APC does not affect the efficacy of the new learning model.

(v) Comparison of results by participant firm

Finally, the analysis considered the effect of the participant's firm on mean improvement scores. Figure 7.17 illustrates the comparison of the mean improvement scores for each of the five participating firms designated as F2, F4, F6, F7 and F8 as described in Chapter Six.

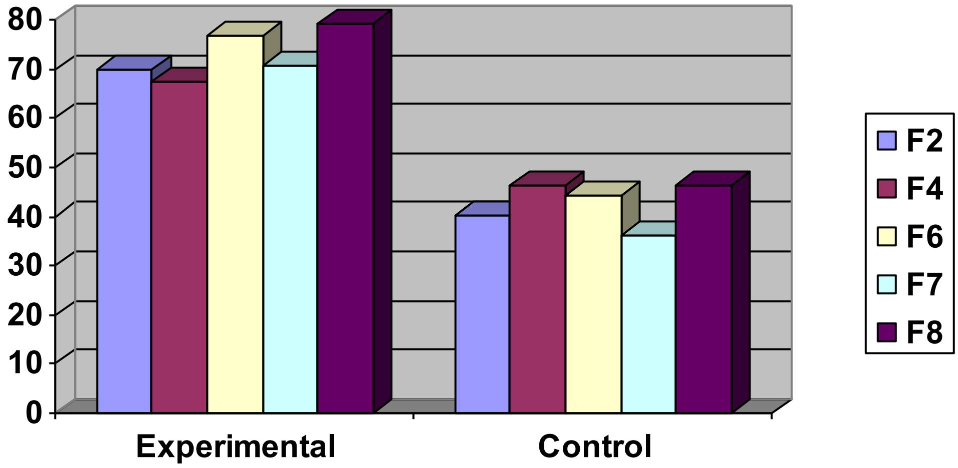


Figure 7.17 - Comparison of mean scores by participant firm

The graph shows that the mean scores for participants from firm F8 were higher in both experimental and control groups, the scores being 79.25% and 46.11% respectively. However, the difference (improvement) between experimental and control group results when comparing with the overall mean score was greater for Firm F7. Table 7.27 shows the comparison of experimental and control group differences.

Table 7.27 - Comparison of differences based on participant firm

Variable: Participating Firm	F2	F4	F6	F7	F8
Experimental Group	69.74%	67.52%	76.92%	70.51%	79.25%
Control Group	40.10%	46.15%	44.29%	36.11%	46.41%
Difference	29.64%	21.37%	32.63%	34.40%	32.84%
Comparison with overall mean improvement score	(-)3.00%	(-)11.27%	(-)0.01%	+1.76%	+0.20%

Again, the results do not affect validity of the new learning model in enhancing the acquisition of professional competence. The analysis shows that even applying the learning model to participants from Firm F4, the lowest firm, would still show an overall mean improvement score of + 21.37%. It is noteworthy that there are differences in the results between the participant firms, all of which are following RICS approved structured training programmes. This is discussed further in the conclusions to the chapter.

7.7 Cross-tabulation of results from individual questions

The next section provides a cross-tabulation analysis of the results from individual questions, to investigate if the empirical data shows any correlation between the different questions and the main ethical issues and challenges identified in Chapter Six. The method applied comprised compilation of contingency tables showing the numbers of participants scoring above and below the mean mark for each question. An examination has then been carried out to identify reverse correlations (reverse of results between questions) and comparative correlations (same results between questions). The contingency table for experimental group results is shown in Table 7.28.

Table 7.28 - Cross tabulation analysis of experimental group results

Experimental Group											
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
No. of scores above mean	36	37	20	28	20	12	28	32	17	20	19
Proportion above mean (%)	81.82	84.09	45.45	63.64	45.45	27.27	63.64	72.73	38.64	45.45	43.18
No. of scores below mean	8	7	24	16	24	32	16	12	27	24	25
Proportion below mean (%)	18.18	15.91	54.55	36.36	54.55	72.73	36.36	27.27	61.36	54.55	56.82
Column totals – No. of scores (n)	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**

The table shows an exact reverse correlation between Question 6 and Question 8 highlighted in green. The proportion of participants scoring below the mean (72.73%) for Question 6 (identification of a conflict of interest), correlates with the proportion of participants scoring above the mean for Question 8 (application of the Money Laundering Regulations). This suggests that the new learning method was effective in developing understanding of the money laundering regulations but less so for conflicts of interest. This appears to support the findings in Section 7.5.6 where the number of participants able to fully address Question 6 was found to remain low, whereas over 50% of participants correctly identified application of the money laundering regulations in Question 8.

The table also shows a comparative correlation (highlighted in yellow) where Question 4 (application of the Bribery Act) and Question 7 (identification of the Money Laundering Regulations) both show 63.64% scoring above the mean. On first examination this appears to be an exception from the general pattern for aggregated scores referred to in Section 7.6.3 where the application workshops were shown to be less effective for codified style questions. However, examination of the individual results in Section 7.5.7 shows that 36% of experimental group participants remained unable to correctly identify the money laundering regulations.

The examination now considers reverse and comparative correlations within the control group results. The contingency table is shown in Table 7.29.

Table 7.29 - Cross tabulation analysis of control group results

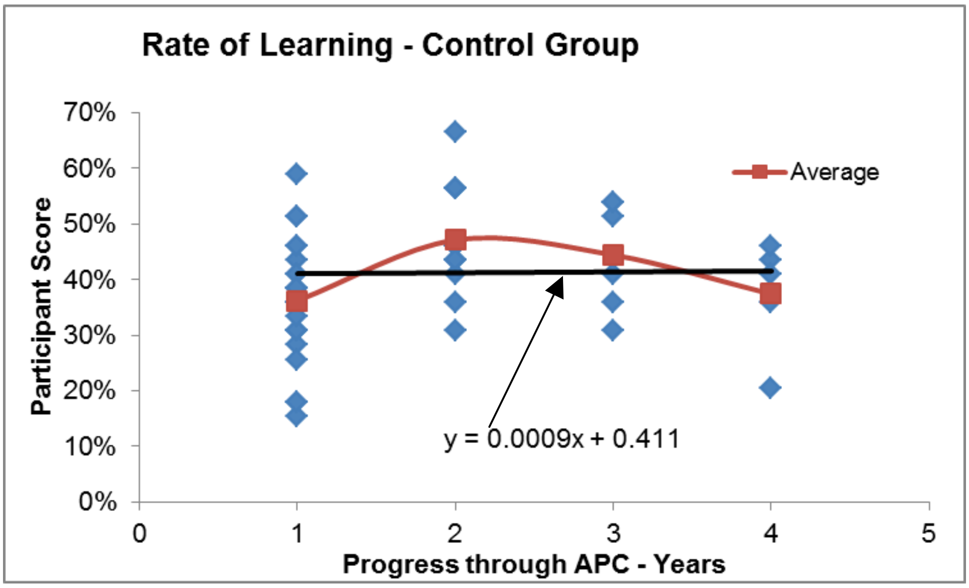
Control Group											
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
No. of scores above mean	25	6	16	24	2	6	8	25	13	24	31
Proportion above mean (%)	54.35	13.04	30.43	52.17	4.35	13.04	17.39	54.35	28.26	52.17	67.39
No. of scores below mean	21	40	30	22	44	40	38	21	33	22	15
Proportion below mean (%)	45.65	86.96	65.22	47.83	95.65	86.96	82.61	45.65	71.74	47.83	32.61
Column totals – No. of scores (n)	46	46	46	46	46	46	46	46	46	46	46

The table shows that for the control group there are no exact reverse correlations between the questions. For comparative correlations (highlighted in yellow), the table shows a correlation between Question 2 (appropriate professional responses to rumours) and Question 6 (identification of a conflict of interest) with 86.96% scoring below the mean. Although only one correlation has been identified this does support the general trend of control group results where participants following a conventional structured training approach score low for questions requiring application knowledge and professional judgement.

The cross tabulation analysis above has shown the extent of correlation between the results of individual questions generally to be low. In part it is suggested this can be attributed to the combined style of several questions. For example, Question 6 combined identification of a conflict of interest with determination of appropriate responses. Similarly, Question 9 required knowledge of applicable regulations together with determination of appropriate actions. The effect of this is to blend the requirement for tacit and codified knowledge within the results of individual questions and therefore make differentiation of scores less clear. Because of this it is contended the analysis of results at an aggregate level provides a more reliable measure of the effectiveness of learning model achieved through the application workshops.

7.8 Acceleration in rate of learning through participation in the application workshops

The final section of analysis considers acceleration in the rate of learning through participation in the application workshops. The method applied was to first determine the average rate of learning for control group participants, who were following conventional structured training programmes, using their assessment questionnaire scores. The graph in Figure 7.18 provides a scatter plot of the individual participant scores in four categories of progress through the APC. The categorisation takes group 0-1 as year 1, group 1-2 as year 2, group 2-3 as year 3 and over 3 group as year 4.



<u>**Figure 7.18 - Graph to show control group scores based on progress through the APC**</u>

The average of results line (in red) show scores rising in years 2 and 3 as participants prepare for interview and final assessment and tailing off in year 4. To determine the rate of learning across the four year period a line of best fit has been constructed based on the complete data set, this shows a minor incline to the right. The rate of learning (change in knowledge level measured by difference in scores from year 1 through to year 4) is then shown by the gradient formula for the best fit line:

$$y = 0.0009x + 0.411$$

This analysis has then been repeated for experimental group participants and is presented in Figure 7.19.

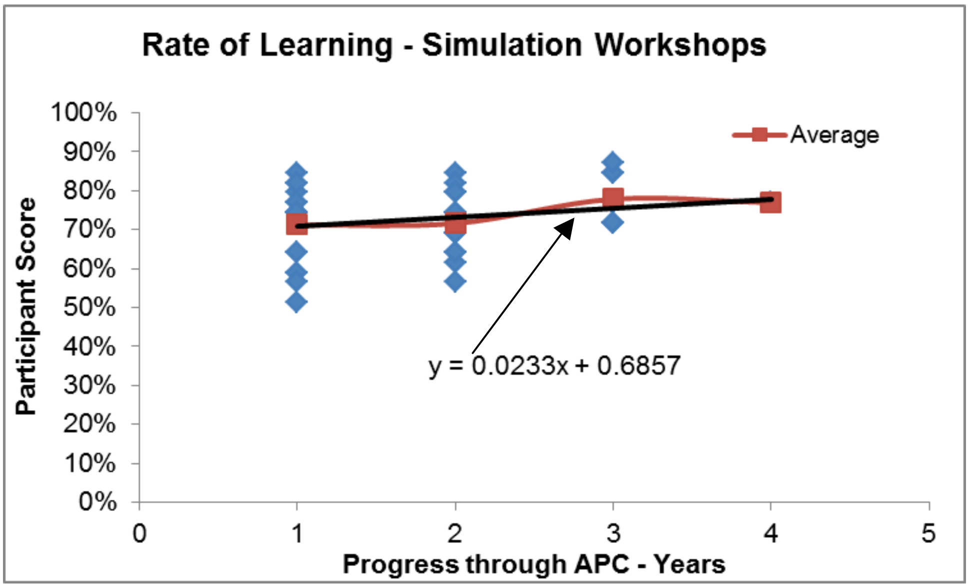


Figure 7.19 - Graph to show experimental group scores based on progress through the APC

The gradient formula for best fit line is:

Y = 0.0233x + 0.6857

This line shows a steeper incline to the right, therefore it can be deduced that this demonstrates an increased rate of learning through participation in the application workshops. Following participation in the application workshops knowledge levels increased from an overall mean score of 70.90% for year 1 participants to 77.89% for year 4 participants. Thus the evidence shows acceleration in the rate of learning through participation in the workshops applying the new learning model.

7.9 Critical review of application approach

This section addresses three issues that could have potentially influenced the conclusions deduced from the results.

(i) Effect of memory i.e. the results could have been affected by short and medium-term memory rather than long-term embedded learning - Brown and Knight (1994) identified that the assessment of students can be influenced by a number of factors, one of these factors is memory capacity. Assessment by written examination may provide an indicator of student's memory capacity, rather than embedded learning. Rose (2007) asserted that there are at least two memories, short term memory and long term memory. Revlin (2012) suggests the duration of short term memory is effectively working memory and may be a little as eighteen seconds without any form of memory rehearsal. Rosenzweig *et al* (1993) introduced the concept of intermediate term memory which might persist for about two to three hours. A common feature of the work emanating from memory theorists is that long term memory applies after short and medium term memory periods have expired. To ensure that the learning was long-term, for both the experimental and control groups, a minimum two week period elapsed from the application workshops before completing the assessment questionnaires. Thereby minimising the risk that the results were due to short and medium term memory, rather than being embedded learning.

(ii) Participants enhance results through research of answers – The assessment process required participants to complete assessment questionnaires in their own time and therefore in an unsupervised environment. This provides an opportunity for participants to research material or look up answers when completing assessment questions. To militate against this possibility, guidance was provided on the completion of questionnaires which requested that participants answered questions based upon their current level of knowledge and understanding. In addition, during the marking process answers were sense checked for obvious signs of wording copied from published material. The number of instances identified through this process was found to be very low (two) therefore it is concluded that the results have not been affected by researched answers and can be considered to be reliable.

(iii) Results may be influenced by the Hawthorne Effect – The Hawthorne effect was identified and named after the experiments conducted in 1924-32 at the Hawthorne Works in Chicago USA by Elton Mayo (1949). The effect has been challenged by numerous authors (Parson 1974, Kolata 1998 and others) but the majority consensus has shown that the effect is real and forms a common part of most participation schemes. In the context of this research, it could be argued that the results have been produced by the interest shown to the participants in the experimental group but not in the control group. It was recognised that it was not possible to remove this effect completely, but to minimise the potential impact the application workshops carried out with the experimental group were conducted at the normal place of work for participants, in surroundings that would be typical for their conventional structured learning programmes. No special handling was accorded to the experimental group and participant firms were asked not to promote the workshops or the selection of the participants to be anything other than ordinary. Such arrangement that deliver particular topics by guest lecturers is a regular occurrence on most structured training programmes employed by these firms. Whilst it cannot be concluded with absolute certainty that there was no Hawthorne effect, because of the measures taken and in light of anecdotal evidence from the participants and their firms, any effect was minimal and unlikely to substantially influence the performance of the experimental group or the results produced.

7.10 Chapter conclusion

The results presented show that application workshops using the new learning model have produced clear evidence of enhanced learning of higher-order professional competence by the graduate trainees. The main outcomes of the chapter are summarised as follows:

- Empirical data has been presented from a total of 90 graduate trainees who participated in the experimental and control groups
- The statistical analysis shows the results obtained can be reliably inferred to the population of graduate trainees registered for the APC Quantity Surveying and Construction Pathway

- The application workshops were shown to be more effective for cognate degree holders, but nevertheless still show significant improvements for non-cognate degree holders
- The application workshops were shown to be more effective for graduate trainees at the start of their training programmes or with over three years post graduation experience. This is likely to be a result of trainees in the intermediate period (years two and three) of training preparing for APC final assessment and consequently at heightened knowledge levels.

Finally, the improvement results were found to be affected by participant firm employing the new entrant graduate quantity surveyors, as shown by the comparative scores against this variable. Participants from two firms F7 and F8 produced results above the other firms The research did not attempt to diagnose the detailed reasons underpinning this finding; however the improvement results do suggest variances in both the capabilities of trainees in particular firms and the effectiveness of their structured training programmes. Exploring these variances was considered beyond the scope of this research.

Chapter Eight – Discussion of the findings

8.1 Introduction

This chapter discusses the findings from the research in two sections. The first section considers the findings and their relationship to existing theories and knowledge, particularly where the findings have developed and or modified existing theories. It also considers where the findings have extended the body of knowledge relating to the acquisition and development of professional competencies, especially higher-order competencies.

The second section discusses the generalisability of the results and findings, and makes the case for transferability to the wider population of new entrants into the built environment and to professionals entering other industries.

8.2 Results and findings

8.2.1 Learning model

The new learning model developed for the experiment is a unique synergistic learning model, composed of elements that have their origins in a number of learning theories, which have been adapted and modified to inform the new learning model. None of these theories relate directly to the learning and acquisition of higher-order professional competencies. Most related to applications in their particular field of origin, such as higher education, game design, medical training, management training, etc. Whilst each of the individual components produced positive effects in their original context, none had been used in the context of this research, neither had they been used as part of a combined learning model, such as the one developed for this research. Each component part does however provide insights into how they might contribute to the success of the model through the connection to individual learning theories. It is these theoretical connections that provide the underpinning and a rationale for the reasons why the new learning model works as a whole.

8.2.2 Acquisition of higher-order professional competencies

The research has shown that the acquisition of higher-order professional competencies has been enhanced by the use of non-traditional learning techniques within the learning model. The results show enhancement through improved acquisition of these competencies, with mean aggregated assessment scores for participants who undertook the non-traditional learning (experimental group) of 73.14%, compared with 40.50%, for non-participants (control group); an increase of 32.64%. These results support and extend the findings of several theorists who have sought to provide measures for the effectiveness of non-traditional learning techniques within an individual context. Examples include Bancroft (1985) who asserts that when the non-traditional technique of accelerated learning is properly applied learning is improved by 2.5 to 3 times. Similarly, Burguillo (2010) observed that applying the game based technique of competition to an undergraduate course resulted in an increase in the percentage of students passing from 90% to 96.56%. Ebner and Holzinger (2007) also observed that a game based approach when tested on a structural concrete course over a period of three months resulted in an improvement of 25% to student marks.

The research results also show acceleration in the rate of learning for higher-order professional competencies. This is measurable by the higher rate of acquisition referred to above and by comparison of the rate of non-traditional learning for participants over years one to four of the APC process.

8.2.3 Use of simulations

The findings have confirmed the contribution and efficacy of simulations, as demonstrated in their application to business and management advocated by Liu, Cheng and Huang (2011). The results confirm the success of their contribution within the learning model, particularly with regard to the link between simulations and game-based approaches. The new learning model has also shown that these principles extend to higher-order learning. Conversely, the findings suggest that the absence of simulations within a game-based learning model would be less successful and possibly not allow the model to succeed.

Liu, Cheng and Huang (2011) assert that simulation games are competitive, situated and provide interactive (learning) environments, these are all aspects of the new non-traditional learning model developed in this research contributing to the results produced. The new learning model was successful because it required participants to engage in learning processes involving exploration, orientation, generation of different options or possible solutions and appraisal of these options as illustrated in Section 6.4, which are all characteristics of successful game-based simulations as identified by De Jong (2006). In addition the higher-order functions of synthesis and critical thinking were also involved, which could reasonably be considered to extend the work of De Jong and others, having shown that these functions also benefit from simulations combined with game-based approaches.

8.2.4 Game-based approaches

The findings confirmed the work of Wolfe (1997) and Pasin and Giroux (2011) that learning and decision-making abilities in complex and dynamic management situations using game-based approaches were more effective than traditional learning techniques. The findings extend these previous findings to show that the principles remain valid when applied to higher-order learning and professional competencies. Additionally and significantly, the findings have provided a definite contribution to resolve the deficiency identified by Wouters *et al* (2009) and Vandercruysse *et al* (2012) who concluded that the outcomes of game-based learning studies were ambivalent. The outcomes of this research are unequivocal and provide clear evidence of the efficacy of game-based learning within the context of the learning model. The research has shown that game-based learning is an important constituent in the model, as such, it clearly contributes to the effectiveness and success of the model, but the extent of this contribution is difficult to evaluate. Quantifying the contribution of individual constituents has not been undertaken as part of this research, however logic suggests game-based learning does make a significant contribution in its own right, but more so in combination with other learning constituents. This research contributes meaningful empirical findings that demonstrate the relationship between game-based learning and performance, of which there is only a limited amount of empirical evidence, a deficiency that appears to persist (Wlodkowski 2003 and McClarty *et al* 2012).

8.2.5 Use of competition

Previous studies identified by Ebner and Holzinger (2007), Burguillo (2010), Charles *et al* (2011) and Liu *et al* (2011), identified competition as a contributory constituent to improved learning using non-traditional learning techniques, which the results of this research support. Whilst the element of competition was deliberately not set high in the model, it was evident during the application sessions as illustrated in Section 6.4 that participants were competitive and that this facet played a part in the enjoyment experienced; which in turn supported the engagement of participants and contributed to the success of the model. However, several theorists recommend caution in the use of competition. Jeffries (2005) asserts that competition can lead to anxiety and stress, and therefore adversely affect learning outcomes. Deterding *et al* (2011) highlight issues in the case of gamification and state that unintended behaviours can result, for example, participants can focus on the desire to win rather than learning content. To counter potential disbenefits of competition Burguillo (2010) proposes the concept of cooperative competition. In this approach learning results from competing rather than the final score achieved and thus avoids unintended behaviours. Kiili (2005) introduces a similar concept within the design of game based approaches. Kiili advocates the use of competition but suggests games must be balanced so that they are fair and support the progress of not so good players. The findings of this research add to these research findings and confirm that competition is an important element in learning. No evidence was observed of anxiety or stress leading to adverse results and it was found participants favoured the competitive element, which was confirmed by the participants in the feedback questionnaires completed at the end of each application session. The results showed 22 out of 44 feedback questionnaires completed included favourable comments regarding the competitive element and points system; no unfavourable comments were made.

8.2.6 Support and learner settings

Application of the non-traditional learning techniques deliberately incorporated a strong element of support for the participants in the form of directions, feedback and hints within the learner settings. This also included support between participants as the learning was undertaken in pairs. The findings endorse the necessity for inclusion of learner support, which was identified to be a central part of the design of game-based learning by Knotts and Keys (1997), Garris *et al* (2002); O'Neil *et al* (2005) and Alfierii *et al* (2011) amongst others. The findings from this research suggest that this principle is equally applicable to higher-order learning and as such, is an important contributor to the success of the model. In particular, the provision of interpretive support, identified by Reid *et al* (2003) supported the participants in critical analysis and synthesis of solutions, which are characteristic of higher-order learning. The correctness of the learning demonstrated by participants through the assessment process confirms the conclusions of Mayer (1998) and De Jong (2006), which showed that support is necessary in simulations to prevent learners from overlooking essential information, performing learning processes incorrectly, or experiencing cognitive overload. The results also extend these conclusions to higher-order learning.

Previous studies suggest delivery of support is affected by size of learner settings. Edelheim and Ueda (2007) advocate groups of 30 participants in their case study to demonstrate the effective use of simulation-based approaches for hospitality management education. Conversely, Apel (2011) suggests simulation-based approaches require a fairly low teacher to student ratio and advocates no more than 16 students per simulation when applied to the education of law practitioners. The point that Apel makes is that the number of participants must be determined by that which can be effectively supported and managed. The need for learner support is also highlighted by McKeon (1995), Rose and Nicholl (1997), Meier (2000) and Simon and Price (2010). Their work suggests that non-traditional learning approaches need to be truly facilitated therefore this is the determining factor for participant group size. However, Meier (2000) offers caution and suggests avoiding domination by the trainer. The point he makes is that over domination by the trainer can result in learner settings becoming more akin to traditional learning approaches such as lectures and presentations. To safeguard against this Meier offers his 30/70 rule which suggests the trainer should not lead more than 30% of a session to ensure participants derive the full benefits from non-traditional techniques. For this research the size of application session was initially tested in a pilot conducted in October 2014 with 20 participants and one facilitator. It was found that this number of participants resulted in the session being difficult to properly manage and maintain flow. This was confirmed by participant questionnaires completed at the end of the pilot session, these showed adverse comments from 7 participants. Examples of comments included “wrong information sheet given out for activity”, “too much time on explanation” and “bit stop/start in some instances”. As a result of this feedback the main application sessions were set at 10 participants and one facilitator. This was found to provide a successful participant to facilitator ratio with the correct level of support. No adverse feedback was recorded from the five main application sessions which followed the pilot.

8.2.7 Engagement and scoring

The theory promulgated by Russell (1999), Pivec and Dziabenko (2004), Jeffries (2005), Anderson and Lawton (2009), Apel (2011) and others suggests participant engagement is critical to the application on non-traditional learning techniques. There is a logical link to the general learning theory of Knowles (1990) who asserts that learning methods must recognise the essential characteristics of effective adult learners in wanting to learn and being engaged. The theorists suggest non-traditional learning techniques address learner engagement by bringing together a combination of motivating elements, for example fun and enjoyment.

The scoring system included in application of the learning model contributed to the engagement of participants directly, but also indirectly, as it contributed to competition and enjoyment. Whilst the scoring system was deliberately low key and limited to gaining and losing points, participants clearly engaged with it, which leads to the conclusion that although minimal it did contribute to the application of the model and explains in part why the model was successful. The scoring supported the participants' need to achieve a certain goal during and through the learning, it provided an on-going measure of progress (and by default success). It was observed during the experiment to be a definite motivator of the participants, especially as they are generally from a computer game playing generation. The findings were confirmed by participant questionnaires completed at the end of each application session. The results showed 140 out of 220 comments received were of a positive nature, with comments such as "I thoroughly enjoyed the session", "Format kept me interested and motivated on a difficult topic" and "Enjoyable game based feel to the session". It is recognised that this feedback may not represent an absolute measure but the results serve as an indicator of the engagement and enhanced learner motivation emanating from the non-traditional techniques incorporated into the application sessions.

8.2.8 Synergy of techniques

There is a further key factor to consider, that of synergy of the non-traditional learning techniques combined in the learning model. It is a conclusion of this research that synergy occurs from the interaction of all the individual constituents of the model, each facilitating the operation and enhancing the effect of other(s). Synergy exists, because of the interaction and dependence shown to occur between certain constituents and their contributions. It is contended that this synergy is not inconsiderable. Whether the synergy of the constituent parts is the main cause of the model's success is at this time uncertain, but there is clear evidence that as a whole, the model outperforms the sum of its individual parts as illustrated by comparison with the results of previous research into individual applications. The synergistic effect of the model is evident, the results indicate that the integrated operation of the constituent parts is an important reason why the combined non-traditional learning methodology applied in this research has been successful.

8.2.9 Impact of gender on higher-order learning

A further finding relates to the learning style preferences of male and female learners and the impact of this on higher-order learning within the model. Wehrwein *et al* (2006) and Lau and Yuen (2010) have demonstrated empirically that learning styles are sensitive to gender, with males and females having different learning style preferences. This was confirmed by

Choudhary *et al* (2011) who concluded that there is a significant difference in learning style preferences, for example their study showed 92% of males had a multimodal learning preference compared to 76% of females. The effectiveness of the learning model in relation to gender was tested within the research by examining the improvement in mean scores between male and female participants within both experimental and control groups. The findings showed there is a difference in the mean improvement results between male and female participants with the score of male participants showing an average of +32.33% compared with female participants of +35.34%, thus supporting the assertion of Wehrwein *et al* (2006) and others described above. However, the findings are in contrast to the work of Choudhary *et al* who showed that it is males that have the higher preference for multimodal learning styles. The findings of this research challenge this assertion and suggest that it is female participants that have a higher preference for multimodal learning.

8.2.10 Critical considerations of the learning model

Several theorists including McKeon (1995), Rose and Nicholl (1997), Edelheim and Ueda (2007), Apel (2011) and Pho and Dinscoe (2015) highlight the extent of trainer time required in the preparation and delivery of non-traditional learning techniques as applied in the model. These theorists contrast the greater preparation and delivery time required in non-traditional learning approaches when compared to traditional teaching and delivery methods. This presents a challenge to the wider implementation of the learning model within structured graduate development programmes. The findings show that the predominant teaching and delivery methods used within existing structured training programmes are lectures and other traditional approaches. No evidence was found to indicate the use of prepared sessions utilising non-traditional learning techniques. Thus, the implication is that additional preparation and delivery time would be required to successfully implement the non-traditional learning model. This may present a barrier to wider implementation and this point is noted in the recommendations made in the thesis.

The results also suggest non-traditional learning techniques are less effective for codified subject/technical knowledge such as awareness of legislation, regulations and procedures. This is evidenced by an analysis of the experimental and control group mean scores categorised by learning outcomes and objectives. The results show the mean scores of the experimental group improved by an average of 41.24% for higher-order learning outcomes/objectives compared with mean improvement scores average of 20% for learning outcomes and objectives related to subject/technical knowledge. This finding supports the current theory of Anderson and Lawton (2009) who argue that the non-traditional learning technique of simulations is less effective for teaching terminology, facts, basic concepts and principles. However, it was found that provision of written information providing context, background, standards and procedural information is an essential element of the learning model and supports the theory of Meier (2000) and Fleming and Baume (2006) which specifically identifies the need for contextual information within non-traditional approaches. This was confirmed by participant questionnaires completed at the end of each application session. The results showed participants favoured written information with comments such as “the information sheets worked well” and “the handout sheets provided good depth to the topics”. Thus confirming the provision of written contextual information is an essential component in implementation of the learning model.

8.2.11 Section conclusion

The unique design of the synergistic learning model developed for this research has been shown to achieve its aim of enhancing and accelerating the acquisition of higher-order competencies. It has done so through identifying best practice revealed in a number of theories and extending them to address the particular characteristics and demands of higher-order learning. The foregoing has shown that existing theories relate to lower/middle-order skills and singular applications in higher-order settings. This research has added to the existing theories by extending their findings and combining them to provide a viable learning model capable of developing higher-order professional competencies.

8.3 Generalisability of the results and findings

8.3.1 Introduction

The second section of this chapter discusses the generalisability of the results and findings, and makes the case for transferability to the wider population of new entrants within the built environment industry and other sectors. The case is based upon the similarity of professional competency requirements for new entrants and therefore the logical applicability of the learning model developed in this research.

8.3.2 Transferability

The focus of this research used student members of the Royal Institution of Chartered Surveyors (RICS) aspiring to become Chartered Quantity Surveyors and following the construction and quantity surveying pathway of the Assessment of Professional Competence (APC). The RICS also provides pathways covering fifteen further chartered surveyor specialisations, including building surveying, land surveying, project management and valuation. Each specialisation has student entry criteria and competency assessment requirements consistent with the construction and quantity surveying pathway. As a result the contention of this thesis is that the learning model can be reasonably transferred to all student members of the RICS.

It is also argued that the findings may be generalised to a wider population of new entrants within the built environment industry and this section sets out the case for transferability. The approach that has been adopted is to review commonality with other professional organisations under three headings:

(i) Provision of a student membership level for new entrants

(ii) Requirement to demonstrate competency to achieve full membership in competencies that include higher-order knowledge and thinking

(iii) Recognition of the application of ethical principles and standards within competency requirements as specifically tested in the controlled experiment within this research.

The five professional organisations examined are:

- Institution of Civil Engineers (ICE)
- Institution of Mechanical Engineers (IMechE)
- Institution of Engineering and Technology (IET), formerly Institution of Electrical Engineers
- Chartered Institute of Building (CIOB)
- Association for Project Management (APM)

As previously identified in Chapter One, all the above organisations have a student level of membership for new entrants together with professional competency development programmes necessary to achieve full professional membership. Therefore commonality is confirmed with the RICS new entrant structure considered within this research.

The sections below review the detailed competency requirements for each organisation and the extent to which they require higher-order competencies and the application of ethical standards/principles.

8.3.3 Engineering professional bodies

The three main engineering professional bodies (ICE, IMechE and IET) all define a set of competencies which individuals must demonstrate to progress to professional qualification. Although the wording and format varies to some extent between the three bodies, all follow the UK standard for professional engineering competence published by the Engineering Council (2008). Table 8.1 summarises the five competency groups within this standard, identifies those which include higher-order competencies with green ticks in column (3) and highlights particular requirements for the application of ethical principles with green ticks in column (4).

Table 8.1 – Analysis of competencies for engineering professional bodies

Institution of Civil Engineers – Chartered Engineer Development Objectives Institution of Mechanical Engineers – Chartered Engineer Competence Statements Institution of Engineering and Technology – Chartered Engineer Competence and Commitment Standard			
(1) Ref	**(2) Competencies**	**(3) Higher-order**	**(4) Ethics application**
A	Use a combination of general and specialist engineering knowledge and understanding to optimise the application of existing and emerging technology		
B	Apply appropriate theoretical and practical methods to the analysis and solution of engineering problems		
C	Provide technical and commercial management		
D	Demonstrate effective interpersonal skills	✓	
E	Demonstrate a personal commitment to professional standards, recognising obligations to society, the profession and the environment		✓

Competency Groups A to C predominantly relate to subject and technical knowledge. This includes application of engineering principles, standards and procedures and includes occasional reference to examples of higher-order thinking such as problem solving. Competency Group D includes specific references to items that would be categorised as higher-order thinking. The requirement for the application of ethical behaviours is noted in Competency Group E and developed in further detail by all three bodies. For example, the Institution of Mechanical Engineers (2016, p.20) specifically refers to the application of ethical principles in sub-competency E5.

8.3.4 Chartered Institute of Building

The Chartered Institute of Building operates a Professional Development Programme (PDP) for graduates and degree students who wish to progress to Chartered membership via a structured and assessed route (CIOB, 2016). The programme develops and assesses competencies across three areas following the institute's requirements for professional review. The three areas cover occupational competencies, management competencies and commitment to professionalism. Table 8.2 summarises the areas and identifies those which include higher-order competencies with green ticks in column (3) and particular requirements for the application of ethical principles with green ticks in column (4).

Table 8.2 – Analysis of competencies: Chartered Institute of Building

Chartered Institute of Building – Competency Areas			
(1) Ref	**(2) Competencies**	**(3) Higher-order**	**(4) Ethics application**
1	**Occupational Competence**		
1.1	Planning and Organising work		
1.2	Managing Health, Safety and Welfare		
1.3	Managing Quality		
1.4	Implementing Sustainable Construction and Development		
1.5	Commercial, Contractual and Legal Issues		
2	**Management Competence**		
2.1	Communication		
2.2	Decision Making	✓	
2.3	Managing Information		
2.4	Leadership and Strategic/Financial Management	✓	
2.5	Developing People or Teams	✓	
2.6	Innovation		
3	**Commitment to Professionalism**		
3.1	Professional Judgement and Responsibility	✓	
3.2	Commitment to Code of Ethics		✓
3.3	Continuing Professional Development		

Competency Area 1 predominantly relates to subject and technical knowledge. Several of the competencies within Competency Areas 2 and 3 have specific references to items that would be categorised as higher-order thinking including problem solving and decision-making. The requirement for application of ethics is covered in Competency 3.2. For example, the competency description addresses application of ethical principles within a professional framework and notes that ethics goes beyond adherence to rules/standards.

8.3.5 Association for Project Management

The Association for Project Management (APM) provides a Competence Framework listing twenty-seven competencies (APM, 2015). Table 8.3 summarises the competencies listed and identifies those which include higher-order requirements in column (3) and the application of ethical principles in column (4).

Table 8.3 – Analysis of competencies: Association for Project Management

Association for Project Management – Competency Areas			
(1) Ref	**(2) Competencies**	**(3) Higher-order**	**(4) Ethics application**
1	Ethics, compliance and professionalism		✓
2	Team management		
3	Conflict management		
4	Leadership	✓	
5	Procurement		
6	Contract management		
7	Requirements management		
8	Solutions development		
9	Schedule management		
10	Resource management		
11	Budgeting and cost control		
12	Risk, opportunity and issue management		
13	Quality management		
14	Consolidated planning		
15	Transition management		
16	Financial management		
17	Resource capacity planning	✓	
18	Governance arrangements		
19	Stakeholder and communications management		
20	Frameworks and methodologies		
21	Reviews		
22	Change control		
23	Independent assurance		
24	Business case	✓	
25	Asset allocation		
26	Capability development	✓	
27	Benefits management		

The APM framework includes a detailed list of subject and technical competencies addressing the core time, cost and quality dimensions of successful project management. Many of the competencies listed have references to items that would be categorised as higher-order thinking. A requirement for application of ethics is covered comprehensively in competence 1 with the definition specifically separating knowledge and application. For example, knowledge is described as understanding relevant national and international legal and social standards, application is seen as determining the boundaries of the standards and acting within the limits of these boundaries.

In conclusion, the analysis above clearly shows the requirement for higher-order competencies and the application of ethical standards/principles within the five professional organisations and thus establishes the case for transferability of the learning model developed in this research.

8.3.6 Case for wider generalisation

The outline case for wider generalisation of the findings to new entrant professionals in other sectors is based upon identifying requirements for higher-order thinking and the ethical principles within professional development generally (Eraut, 1994, Cheetham and Chivers 2005, Wimmers and Mentkowski 2016). Eraut's work is widely acknowledged to be appropriate to a broad range of professionals and makes clear reference to a requirement for knowledge and behaviour that would be classified as requiring higher-order thinking. For example, his category of educational practice specifically notes decision-making and judgement (1994, p.79). Eraut also acknowledges ethical issues in competence and confirms that 'professionals have to be competent in recognising and applying (ethical) values' (p.206). Cheetham and Chivers (2005) provide a definition of professional competence based on their earlier research covering the sectors of Theology, Law, Medicine, Training, Personnel Management and Information Technology. Their model for professional competency (2005, pp.80-82) comprises five components which include meta-competence and professional ethics. The component of meta-competence can be directly correlated to higher-order thinking, for example in creativity, mental agility and problem-solving. In Cheetham and Chivers' model the component of professional ethics relate specifically to defining ethical dimensions within occupational and vocational standards but recognises the need for ethical judgement and interpretation of standards. Wimmers and Mentkowski (2016) consider the challenges of cross-professional competency definition, comparison and assessment. They acknowledge the differences in subject knowledge but assert that there are cross-discipline competency requirements, such as critical thinking, reasoning and problem solving which apply to all professions and therefore affirm the requirement for higher-order thinking. These theorists all acknowledge the requirement for higher-order competencies and ethical behaviours within the wider definition of professional competency. As a result it is logical to infer the learning model developed in this research would be applicable to the development of new entrants in other professional sectors.

8.4 Chapter conclusion

This chapter has discussed the findings from the research and the case for transferability to the wider population of new entrants within the built environment industry and other sectors. Overall the empirical findings have shown the effectiveness of applying non-traditional learning techniques to higher-order professional competencies through the new learning model developed in this research.

Chapter Nine concludes the discussion developed in this chapter, by reaffirming the purpose of the study and the main conclusions that can be drawn. It also confirms the contribution to knowledge of this research and summarises the recommendations for further research which have arisen throughout the study.

Chapter Nine – Conclusions and recommendations

9.1 Aim of the research

The focus of this research centred on the acquisition of higher-order professional competencies by graduate quantity surveyors who have recently entered the built environment industry. The introduction established three broad imperatives; firstly graduate new entrants who aspire to become professionally qualified must acquire a number of professional competencies over and above subject and technical knowledge. Secondly these professional competencies involve critical thinking and subjective decision-making, and therefore require higher-order abilities to accomplish. Thirdly, the acquisition of these professional competencies is not always efficient or fully effective which is detrimental to both employers and graduate surveyors. These imperatives led to the main challenge considered by the research which was how to enhance the efficacy of higher-order competency development and accelerate acquisition within a new entrant development framework. Addressing this problem resulted in the development of new learning theory for the application of non-traditional learning techniques through a unique synergistic learning model.

9.2 Answers to the main research question, hypothesis and sub-objectives

The main research question which addressed the primary problem described above was:

Can the acquisition of higher-order professional competencies be enhanced and/or accelerated?

The research has clearly shown that the acquisition of higher-order professional competencies can be enhanced and accelerated by the use of non-traditional learning techniques formed into the new synergistic learning model.

As part of the process for answering the research question a hypothesis was tested within a controlled experiment conducted in Stage 5 of the research:

"The acquisition of higher-order professional competencies by new entrant graduate quantity surveyors can be enhanced and/or accelerated by a new learning model using non-traditional learning techniques"

The controlled experiment was conducted by testing the synergistic learning model in workshop style application sessions addressing the highest ranked deficient higher-order competency determined to be the application of ethics. The findings from the controlled experiment are presented in Chapter Seven. The findings demonstrate that non-traditional learning techniques applied in a workshop style application setting, using the synergistic learning model developed by this research, result in significant positive improvement in higher-order competency acquisition and thus supports the hypothesis.

Statistical analysis of the results show that the findings can be reliably inferred to the wider population of graduate trainees registered for the APC Quantity Surveying and Construction Pathway. It is further argued in the section 8.3 that the results can reasonably be generalised to professional graduates within the built environment industry and other sectors.

Addressing the research question and hypothesis led to the following sub-objectives:

- Identify the most problematic professional competencies for new entrant graduate quantity surveyors
- Develop a conceptual learning model to apply non-traditional learning techniques within the structured experiential learning process undertaken by new entrant surveyors

The first sub-objective has been answered by examining two aspects, firstly which competencies do graduate trainees find most difficult to achieve, and secondly the competencies considered to be most significant to the employing firms from a business perspective. These aspects have been combined through a process of cross-tabulation analysis. The findings showed the two most problematic professional competencies to be:

1. Application of ethics
2. Leadership and confidence

The research used the highest ordered problematic competency to test the learning model.

The second sub-objective relates to identification of a suitable format for the application of non-traditional learning techniques to competency acquisition within a structured graduate training programme. This question was answered by seeking the views of graduate training managers within the interviews undertaken for the first sub-objective. The results show the preferred approach to be through workshop-style application sessions of approximately a half-day (four hours) duration. The primary reasons given by interviewees supporting this application approach were that the method would fit within existing training programmes and the duration provides flexibility in terms of implementation strategy. A session of four hour duration is suitable for delivery in a morning, afternoon or late afternoon/evening form. This application approach was applied to testing the learning model.

9.3 Recommendations and further study

Several questions have arisen during this research, both directly and indirectly, as a result a number of recommendations and opportunities for further study are made:

(i) The literature review and controlled experiment carried out during the research raised the issue of the extent and form of support provided to participants involved in non-traditional learning for higher-order professional competencies. At present, it cannot be determined whether it is worthwhile to develop an advanced support and advice system for complex simulation games, such as those addressing higher-order professional competencies. This is an aspect of the model that would benefit from further research to help participants to focus on relevant elements and prevent them from missing essential information. A point previously made by Leemkuil and de Jong (2012) in relation to lower-order game simulations, but still not addressed.

(ii) The literature review raised the issue of the preparation and delivery time required for non-traditional learning approaches when compared to traditional teaching and delivery methods. This presents a challenge to the wider implementation of the learning model within structured graduate development programmes. The findings show that the predominant teaching and delivery methods used within the existing structured training programmes are lectures and other traditional approaches. No evidence was found to indicate the use of prepared sessions utilising non-traditional learning techniques. Thus, the implication is that additional preparation and delivery time would be required to successfully implement the non-traditional learning model. This may present a barrier to wider implementation and it is recommended that options are explored to overcome this barrier.

(iii) The pertinent stakeholders for deployment of the learning model within structured graduate training fall into two groups. Firstly, for larger firms who have dedicated graduate training managers it is recommended that the model is adopted within training programmes, notwithstanding the time barrier referred to in (ii) above. Secondly, for SMEs the professional bodies are key stakeholders in supporting deployment of the model. For the RICS APC it is recommended APC supervisors and councillors consider a deployment vehicle for the model, possibly through RICS approved APC training providers.

(iv) Finally, Neville and Shelton (2010, p.62) acknowledge that digital game-based learning is a rapidly emerging area and suggest the learning aspects of three-dimensional games and immersive environments are the next avenue for further development. This is supported by Brady *et al* (2016), who advocate fully immersive environments as the future direction for learning in higher education. The application workbook developed in this research adopted a game-based format and is therefore ideally suited for further development onto a digital platform. Thus, it is recommended that this is a direction for further research.

9.4 Contribution to knowledge

This doctoral research has made a clear contribution to new knowledge:

(i) The research has discovered that professional competencies involving higher-order thinking can be learned faster and more effectively. It has extended the body of knowledge in this area and provided strong empirical evidence to support the findings

(ii) The research has produced a new synergistic learning model, comprising a unique combination of theories and applicational constituents that can overcome the problems encountered in the acquisition of higher-order professional competencies. The success of this model is supported by significant data and has been firmly proven.

9.5 Final conclusion

This research has addressed the problem of acquiring higher-order professional competencies by graduate quantity surveyors entering the built environment industry. In doing so it has made significant contributions to new knowledge on two levels:

Development and extension of wider **learning theory** through the identification of **synergy** as an important factor in applying non-traditional learning approaches in a combined pedagogy

And

Production of an **application framework** applicable at an implementation level for new entrant graduates.

This contribution provides a significant foundation to support the ongoing development of professionals entering the built environment industry and other sectors.

References

Adam, S. 2004. *Using Learning Outcomes: A consideration of the nature, role, application and implication for European education of employing learning outcomes at local, national and international level.* United Kingdom Bologna Seminar. Brussels: European University Association.

Alfieri, L., Brooks, P.J., Aldrich, N.J. and Tenenbaum, H.R. 2011. *Does discover-based instruction enhance learning?* Journal of Educational Psychology, Vol. 103, pp.1-18.

Alliger, G.M. and Janak, E.A. 1989. *Kirkpatrick's Levels of Training Criteria: Thirty Years Later.* Personal Psychology, Vol. 42, Issue 2, pp.331-342.

Anderson, P.H. and Lawton, L. 2009. *Business Simulations and Cognitive Learning. Simulations & Gaming,* Volume 40, Number 2, April 2009, pp.193-216.

Apel, S.B. 2011. *No more casebooks: Using simulation-based learning to educate future family law practitioners.* Family Court Review, Vol. 49, No. 4, October 2011, pp.700-710.

Association for Project Management (APM). 2014. *Introduction to Gamification*. Emerging Trends Guidance. Princes Risborough: APM.

Association for Project Management (APM). 2015. *APM Competence Framework.* Princes Risborough: APM.

Ashworth, P.D. and Morrison, P., 1991. *Problems of competence-based nurse education*. Nurse Education Today 11, pp.256-260.

Bainbridge, W. 2007. *The scientific research potential of virtual worlds.* Science Magazine, Vol. 317, 27 July 2007, pp.471-476.

Bancroft, W.J. 1985. *Accelerated learning techniques for the foreign language classroom.* Per Linguam, Vol. 1, No. 2. pp.20-24.

Barker, B. 2011. *Higher Order, Critical Thinking Skills in National Police Academy Course Development*. ProQuest LLC, Ph.D. Dissertation, Capella University.

Bedrova, E. and Leong, D.J. 2003. *The importance of being playful.* Educational Leadership, Vol. 60, No. 7, pp.50-53.

Binmore, K. 1994. *Game theory and the social contract. Volume 1: Playing Fair*. Cambridge: MIT Press.

Birch, A., Warren, C. and Westcott, T. 2005. *Course provision in Building and Quantity Surveying for Non-Cognate Graduates*. Cobra Conference 3-5 July 2005, Brisbane: RICS.

Blaxter, L., Hughes, C. and Tight, M. 2001. *How to Research*. Maidenhead: McGraw-Hill/Open University Press.

Boak, G., 1991. *Developing Managerial Competences: The Management Learning Contract Approach*. London: Pitman.

Boyatzis, R. E., 1982. *The Competent Manager: A Model for Effective Performance.* New York: Wiley.

Boyd, D. 2004. *Effective Teaching in Accelerated Learning Programs.* Adult Learning, January 2004, Vol. 15, pp.40-43, Maryland, USA: American Association for Adult & Continuing Education.

Brady, M., Devitt, A., Furnell, S., Strevens, C. and Gomez, S. 2016. *Simulations, Serious Games and Immersive Environments in Higher Education*. Proceedings from conference held 15th April 2016. London: Pearson.

Briggs, A. and Giffin, G. 2013. *Playing the Game.* In Project July 2013, p.23. High Wycombe: APM.

British Standards Institute. 2009. *BS EN 12504-1 Testing Concrete in Structures*, London: BSI.

Brown, S. and Knight, P. 1994. *Assessing Learners in Higher Education.* Teaching and Learning in Higher Education Series. London: Routledge Falmer.

Bryman, A. and Cramer, D. 2011*. Quantitative Data Analysis: A Guide for Social Scientists.* London: Routledge Falmer.

Burguillo, J.C. 2010. *Using game theory and Competition-based Learning to stimulate student motivation and performance*. Computers & Education, Vol.55 (2010), pp.566-575.

Charles, D., Charles, T., McNeill, M., Bustard, D. and Black, M. 2011. *Game-based feedback for educational multi-user virtual environments.* British Journal of Educational Technology, Vol. 42, No. 4, pp.838-654.

Cheetham, G. and Chivers, G., 1996. *Towards a Holistic Model of Professional Competence*. Journal of European Industrial Training, Vol. 20, No. 5.

Cheetham, G. and Chivers, G., 1998. *The reflective (and competent) practitioner*. Journal of European Industrial Training, Vol. 22, No.7.

Cheetham, G., 1999*. The Acquisition of Professional Competence*. PhD Thesis, University of Sheffield.

Choudhary, R., Dullo, P. and Tandon, R.V. 2011. *Gender differences in learning style preferences of first year medical students.* Available at: http://www.pps.org.pk/PJP/7-2/Raghyveer.pdf [Accessed 30 June 2015].

CIOB. 2016. *Professional Review Guidance for Candidates.* Bracknell: The Chartered Institute of Building.

Clare, J. 2013. *Advice to Assessment of Professional Competence Candidates*. In Modus 05.13, p.9. London: RICS.

Clapper, T.C. 2010. *Beyond Knowles: What Those Conducting Simulation Need to Know About Adult Learning Theory.* Clinical Simulation in Nursing, Vol. 6, Issue 1, pp.7-14.

Cochran, W.G. 1997. *Sampling Techniques.* New York: John Wiley & Sons.

Coffield, F., Moseley, D., Hall, E. and Ecclestone, K. 2004. *Learning styles and a pedagogy in post 16 learning: A systematic and critical review.* London: Learning and Skills Research centre.

Collis, J. and Hussey, R. 2009. *Business Research: A Practical Guide for Undergraduate & Postgraduate Student.* Basingstoke: Palgrave Macmillan.

Colliver, J. A. 2000. *Effectiveness of Problem-based Learning Curricula: Research and Theory.* Academic Medicine, Vol. 75, No. 3, pp.259-266.

Cowan, J., 2006. *On Becoming an Innovative University Teacher: Reflection in Action.* Maidenhead: Open University Press.

Creative Research Systems. 2012. *The Survey System – Sample Size Calculator.* Available at: http://www.surveysystem.com/sscalc.htm. [Accessed 24 September 2012].

Cresswell, J. 2009. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. London: Sage Publications.

Crowl, T.K., Kaminsky, S. and Podell, D.M. 1997. *Educational psychology: Windows on teaching.* New York: Brown and Benchmark

Cuban, L. 1984. *Policy and Research Dilemmas in the Teaching of Reasoning: Unplanned Designs.* Review of educational Research, Vol. 54, No. 4, pp.655-681.

De Jong, T. 2006. *Computer simulations – Technological advances in inquiry learning.* Science, Vol. 312, pp.532-533.

De Jong, T. 2010. *Cognitive load theory, educations research and instructional design: Some food for thought.* Instructional Science, Vol. 38, pp.105-134.

Delisle, R. 1997. *How to Use Problem-Based Learning in the Classroom.* Alexandria Va: Association for Supervision and Curriculum Development. Cited in Weiss, L. 2003.

Deterding, S., Dixon, D., Khaled, R. and Nacke, L. 2011. *From game design elements to gamefulness: Defining Gamification.* Proceedings of the 15th International Academic MindTrek Conference, pp.9-15.

De Weerdt, S., Hovelynck, J. and Dewulf, A. 2009. In *Using Simulations for Education, Training and Research*. Lengerich: Pabst Science Publications.

Dieckmann, P. 2009. *Using Simulations for Education. Training and Research*. Lengerich: Pabst Science Publications.

Dowie, I. and Phillips, C. 2011. *Supporting the lecturer to deliver high-fidelity simulation.* Nursing Standard August 10, 2011. Vol. 25, p.35(6).

Dreyfus, H. and Dreyfus, S., 1986. *Mind over Machine: the power of human intuition and expertise in the era of the computer.* Oxford: Blackwell.

Drummond-Young, M. and Mohide, E. A. 2001. *Developing Problems for Use in Problem-Based Learning.* In E. Rideout (ed.), *Transforming Nursing Education Through Problem-Based Learning.* pp.165-191. Boston: Jones & Bartlett. Cited in Weiss, L. 2003.

Duch, B. J. 2001. *Writing Problems for Deeper Understanding.* In B. J. Duch, S. E. Groh and D. E. Allen (eds.), *The Power of Problem-Based Learning: A Practical "How to" for Teaching Undergraduate Courses in Any Discipline.* pp.47-58. Sterling: Stylus. Cited in Weiss, L. 2003.

Ebner, M. and Holzinger, A. 2007. *Successful implementation of user-centred game based learning in higher education: An example from civil engineering.* Computers & Education, Vol. 47 (2007), pp.873-890.

Edelheim, J. and Ueda, D. 2007. *Effective Use of Simulations in Hospitality Education – A Case Study.* Journal of Hospitality, Leisure, Sport & tourism Education, Vol. 6. No. 1, pp.18-28.

Emilsson, U.M. and Lilje, B. 2008. *Training social competence in engineering education: necessary, possible or not even desirable? An explorative study from a surveying education programme.* European Journal for Engineering Education, Vol. 33, No. 3, June 2008, pp.259-269.

Engineering Council. 2008. *United Kingdom Standard for Professional Engineering Competence.* London: Engineering Council.

Eraut. M., 1994. *Developing Professional Knowledge & Competence*. Abingdon, Oxfordshire: Routledge Falmer.

Facione, P. 1990. *American Philosophical Association Delphi Research Report: Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction.* The California Academic Press, 217 La Cruz Ave., Millbrae, CA 94030, also available in ERIC as Doc. No. ED 315 423.

Fawcett, S.L. and Lockwood, A. 2000. *Improving the learning environment for the development of hospitality accountancy skills using computer simulation gaming.* Tourism and Hospitality Research, Vol.2, No. 3, pp.262-272.

Felder, R.M. and Silverman, L.S. 1988. *Learning and Teaching Styles in Engineering Education.* Engineering Education, Vol.78 (7), pp.674-681. Author's Preface – June 2002.

Fellows, R. and Liu, A. 2008. *Research Methods for Construction, 3rd Edition.* Chichester: Wiley-Blackwell.

Fitzpatrick, B., Hawboldt, J., Doyle, D. and Genge, T. 2015. *Alignment of learning objectives and assessments in therapeutics courses to foster higher-order thinking*. American Journal of Pharmaceutical Education, Vol. 79(1).

Fleming, N. and Baume, D. 2006. *Learning Styles Again: VARKing up the right tree!* Educational Developments, Issue 7.4, pp.4-7. London: SEDA.

Fletcher, G.C.L., McGeorge, P., Flin, R.H., Glavin, R.J. and Maran, N.J. 2002. *The role of non-technical skills in anaesthesia: a review of current literature.* British Journal of Anaesthesia, Vol. 88 (3), pp.418-429.

Forster, M. 2004. *Thinking Skills.* Research Developments, Vol. 11, Art. 1, pp.2-6. Available at: http://research.acer.edu.au/resdev/vol11/iss11/1. [Accessed 30 June 2015].

Ganiron, T. U. 2013. *Application of Accelerated Learning in Teaching Environmental Control System in Qassim University*. Vol. 2, No. 2, pp. 27-38, International Journal of Education and Learning, Tasmania:SERSC.

Gardner, H. 1983. *Frames of mind: The theory of multiple intelligences.* New York: Basic Books.

Garratt. T., 2013. *The most efficient pathway into surveying*. Modus, October 2013, P.9, London: RICS.

Garris, G., Ahlers, R. and Driskell, J.E. 2002. *Games, motivation and learning: A research and practice model.* Simulation & Gaming, Vol. 33, No. 4, December 2002, pp.441-467.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M.,1994., *The New Production of Knowledge: the dynamics of science and research in contemporary societies*, London: Sage.

Gijselaers, W. H. 1996. *Connecting Problem-Based Practices with Educational Theory.* In L. Wilkerson and W.H. Gijselaers (eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practic*e. New Directions for Teaching and Learning, no. 68. Pp.13-21. San Francisco: Jossey-Bass. Cited in Weiss, L. 2003.

Ginsburg, K.R. 2007. *The Importance of Play in Promoting Healthy Child Development and Maintaining Strong Parent-Child Bonds.* Paediatrics, Vol.119, Issue 1. American Academy of Paediatrics.

Goddard, L. and Jordan, L. 1998. *Changing attitudes about persons with disabilities: effects of a simulation.* Journal of Neuroscience Nursing, 30, 5, pp.307-313.

Gonczi, A., 1999. *A dubious past-An assured future?* Understanding learning at work, London: Routledge.

Greenbaum,J. 1999. *Shifting to Accelerated Learning.* HR Focus (Special Report on Training & Development) Supplement February 1999, Accra: L'aine Services Ltd.

Greene, C.G. 2008. *Is Mixed Methods Social Inquiry a Distinctive Methodology?* Journal of Mixed Methods Research, Vol.2 No.1, pp.7-22.

Greenfield, S. 1997. *The Human Brain: A Guided Tour.* London: Weidenfeld and Nicolson.

Helman, S. and Horswill, M.S. 2002. *Does the introduction of non-traditional teaching techniques improve psychology undergraduates' performance in statistics?* Psychology Learning & Teaching, March 2002, Vol. 2, No.1, pp12-16.

Henry, J. 2007. *Professor pans 'learning style' teaching method*. Available at http://www.telegraph.co.uk. [Accessed 29 August 2010].

Hodkinson, P., 1992. *Alternative models of competence in vocational education and training.* Journal of Further and Higher education, Vol. 16, pp.30-39.

Honey, P. and Mumford, A. 1986. *Using your Learning Styles.* Maidenhead: Peter Honey.

Hughes, M. 1991. *Closing the Learning Gap.* Stafford: Network Educational Press.

Imel, S. 2002. *Accelerated learning in Adult Education and Training and Development.* ERIC, Clearing House on Adult, Career and Vocational Education, Trends and Issues Alert No 33, pp.653-656.

Institution of Mechanical Engineers. 2016. *Chartered & Incorporated Engineers Application Guidance*. Commitment to Professional Standards. Version 13. London: IMechE.

Jaegar, M., 2012. *Communication simulation in construction management education: evaluating learning effectiveness*, Australasian Journal of Engineering Education, Volume 18, Available through: Anglia Ruskin University Library website [Accessed 6 August 2012].

Jarvis, P., 1985. *The sociology of adult and continuing education*. London: Croom Helm.

Jeffries, P.R. 2005. *A framework for designing, implementing and evaluating simulations used as teaching strategies in nursing.* Nursing Education Perspectives, March-April 2005, Vol.26. Available through: Anglia Ruskin University Library website [Accessed 10 August 2012].

Jester, C. 2000. *Introduction to the DVC learning Style Survey.* Available at: http://www.metamath.com/lsweb/dvclearn.htm. [Accessed 25 April 2015].

Jonassen, D. 2000. *Towards a Design Theory of Problem Solving.* Educational Technology Research and Development, 48(4), pp.63-85. Cited in Weiss, L. 2003.

Johnson, H.D. and Dasgupta, N. 2005. *Traditional versus Non-traditional Teaching: Perspectives of Students in Introductory Statistics Classes.* Journal of Statistics Education, Volume 13, Number 2. Available at: www.amstat.org/publications/jse/v13n2/johnson.html.[Accessed [Accessed 15 July 2015].

Johnson, R. B., Onwuegbuzie, A. J. and Turner, L.A., 2007. *Towards a Definition of Mixed methods Research*. Journal of Mixed Methods Research, Vol. 1 No. 2, pp.112-133.

Johnson, E. 2009. *Extending the simulator: Good practice for instructors using medical simulators.* In P. Dieckmann (Ed.), *Using Simulations for Education, Training and Research*, pp.180-201. Lengerich: Pabst Science Publishers.

Janjua, S.Y., Naeem, M.A. and Kayani, F.N. 2012. *The competence classification framework: A classification model for employee development.* Interdisciplinary Journal of Contemporary Research in Business, Vol. 4, No. 1, pp.396-404.

Ke, F. 2009. *A qualitative meta-analysis of computer games as learning tools.* In R.E. Furding (Ed.) *Handbook of Research on Effective Electronic Gaming in*

Education. pp.1-32. New York: IGI Global.

Kennedy, D., Hyland, A. and Ryan, N., 2009. *Learning Outcomes and Competences,* Bologna Handbook, Brussels: European University Association.

Revlin, R. 2012. *Cognition: Theory and Practice*. Edition 1. New York: Worth Publishers.

Keys, B. and Wolfe, J. 1990. *The Role of Managerial Games and Simulations in Education and Research.* Journal of Management, Vol. 16, No. 2, pp.307-336.

Kiili, K. 2005. *Digital game-based learning: Towards an experiential gaming model.* Internet and Higher Education. Vol. 8 (2005), pp.13-24.

King, F.J., Goodson, L and Rohani, F. 1998. *Higher Order Thinking Skills.* Education Services Program. Florida State University: Center for Advancement of Learning and Assessment.

Kirriemuir, J. and McFarlane, A. 2004. Literature review in games and learning. Available at: http://archive.futurelab.org.uk/resources/publications-reports-articles/literature-reviews/Literature-Review378 [Accessed 22 June 2015].

Knight, P. 1995. *Assessment for Learning in Higher Education.* London: Kogan Page.

Knotts, U.S. and Keys, J.B. 1997. *Teaching strategic management with a business game*. Simulation and GAMING, Vol. 28, PP.377-394.

Knowles, M. 1990. *The Adult Learner: A Neglected Species.* Houston: Gulf Publishing Company.

Kolata, G. 1998. *Scientific Myths That Are Too Good to Die.* Week in Review 1998/12/06. New York: New York Times.

Kolb, D. A., 1984. *Experiential Learning: Experience as the Source of Learning and Development,* New Jersey: Prentice Hall.

Kolb, A.Y. and Kolb, D.A. 2005. *The Kolb Learning Style Inventory – Version 3.1 2005 Technical Specifications.* Boston: Hay Group.

Lau, W. and Yuen, A. 2010. *Promoting Conceptual Change of Learning Sorting Algorithm through the Diagnosis of Mental Models: The Effects of Gender and Learning Styles.* Computers & Education, Vol. 54, No. 1, pp.275-288.

Lee, C. and Hogg, K., 2009. *Early career training of quantity surveying professionals*, COBRA Conference September 2009, pp.267-277, London: RICS.

Leemkuil, H. and De Jong, T. 2012. *Adaptive advice in learning with a computer-based knowledge management simulation game.* Academy of Management Leaning & Education. Vol. 11(4), pp.653-665.

Le Deist, F. and Winterton, J. 2005. *What is competence?* Human Resource Development International, Vol. 8, No. 1, pp.27-40.

Le Var, R.M.H., 1996. *NVQ's in nursing, midwifery and health visiting: a question of assessment and learning*. Nurse education Today, Vol.16, pp.85-93.

Lewis, A. and Smith, D. 1993. Defining Higher Order Thinking. Theory into Practice, Vol.32(3), pp.131-137.

Lillyman, S., 1998. *Assessing Competence. Advanced and Specialist Nursing Practice.* Oxford: Blackwell Science.

Liu, C.C., Cheng, Y.B. and Huang, C.W. 2011. *The effect of simulation games on the learning of computational problem solving*. Computers and Education, Vol. 57, pp.1907-1918.

Livingstone, I. 2009. *Deathtrap Dungeon*. London: Wizard Books.

Lloyds Bank, 2015. *Building for Growth – Lloyds Bank Research Series*, London: Lloyds Bank plc.

Madhuri, G. V., Kantamreddi, V. S. S. N., Prakash Goteti, L. N. S. 2012. *Promoting Higher Order Thinking Skills Using Inquiry-Based Learning.* European Journal of Engineering Education, Vol.37(2), pp.117-123.

Manley, K. and Garbett, B. 2000. *Paying Peter and Paul: reconciling concepts of expertise with competency for a clinical career structure*. Journal of Nursing, Vol. 9.

Mayer, R. E. 1998. *Cognitive, Metacognitive, and Motivational Aspects of Problem Solving.* Instructional Science, 26, pp.49–63.

Mayo, G.E. 1949. *Hawthorne and the Western Electric Company. The Social Problems of an Industrial Civilisation.* Abingdon: Routledge.

Maxwell, J.A. 2005. *Qualitative Research Design: An Interactive Approach.* 2nd Edition. New York: SAGE Publications.

McAlleer, J. and Hamill, C., 1997. *The Assessment of Higher Order Competence Development in Nurse Education: Executive Summary*. Belfast: University of Ulster.

McCarthy, J.P. and Anderson, L. 2000. *Active Learning Techniques Versus Traditional Teaching Styles: Two Experiments from History and Political Science.* Innovative Higher Education, Volume 24, Issue 4, pp.279-294.

McClarty, K.L., Orr, A., Frey, P.M., Dolan, R.P., Vassileva, V. and McVay, A. 2012. *A Literature review of Gaming in Education: Research Report.* New Jersey: Pearson Education.

McClelland, D. C., 1973. *Testing for competence rather than intelligence.* American Psychologist, Vol. 28(1), pp.1-14.

McConville, S.A. and Lane, M.A. 2006. *Using on-line video clips to enhance self-efficacy toward dealing with difficult situations among nursing students*. Nurse Education Today, 26, 3, pp.200-208.

McKeon, K.J. 1995. What is this thing called accelerated learning? Training & Development, Vol. 49, No. 6, pp. 64-66. ProQuest Business Collection.

Meier, D. 2000. *The Accelerated Learning Handbook*. New York: McGraw-Hill.

Miles, A. and Huberman, A. 1995. *Qualitative data analysis: an expanded sourcebook.* London: Sage.

Miller, C., Hoggan, J., Pringle, S. and west, C. 1988. *Credit where Credit's due*. Report of the Accreditation of Work-based Learning Projects, Glasgow: SCOTVEC.

Moule, P., Wilford, A., Sales, R., Haycock, L., Lockyer, L. 2006. *Can the use of simulation support pre-registration nursing students in familiarising themselves with clinical skill before consolidating them in practice?* Bristol: Centre for Learning and Workforce Research, University of the West of England.

Myerson, R.B. 1991. *Game Theory: Analysis of Conflict.* Chapter 1, p.1. Harvard: Harvard University Press.

Neville, D.O. and Shelton, B.E. 2010. *Literary and Historical 3D Digital Game-Based Learning: Design Guidelines.* Simulation & Gaming, Vol. 41(4), pp.607-629.

Newman, I. and Benz, C.R. 1998. *Qualitative – Quantitative Research Methodology: Exploring the Interactive Continuum.* Illinois: SIU Press.

Oakeshott, M., 1962. *Rationalism in Politics and Other Essays*, London: Methuen.

Office for National Statistics. 2015. *Construction Statistics.* No.16, 2015 Edition. Newport: Office for National Statistics.

O'Neil, H.F., Wainess, R. and Baker, E.L. 2005. *Classification of learning* *outcomes: Evidence from the computer games literature.* Curriculum Journal, Vol. 16, pp.455-474.

Oxford Dictionaries, 2008. *Concise Oxford English Dictionary*, Eleventh Edition, Oxford: Oxford University Press.

Pardew, L. 2005. *Beginning Illustration and Storyboarding for Games.* Boston: Thomson Course Technology.

Parson, H.M. 1974. *What happened at Hawthorne? New evidence suggests the Hawthorne Effect resulted from operant reinforcement contingencies.* Science, 183 (2128), pp.922-932.

Pasin, F. and Giroux, H. 2011. *The Impact of a Simulation Game on Operations Management.* Computers & Education. Vol. 57, pp.1240-1254.

Paul, R.W. 1993. *Critical thinking: What every person needs to survive in a rapidly changing world.* Santa Rosa: Foundation for Critical Thinking.

Paul, R., Elder, L. and Bartell, T. 1997. California teacher preparation for instruction on critical thinking: Research findings and policy recommendations. Santa Rosa: Foundation for Critical Thinking.

Pho, A. and Dinscore, A. 2015. *Game-Based Learning.* Tips and Trends Spring 2015, Instructional Technologies Committee, Published by Association of College and Research Libraries and American Library Association.

Pivec, M. and Dziabenko, O. 2004. *Aspects of Game-Based Learning.* Available through: Anglia Ruskin University Library website [Accessed 6 August 2012].

Plackett, R. and Hoxley, M., 2009. *Surveying education and Training in the UK: a cross profession comparison.* COBRA Conference, Cape Town, London: RICS, pp.314-331.

Polanyi, M., 1967. *The Tacit Dimension*, New York: Anchor Books.

Prensky, M. 2005. *Computer Games and Learning: Digital Game-Based Learning.* In Handbook of Computer Game Studies, edited by Raessens, J. and Goldstein, J. Cambridge, USA: MIT Press.

Quarterman, M., Frame, I. and Coffey, M., 2011. *Knowledge Transfer to surveyors and project managers entering the construction industry: examining the efficiency and effectiveness*. COBRA Conference, Paris, London: RICS.

Race, P., 2007. *The Lecturer's Toolkit*, Abingdon, Oxfordshire: Routledge.

Reading Construction Forum, 1995. *Trusting the Team – Best practice guide to*

Partnering in Construction. Reading: Centre for Strategic Studies in Construction.

Reid, D.J., Zhang, J. and Chen, Q. 2003. *Supporting scientific discovery learning in a simulation environment.* Journal of Computer Assisted Learning. Vol. 19, pp.9.20.

Ricketts, B. 2011. *The role of simulation for learning within pre-registration nursing education.* Nurse Education Today, 31, 2011, pp.650-654.

RICS. 2008. *Quantity Surveyors and Project Managers Recommended for National Shortage Occupations List.* Press Release 12 May 2008, London: RICS.

RICS. 2010. *APC Trainee Intake Survey: Summary Findings*, London: RICS.

RICS. 2011. *What surveyors do.* RICS Website. Available at: http://www.rics.org. [Accessed 30 December 2011].

RICS. 2012. *The Global Professional and Ethical Standards.* London: RICS.

RICS. 2012a. *Money Laundering.* 07 September 2012. Money Laundering Guidance July 2011 Download. Available at: http://www.rics.org. [Accessed 30 May 2012].

RICS. 2014. *APC Requirements and Competencies.* London: RICS.

Roberts, C. 1999. *Using computer simulations to enhance teaching: Overcome the fear.* Journal of Hospitality & Tourism Education, Vol. 10 (4), pp.42-44.

Rogers, J. 2001. *Adults Learning*. 4th Edition, p.24. Maidenhead: Open University Press.

Rose, C. and Nicholl, M.J. 1997. *Accelerated Learning for the 21st Century.* New York: Dell Publishing.

Rosenzweig, M.R., Bennett, E.L., Colombo, P.J., Lee, D.W. and Serrano, P.A. 1993. *Short-term, intermediate-term and long-term memories.* Behavioural Brain Research, Vol. 57 (2), pp.193-198.

Russell, L. 1999. *The Accelerated Learning Fieldbook.* Pfeiffer, USA: Jossey-Bass.

Salkind, N. J., 2008. *Statistics for people who (think they) hate statistics,* Thousand Oaks, California: Sage Publications.

Saunders, M., Lewis, P. and Thornhill, A., 2009. *Research Methods for Business Students*, Harlow, Essex: Pearson Education Limited.

Scalese, R.J., Obeso, V.T. and Issenberg, S.B. 2007. *Simulation Technology for Skills Training and Competency Assessment in Medical Education.* Journal of General Internal Medicine (JGIM), 23(Suppl 1), pp.46-49.

Schein, E., 1973. *The Study of Organisations*, The Journal of Business, 1 April 1973, Vol (46)2. Pp.319-320.

Schon, D., 1983. *The Reflective Practitioner- How professionals think in action,* Franham: Ashgate Publishing Limited.

Schraw, G. and Robinson, D.H. 2011. *Assessment of Higher Order Thinking Skills: Current Perspectives on Cognition, Learning and Instruction*. Charlotte: IAP-Information Age Publishing.

Schroder, H.M., 1989. *Managerial Competence: the Key to Excellence*, Doubuque: Kendall/Hall Publishing.

Schuck, P. 2010. *Simulations in Education*. New York: Center for Teaching Excellence, United States Military Academy.

Scriven, M. and Paul, R. 2004. *Our concept of critical thinking*. Retrieved from http://www.criticalthinking.org/aboutCT/define_critical_thinking.cfm. Cited in Barker, 2011, p.8.

Shelton, B.E., Satwicz, t. and Caswell, T. 2013. *Historical Perspectives on Games and Education from the Learning Sciences.* Hershey, USA: IGI-Global.

Simon, P. and Price, M. 2010. *Accelerated Learning*, In Project June 2010, pp. 8-9. Princes Risborough: APM.

Smith, E.T. 1996. *Designing in-class simulations. Political Science & Politics, Dec1996, Vol.29.* Available through: Anglia Ruskin University website [Accessed 10 august 2012].

Smith, A. 1998. *Accelerated Learning in Practice: Brain-based methods for accelerating motivation and achievement.* Stafford: Network Educational Press.

Smith, A., Lovatt, M. and Wise, D. 2003. *Accelerated Learning: A User's Guide.* Stafford: Network Educational Press.

Spencer, L. and Spencer, S., 1993. *Competence at work: A model of superior performance.* New York: Wiley.

Squire, K. 2003. *Video Games in Education.* Cambridge, USA: Massachusetts Institute of Technology.

Stahl, S.A. 2002. *Different strokes for different folks?* In L. Abbeduto (Ed.), *Taking sides: Clashing on controversial issues in educational psychology*, pp.98-107. Guildford, USA: McGraw-Hill.

Stake, R.E. 1995. *Qualitative Case Studies.* In N.K Denzin and Y.S. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research*. Thousand Oaks: Sage.

Stinson, J.E. and Milter, R.G.1996. *Problem-Based Learning in Business Education:Curriculum Design and Implementation Issues*. In L. Wilkerson and W. H. Gijselaers. Designing Problems to Promote Higher-Order Thinking 31 (eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice.* New Directions for Teaching and Learning, no. 68. pp.33-42. San Francisco: Jossey-Bass. Cited in Weiss, L. 2003.

Sternberg, R.J. 1995. *Conceptions of expertise in complex problem solving: a comparison of alternative conceptions.* In: P.A. Frensch and J. Funke, (eds). *Complex problem solving: The European perspective*. pp.295-321. Hillsdale, NJ: Mindbridge.

Sullivan, M., 2010. *Lets get technical – Plugging the skills gaps in graduate education*. Construction Journal April-May 2010, p.5, London: RICS.

Sutter, J.D. 2010. *Browse the Web, earn points and prizes.* Available at: http://edition.cnn.com/2010/TECH/web/09/30/web [Accessed26 July 2013].

Swenson, C. 2003. *Accelerated and Traditional Formats: Using Learning Criterion for Quality.* New Directions for Adult and Continuing Education, Vol.97, Spring 2003, pp.83-92.

Taylor-Powell, E. and Renner, M. 2003. *Analysing Qualitative Data.* Available at: http://www.learningstore.uwex.edu/pdf/G3658-12.pdf. [Accessed 10 July 2103].

Tennyson, R.D., Thurlow, R. and Breuer, K., 1987. *Problem-oriented simulations to develop and improve higher-order thinking strategies*. Computers in Human Behaviour, 3(3), pp.151-165.

Thomas, A. and Thorne, G. 2010. *How to Increase Higher-Order Thinking.* Metairie, Louisiana: Centre for Development and Learning.

Thuraisingam, T., Kaur, P., Briguglio, C., Wallace, M., Mahmud, S., Yeo, S. and Sanderson, G. 2009, *Perspectives of offshore academics on assessment moderation in a transnational education program.* In Observatory on Borderless Higher Education's (OBHE) Global Forum*. Global Connections and Local Impacts: Best Practices, Models and Policies for Cross-Border Higher Education*, Kuala Lumpur, Malaysia, pp.21-24.

Trybus, J. 2015. *Game-Based Learning: What it is, Why it Works and Where it's Going.* New Media Institute. Available at: http://www/newmedia.org/game-based-learning--what-it-is-why-it-works-and-where-its-going.html [Accessed 13 May 2015].

Vandercruysse, S., Vandewaetere, M. and Clareboult, G. 2012. *Game-based learning: A review on the effectiveness of education games.* In M. M. Cruz-Cunha, (ed). Handbook of research on serious games as educational, business and research tools: Development and design, Hershey, USA: IGI-Global.

Van der Meij, H., Albers, E. and Leemkuil, H. 2011*. Learning from games: Does collaboration help?* British Journal of Educational Technology, Vol. 42, No. 4, pp.655-664.

Vernon, D.T. and Blake, R.L. 1993. *Does problem-based learning work? A meta-analysis of evaluative research.* Academic Medicine, Vol. 68, Issue 7.

Walberg, H.J. 1998. *Synthesis of Research on Time and Learning.* Educational Leadership, Vol. 45, pp.76-85.

Walford, G. 2001. *Doing qualitative education research: A personal guide to the research process.* London: Continuum.

Wehrwein, E.A., Collins, H.L. and DiCarlo, S.E. 2006. *Gender Differences in Learning Style Preference Among Undergraduate Physiology Students.* FASEB Journal, Vol. 20, No. 5.

Weiss, R.E. 2003. Designing Problems to Promote Higher-Order Thinking. New Directions for Teaching and Learning, No.95, Wiley Periodicals.

White, H. *Getting Started in Problem-Based Learning.* In B. J. Duch, S. E. Groh, and D. E. Allen (eds.), *The Power of Problem-Based Learning: A Practical "How to" for Teaching Undergraduate Courses in Any Discipline.* Sterling, Va.: Stylus, pp. 69–78.

Wildman, S. and Reeves, M. 1997. *The value of simulations in the management education of nurses: student's perceptions.* Journal of Nursing Management, 5, pp.207-215.

Wimmers, P.F. and Mentkowski, M. 2016. *Assessing Competence in Professional Performance across Disciplines and Professions.* New York: Springer Publishing Company.

Winterton, J., Delemare-Le Deist, F. and Stringfellow, E. 2005. *Typology of knowledge, skills and competences: clarification of the concept and prototype*. Thessaloniki: CEDEFOP.

Wlodkowski, R.J. 2003. *Accelerated Learning in Colleges and Universities.* New Directions for Adult and Continuing Education, Vol.97, Spring 2003, pp.5-15.

Wolf, A., 1989. *Can competence and knowledge mix?* Competency-based Education and Training. Lewes: Falmer Press.

Wolfe,J. 1997. *The effectiveness of business games in strategic management course work.* Simulation and Gaming, Vol.28, pp.360-376.

Wouters, P., Van der Spek, E. and Van Oostendorp, H. 2009. *Current practices in serious game research: A review from a learning outcomes perspective.* In T. M. Connolly, M. Stansfield and L. Boyle, (Eds.), Game-based learning advancements for multisensory human computer interfaces: techniques and effective practices. pp.232-250. Hershey, USA: IGI Global.

Zeisel, J.1984. *Inquiry by Design: Tools for Environment Behaviour Research*. Cambridge: Cambridge University Press.

Appendix A – Companies/organisations participating in the initial significance investigation

For the initial significance investigation a sample of five companies/organisations was selected using a convenience sampling approach. Details of the participating companies/organisations are as follows:

Company 1 – Small and Medium Enterprise (SME), Regional based practice of Quantity Surveyors & Cost Consultants

Company 2 – Small and Medium Enterprise (SME), Regional & London based practice of Chartered Quantity Surveyors & Cost Consultants

Company 3 – National practice of Quantity Surveyors & Cost Consultants with over 250 employees

Company 4 – Independent Multi-National Cost Management Consultancy with over 70 Offices worldwide

Company 5 – Global Construction Project & Cost Management Consultancy (forming part of multi-discipline group) with over 2,000 employees.

Appendix B – Faculty Research Ethics Panel approval

The research described in the thesis has been undertaken subject to Anglia Ruskin University ethical procedures. Approval was received from the Faculty Research Ethics Panel on 31 October 2013.

Anglia Ruskin University
Cambridge & Chelmsford

Chelmsford Campus
Bishop Hall Lane
Chelmsford
CM1 1SQ

T: 0845 271 3333
Int: +44 (0)1245 493131
www.anglia.ac.uk

Mr Martyn Quarterman
62 Fenchurch Road
Maidenbower
Crawley
West Sussex
RH10 7XA

31st October 2013

Dear Martyn

Project Number: *FST/FREP/12/314*
Project Title: ***Knowledge transfer to new entrant surveyors; determining the efficacy of simulation and accelerated learning techniques on competency acquisition.***
Principal Investigator: *Martyn Quarterman*

The Chair of Faculty Research Ethics Panel (FREP), acting on behalf of the Committee, has agreed to grant ethical approval for your research. Under the terms of Anglia Ruskin University's *Policy and Code of Practice for the Conduct of Research with Human Participants* approval is for a period of three years from 31st October 2013.

It is your responsibility to ensure that you comply with Anglia Ruskin University's Policy and Code of Practice for Research with Human Participants, and specifically:

- The Participant Information Sheet and Participant Consent Form should be on Anglia Ruskin University headed paper.
- For online surveys it is recommended that the researcher turns off the IP logging software to ensure secure communication between the survey taker and server.
- The procedure for submitting substantial amendments to the committee, should there be any changes to your research. You cannot implement these changes until you have received approval from FREP for them.
- The procedure for reporting adverse events and incidents.
- The Data Protection Act (1998) and any other legislation relevant to your research. You must also ensure that you are aware of any emerging legislation relating to your research and make any changes to your study (which you will need to obtain ethical approval for) to comply with this.
- Obtaining any further ethical approval required from the organisation or country (if not carrying out research in the UK) where you will be carrying the research out. Please ensure that you send the FREP Secretary copies of this documentation.
- Any laws of the country where you are carrying the research out (if these conflict with any aspects of the ethical approval given, please notify FREP prior to starting the research).
- Any professional codes of conduct relating to research or research or requirements from your funding body (please note that for externally funded research, a project risk assessment must have been carried out prior to starting the research).
- Notifying the FREP Secretary when your study has ended.

Appendix B – Faculty Research Ethics Panel approval (cont'd)

Information about the above can be obtained on our website at:

http://web.anglia.ac.uk/anet/rdcs/ethics/index.phtml/ and or
http://www.anglia.ac.uk/ruskin/en/home/faculties/fst/research0/ethics.html

Please also note that your research may be subject to random monitoring by the Committee.

Please be advised that, if your research has not been completed within three years, you will need to apply to our Faculty Research Ethics Panel for an extension of ethics approval prior to the date your approval expires. The procedure for this can also be found on the above website.

Should you have any queries, please do not hesitate to contact me. I would like to wish you the best of luck with your research.

Yours sincerely,

Sue Short

Secretary to the Faculty Research Ethics Panel (FREP)
Faculty of Science and Technology
Tel: 01245 683927 or 0845 196 3927
Email: FST-Ethics@anglia.ac.uk

cc. Dr Michael Coffey

Appendix C – Contact Summary Sheets from initial practice-based investigation

Interview Contact Sheet for Training Managers:

Name: Graduate Training Manager Date: 23/12/13 Time: 13.30 – 14.15
Company: Firm F1 Location: Telephone Interview

1.	Can you tell me your role in the company? Associate Director – Graduate Training Manager Responsible for training of graduates in South West/Wales
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 1000 + in UK at all levels b. Worldwide? Approx. 3000 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? Approx 100 joined in 2013 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 50%/50% Cognate/Non Cognate (in part due to company policy and desire to develop graduates beyond quantity surveying into project management) b. Gender (Male/female)? Split is broadly 70%/30% c. Age Range? 95% of candidates in 21-29 age range (occasional candidates go beyond this)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS (Would need to seek formal Board approval if actual copy of programme is required)

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal and informal programmes Follow on: How does the scheme operate? Graduates allocated to Supervisor and Councillor, also Mentor as part of Buddy Scheme All graduates attached to Centre of Excellence Formal sessions 2-3 hours monthly covering 2 or 3 competencies Suite of Training Information provided centrally by business delivered locally Mock Interviews run locally Formal pre-qualification interview held in London Office (chaired by training consultant) Presentation Skills Workshops run by training consultant Candidates must pass pre-qualification interview before being permitted to submit for APC interview (failure at pre-qualification interview typically results in months delay)
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Workshops used for presentation skills Training sessions and coaching used for technical skills and softer skills such as managing workload, managing oneself, client empathy
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Must have accurate technical knowledge (this is tested before sign-off) Must have client facing skills, these include confidence, ability to lead meetings, etc (In the interviewees experience Non Cognate degree holders achieve this much quicker)

9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Two years is exception, generally candidates take 3 years. Not permitted to sit APC until pre-qualification interview has been passed
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Graduates have rough understanding but do not understand problems that may arise on a day to day basis b. How to deal with problems administering contracts – Not really an issue for level of experience, but often do not recognise that individual contracts may differ due to contract amendments c. How to communicate what they have done – Not difficult, although non-cognates often better d. How sustainability impacts on the surveyors role – Not difficult e. Application of RICS rules to the job – Difficulty with the practicalities f. How to apply ethics to day to day scenarios – Again, do not understand the practical application to day to day situations g. Extent of leadership surveyor should display – Particularly difficult for cognate graduates. Have some technical understanding but need confidence, ability to lead a meeting and direct staff h. Application of health and safety principles to the job –All have CSCS cards, but lack confidence to speak up (what should be done if health & safety breaches seen on site) i. Any others? None raised Follow on: From your experience which are the most difficult to achieve? Showing leadership and understanding knowledge that is taken as read in the different sectors such as extent of circulation space

11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm most difficult to achieve leadership and ethical application b. For the new entrant graduates – For new entrant graduates most have only been taught the standard contract conditions. They need to understand contract amendments and how contracts are tailored to differing client requirements (therefore answers to questions are not always the same)
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): Technical Competencies a. Understanding of forms of contract used in the construction industry – Focus on standard forms, see previous comments on amendments b. Understanding procurement routes and tendering, negotiation and award processes – Usually not an issue c. Measurement and valuing construction works at the various stages of a project – Applying measurement principles to pre-contract and cost planning d. Understanding the principles of design and construction – Don't understand spatial requirements and services e. Understanding the principles of effective cost control of during a project – Not an issue post contract, but not understood pre-contract. First figure is important, implications of pre-contract design changes not understood Mandatory and Soft Competencies a. Understanding the quantity surveyor's role in the avoidance,

	management and resolution of disputes – Not an issue b. Understanding the principles and responsibilities for health and safety within the construction industry – Not an issue, but see comments on speaking up c. Understanding business accounts, taxation, cash flow and auditing – Not an issue but need to be able to understand what accounts are showing d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Problem applying rules to practical examples, see above e. Understanding the principles and significance of sustainable development/construction – Not an issue
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? One of the most significant deficient competencies to the business is the application of ethics. Small errors can have major financial implications and affect the reputation of the business. Client relationships can be affected forever and clients lost. Other significant areas are leadership and pre-contract cost control (making estimates accurate and controlling them)
14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional techniques) covering the most significant deficient skills/competencies identified from this research? Interviewee would recommend that firm participates and would benefit graduate trainees, but would need Board approval. One day format fine. Could offer workshop to members of control group later (so that all trainees are treated equally).

FOLLOW ON:

- Knowledge is required for different construction types and all elements. So graduates need to learn for example what the implications would of a change to services. How does it affect other elements? How does it affect spatial requirements?

Interview Contact Sheet for Training Managers:

Name: Graduate Trainee Coordinator Date: 11/02/14 Time: 09.00 – 10.30
Company: Firm F2 Location: London Office

1.	Can you tell me your role in the company? Graduate Trainee Coordinator (QS/Construction) London & South East Region, APC Assessor (Actual GT scheme is administered by HR)
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 1000 in UK at all levels b. Worldwide? Approx. 1500 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? Over 100 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 95%/5% Cognate/Non Cognate (Predominantly Cognates now, although prior to recession percentage of Non Cognates was higher) b. Gender (Male/female)? 70%/30% c. Age Range? Over 90% of candidates in 21-29 age range (small percentage of candidates are beyond this, primarily following other Pathways)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS (Training programme is provided to graduates via Intranet Portal with Structured Training Agreement)

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal graduate training programme Follow on: How does the scheme operate? Graduates allocated to Supervisor and Councillor as required by APC Scheme is underpinned by firms Intranet Portal with Study pack Scheme operates at National and Local level At National Level APC Information Day, Pre-Qualification Day, Report Writing/Critical Analysis/Preparing for Interview At local level Monthly meetings, focus on Study pack Mock Interviews run informally locally (with two candidates reviewing performance) and formal format nationally Generally Candidates must pass formal interview before being permitted to submit for APC assessment, but borderlines are allowed through
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Use Lectures (for process training) Report Writing Exercises/Grammar Role Play exercises used Typical Question workshops run by recently qualified graduates Intranet Library Page provides Study Pack
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Key measure is that trainees must show they "know their Limits", this means they know what advice can/cannot be given to Clients and where to go when they are outside their boundary. Need interpersonal skills, this means coming over as confident

9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Generally candidates take 2.5 to 3 years, in recent times only one candidate in London/SE sufficiently competent for APC in 2 years
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Reasonable understanding of role but sometimes don't fully appreciate broadness of service b. How to deal with problems administering contracts – Most candidates have reasonable understanding of JCT and NEC, but generally text book knowledge. Specialist issues such as Collateral Warranties not understood c. How to communicate what they have done – Not difficult, shy trainees are given additional training and support d. How sustainability impacts on the surveyors role –Generally not a difficult area (but this may be because increasingly covered at University) e. Application of RICS rules to the job – Can be difficult because learn rules on route to APC so understand principles but not always application f. How to apply ethics to day to day scenarios – This is same as RICS Rules, aware of principles but application can be difficult g. Extent of leadership surveyor should display – Generally not an issue, some have good leadership understanding others do not. These are given additional support h. Application of health and safety principles to the job – All have CSCS cards, not seen as difficulty i. Any others? The two most difficult areas are understanding

	Construction Technology and appropriate measurement skills Follow on: From your experience which are the most difficult to achieve? Most difficult to achieve is understanding how construction fits together (all University teaching looks to be focussed and Buildings and doesn't cover infrastructure, civil engineering) It is essential to understand construction technology in order to be able to measure quantities. This means graduates cannot do measurement for estimates or BQs until they have considerable experience (Company often has to use senior staff and not always economical). Need to understand technology to pick-up mistakes, pick-up what is missing, drawings often don't all work together
11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm difficult to achieve construction technology and measurement because inevitably takes time. Can be difficult to give graduates broad experience because of the balance between fee earning and training b. For the new entrant graduates – For new entrant graduates the problem is that they don't see construction technology and measurement as important. More concerned with topics such as contract and commercial advice.
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): <u>Technical Competencies</u> a. Understanding of forms of contract used in the construction industry – This can be difficult to achieve because of the tendency to focus on JCT b. Understanding procurement routes and tendering, negotiation and award processes – Usually not an issue

	c. Measurement and valuing construction works at the various stages of a project – Have real difficulty with understanding how construction fits together (essential to do measurement process) d. Understanding the principles of design and construction – Don't understand design and construction processes e. Understanding the principles of effective cost control of during a project – Usually not an issue Mandatory and Soft Competencies a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes –Most know the text book information but applying to practical experience can be difficult b. Understanding the principles and responsibilities for health and safety within the construction industry – Not an issue c. Understanding business accounts, taxation, cash flow and auditing – Not an issue but need to be able to understand principles and where to go for information d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Can be an issue (see comments above). Firm have had several referrals in this area e. Understanding the principles and significance of sustainable development/construction – Not an issue. Usually well understood from University
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? Most significant deficient competencies to the business are understanding of construction technology and measurement. These are significant to the business because senior staff often have to be used and this may not be economical.

14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Will confirm in separate email (Post Interview Note: Email of 12 February 2014 confirms firm would be interested in taking part with a some graduates)

FOLLOW ON:

- Thinking about addressing the construction technology/measurement issue the problem is that graduates don't see these areas as important. The emphasis must change at University, but these topics are often seen as vocational by universities
- Another issue regarding the APC is the difficulty in finding a suitable Critical Appraisal. Graduates often revert to academic studies in order for it to be seen as extraordinary (RICS should look at the requirements for CA)

Interview Contact Sheet for Training Managers:

Name: Graduate Training Manager Date: 21/01/14 Time: 09.30 – 10.15
Company: Firm F3 Location: Telephone Interview

1.	Can you tell me your role in the company? Associate Director – Graduate Training Manager, Responsible for training of graduates in Scotland & NI Region
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 1500 in UK at all levels b. Worldwide? Approx. 2500 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? 70 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 55%/45% Cognate/Non Cognate (Non Cognates normally study for part time MSc in Surveying such as CEM Reading) b. Gender (Male/female)? 75%/25% c. Age Range? 95% of candidates in 21-29 age range (5% beyond this)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS (National Graduate Training Programme document being updated but copy of current version will be provided)

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal graduate training programme Follow on: How does the scheme operate? Graduates allocated to Supervisor and Councillor as required by APC Scheme follows APC process plus Company's learning & Development Programme (35 Box Model i.e. 35 Skill Sets) Formal sessions annually in London for all trainees Graduate Trainees attend courses if applicable (when more than one trainee) Mock Interviews run informally locally and in formal format nationally Candidates must pass formal interview before being permitted to submit for APC assessment
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Lectures One-to-One Coaching Use Case Study/Role Play Exercises at formal away-days, typically 12 teams of 4
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Must have sound understanding of basic QS Skills Must be ready to "hit the floor running" Must understand how to work for a client Must be quick learner

9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Generally candidates take 2 years. Some a little longer
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Graduates have basic understanding of QS skills, but issue is applying on day to day basis b. How to deal with problems administering contracts – Understand basics of contracts but struggle with detail of contract administration and dealing with, change on different forms c. How to communicate what they have done – Not difficult d. How sustainability impacts on the surveyors role – Not difficult e. Application of RICS rules to the job – Not an issue, but see below f. How to apply ethics to day to day scenarios – Not observed as a major issue but this is due to team structures. All ethical issues must be referred to the senior in the team g. Extent of leadership surveyor should display – Would expect graduates to understand how to work in teams. They find it difficult to know how to manage people h. Application of health and safety principles to the job –All have CSCS cards, not seen as difficulty i. Any others? A difficulty is understanding the boundaries of the company's service provision i.e. must not give advice on issues outside boundary for insurance reasons (for example this would include insurance advice) Follow on: From your experience which are the most difficult to achieve? Most difficult to achieve is pre-contract services e.g. early estimates and quantities. This is a risk area to the client. Firm address this by using senior people to oversee with graduates in supporting roles

11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm difficult to achieve because there is always a balance between fee earning and training. If doing a good job clients may want to retain a graduate and it is difficult to rotate for experience b. For the new entrant graduates – For new entrant graduates the difficulty is in ensuring the range of experience. This is dictated by work available/role. This is much more an issue for graduates in smaller firms
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): <u>Technical Competencies</u> a. Understanding of forms of contract used in the construction industry – Young professionals struggle with the specific detail on different forms, for example dealing with change b. Understanding procurement routes and tendering, negotiation and award processes – Usually not an issue c. Measurement and valuing construction works at the various stages of a project – Have technical understanding but difficulty with practical application (i.e. how to do the measurement process) d. Understanding the principles of design and construction – Don't understand design and construction processes e. Understanding the principles of effective cost control of during a project – Usually not an issue <u>Mandatory and Soft Competencies</u> a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Difficult to achieve because usually no practical experience in dispute management b. Understanding the principles and responsibilities for health and

	safety within the construction industry – Not an issue c. Understanding business accounts, taxation, cash flow and auditing – Not an issue but need to be able to understand what accounts are showing d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Can be an issue but see firm's approach above e. Understanding the principles and significance of sustainable development/construction – Not an issue. Usually well understood for development schemes, less so for Infrastructure
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? Most significant deficient competencies to the business are the details of different contracts and provision of pre-contract services. Errors in measurement and estimating can have major implications for the business.
14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Would be interested in principle but would need HR approval.

FOLLOW ON:

- Thinking about addressing the pre-contract services issue the problem is one of gaining sufficient experience. This would lend itself to a simulation approach

- Firm does use a form of scenarios in the Away-Day sessions, but this is annual. Not widely applied to competencies in Graduate Training Scheme
- Young professionals struggle with broad experience of different contract types, again anything to accelerate experience would be helpful

Interview Contact Sheet for Training Managers:

Name: Graduate Training Manager Date: 03/12/13 Time: 14.06 – 14.56
Company: Firm F4 Location: Telephone Interview

1.	Can you tell me your role in the company? Associate Director of Cost Management – Graduate Training Manager North West Region (also APC Assessor and Chair of Assessors). Involved in set up of original Graduate Development Programme (GDP) for firm
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 500 + in UK b. Worldwide? Approx. 2000 – 3000 in cost management worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? Currently 173 on company's GDP. Around 70% (approx. 120) of these are following QS/Construction Pathway (also some external candidates part of this)
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 80%/20% b. Gender (Male/female)? Exact split is 153 Male and 38 Female (78%/22%) c. Age Range? 90% of candidates in 21-29 age range
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, called GDP. Copy will be provided

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal and informal programmes Follow on: How does the scheme operate? Formal Graduates allocated to Supervisor/Mentor and Councillor) 5 X GDP Weeks at intervals over two years Mock APC interview & Assessment Guidance in Week 5 (No candidates proceed to APC assessment unless pass mock) Informal Fortnightly Graduate Group Meetings Typically 8.30 -9.30 Candidates select topic, gives presentation and Q&A Local mock interviews in front of actual Assessors (Interviewee believes firm has 100% pass rate, but this would need confirmation)
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Main component of GDP Weeks is the use of Case Studies. These are structured as follows: Issue of Brief, Candidates divide into groups, New information injected as they move through the case study, focus on team working, presentation of results and feedback. Candidates observed during week
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Sound performance at numerous mock interviews Ability to support knowledge with actual practical examples

	Key measure is can graduate sit in front of clients (presence, confidence, judgement, justification) Must understand requirement to stand back and sense check before issue
9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Average 30 to 36 months (some exceptional candidates achieve APC in minimum periods). Must give sound performance at mock interviews or not permitted to submit
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Key issue is general ability to do measurement at any level. Candidates understand NRM1 but can't get started or structure the measurement process b. How to deal with problems administering contracts – Not an issue for level of experience, but tend to be JCT biased (must move further with NEC knowledge) c. How to communicate what they have done – Not difficult d. How sustainability impacts on the surveyors role – Not difficult e. Application of RICS rules to the job – Understand rules but not practical application f. How to apply ethics to day to day scenarios – This is a major issue and an immediate referral point at APC interview. Graduates need to know how to apply ethics requirements to actual issues g. Extent of leadership surveyor should display – Not an issue (focus on leadership in case studies on GDP training weeks) h. Application of health and safety principles to the job –All have CSCS cards, but too text book orientated. Difficult to embed the practical steps e.g. what would be the steps for a site visit (Risk

	Assessment, Site Induction, PPE, etc) i. Any others? Nothing raised Follow on: From your experience which are the most difficult to achieve? As above and concluding discussion
11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm most difficult is application of measurement at all levels to practical construction. This can include early estimating and detailed quantities b. For the new entrant graduates – For new entrant graduates most difficult is application to actual practical examples, this includes Ethics, Measurement and Safety
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): <u>Technical Competencies</u> a. Understanding of forms of contract used in the construction industry – Need broader NEC experience beyond just JCT b. Understanding procurement routes and tendering, negotiation and award processes – Often confusion about procurement routes and tendering options, need to be able to advise clients confidently c. Measurement and valuing construction works at the various stages of a project – Applying measurement principles to practical examples is a major problem area d. Understanding the principles of design and construction – Need to understand practical examples in order to get started with measurement e. Understanding the principles of effective cost control of during a project – Not an issue

	<u>Mandatory and Soft Competencies</u> a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Not an issue b. Understanding the principles and responsibilities for health and safety within the construction industry – Understood at CSCS level, but difficulty understanding how this relates to their practical day to day work (what do they need to do?) c. Understanding business accounts, taxation, cash flow and auditing – Not an issue for large firms, but more applicable to small practices d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Problem applying rules to practical examples e. Understanding the principles and significance of sustainable development/construction – Not an issue
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? One of the biggest deficiencies is measurement at all levels. It is not understanding NRM1 or SMM but actually applying this to early estimates, cost plans and BQs Graduate trainees have difficulty knowing how to get started with measurement as they can't visualise the construction process There is deficiency in give practical examples to ethics and safety
14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Firm would consider participation for say 10 graduate trainees, particularly in NW Region. Briefing session and 1 day workshop would be acceptable format. If using control group to validate assessment process may need to offer the workshop to members of control group later (so that all trainees are treated equally)

FOLLOW ON:

- Not such an issue for firm because they have a significant GDP and train graduates to pass the APC. Firm's head of training is quoted as saying it costs the company £100,000 to train each graduate. Much more of an issue for smaller firms who do not have this kind of budget. But firm is always interested in how they can enhance their GDP and would happily consider participation in workshops
- There remains an issue with basic reading, writing and maths for (a significant proportion) of new entrant graduates. Firm addresses this during the five GDP weeks.

Interview Contact Sheet for Training Managers:

Name: Graduate Trainee Coordinator Date: 18/02/14 Time: 14.00 – 15.00
Company: Firm F5 Location: London Office

1.	Can you tell me your role in the company? Director Graduate Trainee Coordinator (QS/Construction) London, APC Assessor (Actual GT scheme is administered by HR)
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 800 in UK at all levels b. Worldwide? Approx. 1900 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? Circa 50 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 70%/30% Cognate/Non Cognate (Firm favours Non Cognates where practical as often higher calibre of graduate) b. Gender (Male/female)? 75%/25% c. Age Range? Most graduate trainees in 21-29 age range (small percentage of candidates are beyond this)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS (Training programme is provided to graduates via Website)

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal graduate training programme Follow on: How does the scheme operate? Graduates allocated to Supervisor and Councillor as required by APC Scheme is underpinned by Website Individual training requirements are demand driven (onus on graduates) Formal training once every three months How to pass interview/Presentations/Critical Analysis Mock Interviews run informally and formally Generally candidates are permitted to sit APC assessment when they feel they are ready (with Supervisor/Councillor view)
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Use Lectures On-Line Training CPD Study Packs Scenarios used for competency questions Generally Simulations not used or formalised
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Key measure is what they produce Are reports presentable and competent, can be given to Clients Is work being carried out in a competent manner commensurate with their level Is graduate practically aware of where to go for information/advice Need appropriate presentation/ interpersonal skills

9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Generally candidates take 3 years (only brighter graduates ready after 2 years)
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Reasonable understanding of role but sometimes lacks depth (to be expected at point in career) b. How to deal with problems administering contracts – This is one of the difficult areas. Majority of new entrants have JCT knowledge and some NEC (although differences not fully understood). Solution is to refer up management tree c. How to communicate what they have done – Not major difficulty. Some new entrants are quiet. Trained to explain clearly why they have done things, often lack of clarity in their explanations d. How sustainability impacts on the surveyors role – Generally good on rules, difficulty is in application e. Application of RICS rules to the job – Can be difficult because of differing cultures. How to apply rules is stressed within the business f. How to apply ethics to day to day scenarios – This is same as RICS Rules, aware of principles but application can be difficult g. Extent of leadership surveyor should display – This can be a difficult area because too passive within project team (quiet QS in the corner). QS needs to be more proactive h. Application of health and safety principles to the job – Well covered, all have CSCS cards, not seen as difficulty, business is proactive on safety i. Any others? The three most difficult areas are Contract Practice, Construction Technology (understanding how things are built) and understanding M&E services

	Follow on: From your experience which are the most difficult to achieve? Most difficult to achieve is understanding how buildings are build. It is difficult to influence cost unless you understand how buildings fit together. In the early stages QS must understand the construction process to add value. Need to pick out complexity, explain what doesn't work, that way issues are designed out pre-construction
11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm most difficult to achieve is construction technology, this is because of limited opportunities to work on site and learn the process of building assembly b. For the new entrant graduates – For new entrant graduates the most difficult to achieve is contract practice. Can read contracts but learning what words mean comes from practice. Also struggle with construction technology because they haven't seen the process of assembly
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): <u>Technical Competencies</u> a. Understanding of forms of contract used in the construction industry – This can be difficult to achieve because the tendency is to read the contracts rather than understanding the practical application b. Understanding procurement routes and tendering, negotiation and award processes – Usually not an issue, part of core study c. Measurement and valuing construction works at the various stages of a project – Have real difficulty with understanding how buildings are built (essential to do measurement process and point out what doesn't work in the design)

	d. Understanding the principles of design and construction – Don't understand the process of assembly, can't influence cost unless you understand the principles of how it fits together. As an example Piling often not understood e. Understanding the principles of effective cost control of during a project – Usually not an issue <u>Mandatory and Soft Competencies</u> a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Most have done their homework, therefore not difficult to achieve b. Understanding the principles and responsibilities for health and safety within the construction industry – Not an issue c. Understanding business accounts, taxation, cash flow and auditing – Not difficult because not a significant area (question whether this should be listed as a separate competency) d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Difficulty is practical application and different cultures e. Understanding the principles and significance of sustainable development/construction – Not an issue. Usually well understood from University
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? Most significant deficient competencies to the business are understanding of construction technology, contract practice and need for cost leadership. Cost leadership is significant to the business because this is where QS can add value; it is why clients come to you.

14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Would be very interested in taking part. Interviewee would be happy to recommend to HR.

FOLLOW ON:

- Grammar and spelling continues to be an issue (doesn't seem to be addressed by universities)
- M&E Services is also an important area. Understanding how M&E fits together is key to measurement (Interviewee feels this should be a separate competency)
- APC process is too academic, larger practices are able to 'teach' graduates to pass APC. This is unfair on smaller practices who can't afford the time
- RICS should ask those not directly involved in APC process what they think (Clients, Surveyors, Directors not involved in running the process).

Interview Contact Sheet for Training Managers:

Name: Development Director Date: 22/01/14 Time: 08.30 – 10.00
Company: Firm F6 Location: London Office

1.	Can you tell me your role in the company? Development Director – Member of Graduate Recruitment & Development Team (QS/PM representative), APC Assessor
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 600 in UK at all levels b. Worldwide? Approx. 850 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? 60 - 70 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 70%/30% Cognate/Non Cognate (Non Cognates normally study for part time MSc in Surveying) b. Gender (Male/female)? 90%/10% c. Age Range? 90% of candidates in 21-29 age range (10% of candidates beyond this, normally Non Cognates)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS (Copy will be provided)

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal graduate training programme Follow on: How does the scheme operate? Graduates allocated to Supervisor and Councillor as required by APC Scheme is underpinned by firms electronic portal Portal provides template files, documentation, electronic reminders, all to allow following of RICS structured training Formal session two days per year in London for all trainees Some funding for external workshops and CPD Mock Interviews run informally locally and in formal format nationally Candidates must pass formal interview before being permitted to submit for APC assessment
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) One-to-One Coaching Use Case Study/Role Play Exercises at two-day session Ad-hoc workshops run by recently qualified graduates Intranet Library Page (run by successful APC candidates) provides source of useful knowledge/data
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Rounded experience (Pre and Post Contract mix) Need interpersonal skills, this means come over as confident, can present a sound argument, can take on board the view of others

9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Generally candidates take 2 years, but depends on brightness and proactivity of candidates. More towards 3 years on average
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Reasonable understanding of role but as ever issue is application b. How to deal with problems administering contracts – Most candidates have reasonable understanding of property sector (JCT), but short on the Heavy Infrastructure Sector and different forms of contract used c. How to communicate what they have done – Not difficult d. How sustainability impacts on the surveyors role – Generally this is a weak area, but this is in part due to the company's exacting expectations (trying to drive sustainability as a future differentiating factor for the business) e. Application of RICS rules to the job – Issue when first join, but company's policy is to drive rules into them f. How to apply ethics to day to day scenarios – Most graduates can soon recite RICS requirements, but the issue is testing understanding. Some try to be too clever and don't understand practical implications g. Extent of leadership surveyor should display – Graduates find it difficult due to the roles/positions they hold. Need to be encouraged to speak up and build confidence to lead h. Application of health and safety principles to the job – All have CSCS cards, not seen as difficulty. This is an important area for the firm as H&S is paramount, full company structure in place i. Any others? There is also the measurement one. Good surveyors

	can visualise and pick up what is not there. This is essential to ensure full allowances in Cost Plan Follow on: From your experience which are the most difficult to achieve? Most difficult to achieve are the areas where graduates need to build experience i.e. Contract Practice and looking at drawings
11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm most difficult to achieve is Contract practice because it may not always be possible to provide the variety of Contracts b. For the new entrant graduates – For new entrant graduates the difficulty is in ensuring the range of experience, particularly coverage of the optional competencies, it depends on what is available in the business
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): <u>Technical Competencies</u> a. Understanding of forms of contract used in the construction industry – Difficult to achieve because not the broadness available. Tend to be JCT or NEC. Focus should be more on understanding the differences over a wider variety of contracts b. Understanding procurement routes and tendering, negotiation and award processes – Usually okay c. Measurement and valuing construction works at the various stages of a project One of the most difficult to achieve, can put together the structure for cost plan, but not develop the quantities d. Understanding the principles of design and construction – Generally find it difficult to visualise the construction processes e. Understanding the principles of effective cost control of during a

	project – Usually not an issue, most graduates understand the principles of cost control and cost management Mandatory and Soft Competencies a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Difficult to achieve because usually have only basic knowledge not technical detail b. Understanding the principles and responsibilities for health and safety within the construction industry – Not an issue, well versed and embedded in the firm c. Understanding business accounts, taxation, cash flow and auditing – Some weakness but not an issue as can readily seek advice within the business d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Graduates are well versed in the rules but understanding application can be an issue e. Understanding the principles and significance of sustainable development/construction – Not an issue. Usually fully understood for basic stuff. May become more of an issue in the future, particularly as this is priority development area for the business
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? Most significant deficient competencies to the business are the details of different contracts and the measurement one. The key is to develop rounded surveyors. Good surveyors can visualise construction and pick up everything that is needed. An example is Master Planning , information tends to be generic, need experience to look at the drawings and make sure allowances are adequate in Cost Plan

14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Firm would be very interested in inviting graduate trainees to participate. Also happy for the firms name to be mentioned.

FOLLOW ON:

- An issue for RICS is Councillor and Supervisor sign-off (fear is that it may be tick-box in some firms). Some candidates particularly from small firms come forward to interview too early. Should RICS 'Police' this a little more
- In some instances Sandwich Degrees are still used but firm finds the year out to be of limited value. Post graduation experience is much more useful

Interview Contact Sheet for Training Managers:

Name: Partner | Date: 18/12/13 | Time: 09.30 – 11.00
Company: Firm 7a | Location: London Office

1.	Can you tell me your role in the company? Partner, chairman of firm's Training Committee (also APC Assessor)
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 500 + in UK at all levels b. Worldwide? Approx. 650 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? Currently approx 50 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 100% Cognate (although in the past have had some Non Cognates) b. Gender (Male/female)? Split is broadly 50%/50% (in part due to graduates available in recruitment process) c. Age Range? 95% of candidates in 21-29 age range (a few candidates drift to and beyond 29)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS. Copy will be provided

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal and informal programmes Follow on: How does the scheme operate? Graduates allocated to Supervisor/Mentor (1 to 1) and Councillor Divided into Year Peer Groups (so always three Peer Groups coming through) 3 X 2 Day formal sessions each year Final year focuses on how to pass APC interview, 2 mock interviews plus group interviews (5 graduates and 3 assessors – Peer feedback) In the first year training programme covers working in office environment, basic skills, low tech tasks Graduates also do topic presentations CPD programme also in place (normally one lecture/presentation/session each fortnight)
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Main component of training/development days are what the firm have developed called "Hypotheticals". These are facilitated problem solving exercises i.e. "What would you do if?" – Aimed at what graduates don't know Also use Talks, Lectures and Workshops (groups develop solutions)
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Sound performance at mock interviews – Firm doesn't let candidates sit APC assessment until they are ready Main judgement is enthusiasm, confidence and ability to show intelligence i.e. sensible documents and sound advice

9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Candidates progress at different rates but target is 75% to pass APC within 3 years. Must give sound performance at mock interviews or not permitted to submit
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Issue is ability to see beyond written material (this is a key aspect of the surveyor role) b. How to deal with problems administering contracts – Not an issue for level of experience c. How to communicate what they have done – Not difficult, most of the firm's graduates are articulate, this is assessed at selection d. How sustainability impacts on the surveyors role – Not difficult e. Application of RICS rules to the job – Perception is that not taught at University and most graduates unaware of rules f. How to apply ethics to day to day scenarios – Again, not covered at University and graduates must learn in post. Firm guided by company standards, code of conduct and ethics established long term within the business g. Extent of leadership surveyor should display – Firm have a number of excellent graduate surveyors who are poor managers/leaders, could use simulation to help development h. Application of health and safety principles to the job –All have CSCS cards, but too tick-box orientated. Difficult to embed the practical steps, basic shortfall dealt with through induction process, but must be seen as corporate and personal responsibility i. Any others? Nothing raised Follow on: From your experience which are the most difficult to achieve? See concluding discussion

11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm most difficult to achieve is the ability to visualise what is not shown. This comes from learning on the job, but takes time b. For the new entrant graduates – For new entrant graduates most have never been to site, therefore don't understand how construction fits together, this includes M&E, terminology and more complex construction such as Piling
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): Technical Competencies a. Understanding of forms of contract used in the construction industry – Focus tends to be on JCT, but can be taught therefore not a key issue b. Understanding procurement routes and tendering, negotiation and award processes – Usually not an issue. Interestingly candidates often cover this in their APC critical analysis c. Measurement and valuing construction works at the various stages of a project – Applying measurement principles to practical examples is an important area, graduates often have limited measurement experience and find it difficult to visualise construction technology d. Understanding the principles of design and construction – Understanding of construction technology is a difficult area e. Understanding the principles of effective cost control of during a project – Not an issue Mandatory and Soft Competencies a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Not an issue

	b. Understanding the principles and responsibilities for health and safety within the construction industry – Understood at CSCS level, but difficulty understanding how this relates to their practical day to day work, but firm's development programme addresses this c. Understanding business accounts, taxation, cash flow and auditing – Not an issue for large firms, but more applicable to small practices. Although there is a question about the significance as any surveyor contemplating own business would surely seek specialist advice on these issues d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Problem applying rules to practical examples, see above e Understanding the principles and significance of sustainable development/construction – Not an issue
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? The biggest deficiency is in the area of Construction Technology. Understanding how construction fits together is essential for early estimates, cost plans and BQs Graduate trainees have difficulty knowing how to include for what is not shown in the information provided or on the drawings. The second biggest challenge is turning graduate surveyors into manager/leaders. Back of house staff are important but firm needs graduates who can lead teams. There is also a deficiency in not being able to give practical examples to ethics, but firm goes some way to address this

14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Firm would be prepared to invite say 10 graduate trainees to participate. Briefing session and 1 day workshop would be acceptable format. Firm would be happy to make room available at their offices. If using control group to validate assessment process may need to offer the workshop to members of control group later (so that all trainees are treated equally), but firm would see this as the graduates choice

FOLLOW ON:

No further points raised.

Interview Contact Sheet for Training Managers:

Name: Graduate Training Manager Date: 18/12/13 Time: 09.30 – 11.00
Company: Firm 7b Location: London Office

1.	Can you tell me your role in the company? Graduate Training Manager (also APC Assessor)
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 500 + in UK at all levels b. Worldwide? Approx. 650 worldwide
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? Currently approx 50 following QS/Construction Pathway
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 100% Cognate (although in the past have had some Non Cognates) b. Gender (Male/female)? Split is broadly 50%/50% (in part due to graduates available in recruitment process) c. Age Range? 95% of candidates in 21-29 age range (a few candidates drift to and beyond 29)
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes, accredited by RICS. Copy will be provided

6.	Could you describe the structure and primary components of the training programme? RICS APC competencies plus formal and informal programmes Follow on: How does the scheme operate? Graduates allocated to Supervisor/Mentor (1 to 1) and Councillor Divided into Year Peer Groups (so always three Peer Groups coming through) 3 X 2 Day formal sessions each year Final year focuses on how to pass APC interview, 2 mock interviews plus group interviews (5 graduates and 3 assessors – Peer feedback) In the first year training programme covers working in office environment, basic skills, low tech tasks Graduates also do topic presentations CPD programme also in place (normally one lecture/presentation/session each fortnight)
7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) Main component of training/development days are what firm have developed called "Hypotheticals". These are facilitated problem solving exercises i.e. "What would you do if?" – Aimed at what graduates don't know Also use Talks, Lectures and Workshops (group working to develop solutions)
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Sound performance at numerous mock interviews – Firm doesn't let candidates sit APC assessment until they are ready Ability to address issues which are not written down, for example

	looking beyond what is shown on drawings (it is not acceptable to adopt the "not shown on drawings therefore not measured" approach) Must be able to visualise construction and procurement processes
9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Candidates progress at different rates but target is 75% to pass APC within 3 years. Must give sound performance at mock interviews or not permitted to submit
10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Issue is ability to see beyond written material (this is a key aspect of the surveyor role) b. How to deal with problems administering contracts – Not an issue for level of experience c. How to communicate what they have done – Not difficult, most of the firm's graduates are articulate, this is assessed at selection d. How sustainability impacts on the surveyors role – Not difficult e. Application of RICS rules to the job – Perception is that not taught at University and most graduates unaware of rules f. How to apply ethics to day to day scenarios – Again, not covered at University and graduates must learn in post. Firm guided by company standards, code of conduct and ethics established long term within the business g. Extent of leadership surveyor should display – This is a key issue for the firm, perception is that graduates not trained as managers or leaders h. Application of health and safety principles to the job –All have CSCS cards, but too tick-box orientated. Difficult to embed the practical steps, basic shortfall dealt with through induction process, but

	must be seen as corporate and personal responsibility i. Any others? Nothing raised Follow on: From your experience which are the most difficult to achieve? See concluding discussion
11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm most difficult to achieve is the ability to visualise what is <u>not</u> shown. This comes from learning on the job, but takes time b. For the new entrant graduates – For new entrant graduates most have never been to site, therefore don't understand how construction fits together, this includes M&E, terminology and more complex construction such as Piling
12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): <u>Technical Competencies</u> a. Understanding of forms of contract used in the construction industry – Focus tends to be on JCT, but can be taught therefore not a key issue b Understanding procurement routes and tendering, negotiation and award processes – Usually not an issue. Interestingly candidates often cover this in their APC critical analysis c. Measurement and valuing construction works at the various stages of a project – Applying measurement principles to practical examples is an important area, graduates often have limited measurement experience and find it difficult to visualise construction technology d. Understanding the principles of design and construction – Understanding of construction technology is a difficult area e. Understanding the principles of effective cost control of during a

	project – Not an issue Mandatory and Soft Competencies a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Not an issue b. Understanding the principles and responsibilities for health and safety within the construction industry – Understood at CSCS level, but difficulty understanding how this relates to their practical day to day work, but firm's development programme addresses this c. Understanding business accounts, taxation, cash flow and auditing – Not an issue for large firms, but more applicable to small practices. Although there is a question about the significance as any surveyor contemplating own business would surely seek specialist advice on these issues d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Problem applying rules to practical examples, see above e. Understanding the principles and significance of sustainable development/construction – Not an issue
13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? The biggest deficiency is in the area of Construction Technology. Understanding how construction fits together is essential for early estimates, cost plans and BQs Graduate trainees have difficulty knowing how to include for what is not shown in the information provided or on the drawings. The second biggest challenge is turning graduate surveyors into manager/leaders. Back of house staff are important but the firm, need graduates who can lead teams. There is also a deficiency in not being able to give practical examples to ethics, but firm does address this

14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Firm would be prepared to invite say 10 graduate trainees to participate. Briefing session and 1 day workshop would be acceptable format. Firm would be happy to make room available at their offices. If using control group to validate assessment process may need to offer the workshop to members of control group later (so that all trainees are treated equally), but firm would see this as the graduate's choice

FOLLOW ON:

- Thinking about addressing the Construction Technology issue the workshops need to look at a series of construction types:
  Factories/Warehouses (Sheds)
  Offices (Cat A, Cat B, etc)
  Schools (Functional Units)
  Residential (Circulation Space, Communal Provision, etc)
  ALL OF THESE TYPES HAVE THEIR OWN JARGON/TERMINOLOGY

Interview Contact Sheet for Training Managers:

Name: Director Date: 18/11/13 Time: 12.30 -14.00
Company: Firm 8 Location: London Office

1.	Can you tell me your role in the company? Director of Cost Management – Lead for company's QS graduate training programme
2.	What is your company's approximate number of QS staff in: a. UK? Approx. 700 (approx. 50% of turnover relates to quantity surveying) b. Worldwide? Approx. 1200
3.	How many graduate trainees have you in the UK following the QS/Construction Pathway? 40
4.	Can you indicate the mix of these graduate trainees: a. Cognate/Non Cognate Degrees? 70/30 b. Gender (Male/female)? 90/10 c. Age Range? 21-29
5.	Does your company have a Structured Graduate Training Programme? (If so, could you please provide a copy?) Yes. Copy can be made available
6.	Could you describe the structure and primary components of the training programme? RICS core competencies plus presentation skills, ethics and RICS process Follow on: How does the scheme operate? Graduates allocated to Supervisor/Mentor (typically 2 or 3 to 1) Beginner and Advanced graduate weeks Pre Mock APC interview 6 months out (in front to 3 surveyors) Mock APC interview (3 different surveyors)

7.	What teaching/delivery methods are used? (For example, one to one coaching, training sessions/courses, lectures, case studies, role play, etc) On line training modules Formal sessions including examples, case studies, role play External speakers and lunch time CPD Ad hoc sessions arranged by graduate trainees
8.	How does your company judge whether trainees are competent? Follow on: What characteristics are you looking for? (For example, Technical Skills, Presentation Skills, Interpersonal skill, Etiquette, etc) Use Q&A sessions (i.e. what advice would you give to client?) Key characteristic is ability to give sound advice to client Must be able to use judgement Need to understand requirement to stand back and sense check before issue Need to challenge and probe before issue Understand presentation/justification
9.	Typically how long does it take for new entrant graduates to become sufficiently competent? Average 3 years (some take longer). Must give sound performance at Pre Mock and Mock interviews

10.	Turning now to the aspects of competency that you find most difficult to achieve. What would you expect new entrant graduates should understand? For example: a. Role of a surveyor on a day to day basis i.e. nature of the job – Key measure is when they can propose solutions rather than asking b. How to deal with problems administering contracts – See above c. How to communicate what they have done – Not difficult d. How sustainability impacts on the surveyors role – Not difficult e. Application of RICS rules to the job – Not difficult f. How to apply ethics to day to day scenarios – Does present some issues understanding balance between impartial advice and client paying fee g. Extent of leadership surveyor should display – Leadership can be issue, competency is ability to work unaided and deal with problems h. Application of health and safety principles to the job – Not an issue (all have CSCS cards) i. Any others? None Follow on: From your experience which are the most difficult to achieve? As above and concluding discussion
11.	For those identified as most difficult to achieve could you please explain the main reasons for this? a. For your firm – For the firm it is most difficult because client requirements are often bespoke. Key is tailoring service to suit individual client needs b. For the new entrant graduates – Difficult for new entrants because the undergraduate training does not fully address the need to challenge/interrogate and foresee questions

12.	Turning now to the RICS, the APC divides required skills/competencies into Technical and Mandatory/Soft categories. From the following lists please identify those which you consider are the most difficult to achieve (i.e. create a problem for developing): Technical Competencies - None of these are an issue because large firms can provide the variety of experience (in line with RICS Level 1, 2 & 3 requirements) a. Understanding of forms of contract used in the construction industry b. Understanding procurement routes and tendering, negotiation and award processes c. Measurement and valuing construction works at the various stages of a project d. Understanding the principles of design and construction e. Understanding the principles of effective cost control of during a project Mandatory and Soft Competencies a. Understanding the quantity surveyor's role in the avoidance, management and resolution of disputes – Only Level 1 APC requirement b. Understanding the principles and responsibilities for health and safety within the construction industry – CSCS for all graduate trainees c. Understanding business accounts, taxation, cash flow and auditing – Only Level 1 APC requirement d. Understanding RICS rules of conduct and ethical conduct befitting a chartered surveyor – Part of firm's core structured training programme e. Understanding the principles and significance of sustainable development/construction – Only Level 1 APC requirement

13.	Returning now to the aspects of skill/competency we have discussed, could you please identify those where you have experienced the largest deficiencies and are most significant to your business? A large part of the QS business is early cost advice/order of cost estimating Graduate trainees have no experience of visualising construction/scope requirements from limited detail drawings
14.	Finally, would you be willing to invite participation of your graduate trainees in workshops (incorporating non-traditional learning techniques) covering the most significant deficient skills/competencies identified from this research? Research looks to be of benefit to small/medium firms. But would consider participation for benefit of the industry, say 10 graduate trainees. Briefing session and 1 day workshop would be acceptable format

FOLLOW ON:

- Key issue for firm is lack of practical application at undergraduate level. Simulation workshops could usefully be applied more at undergraduate level
- New entrants lack experience of drawings at different RIBA levels. The detail at RIBA A/B is completely different than say RIBA C/D. Measurement at undergraduate level tends to focus on BQ level
- Simulations/Accelerated learning could have real benefits for small/medium firms. This is because they cannot always provide the breadth of experience for graduate trainees
- Also real potential for the emerging markets (Firm looking to fast track new entrants in India)

- May be little real benefit to firm in UK because they are able to provide guided experiential learning through ‘real world’ on the job experience
- But have noticed the difference at mock interviews between firms graduate trainees based in large offices and those based in smaller regions (supporting case of benefit to smaller firms)
- Could also test on group of undergraduates

Appendix D – Learning Workshop Workbook: Example Sheets and Learning Objectives

The following shows example sheets and learning objectives used in the learning workshop workbook.

Faculty of Science & Technology

Department of Engineering & the Built Environment

Anglia Ruskin University

"SURVEYORS CHALLENGE"

Ethical issues and dilemmas
- A Scenario based exercise

WORKBOOK

Developed by Martyn Quarterman

EXAMPLE ONLY

Appendix D – Learning Workshop Workbook – Example Sheets and Learning Objectives (Cont'd.)

WELCOME TO "SURVEYORS CHALLENGE"

Learning objectives

After completing this exercise you should, at an appropriate level, be able to:

- Identify the five RICS Professional and Ethical Standards
- Understand the implications of the Bribery Act 2010
- Recognise a conflict of interest
- Understand the implications of the law relating to money laundering and the Money laundering Regulations 2007
- Understand the implications of errors and professional indemnity
- Recognise where these may occur in the work of surveyors and identify appropriate actions

PLEASE TURN OVER

EXAMPLE ONLY

Appendix D – Learning Workshop Workbook – Example Sheets and Learning Objectives (Cont'd.)

SHEET 1 - THE SCENARIO

- The project is a new build office/warehouse scheme located on a business park in a designated development area
- The business park comprises parcels of land available for purchase

PLEASE TURN OVER

EXAMPLE ONLY

Appendix D – Learning Workshop Workbook – Example Sheets and Learning Objectives (Cont'd.)

SHEET 4 - PLANNING ADVISOR ACTIVITY

- The Client has been approached by a Planning Advisor offering to speed the planning approval process
- You have heard rumours that this advisor rarely delivers on promises
- Discuss how you should respond or whether Ethical Standards apply

AFTER DISCUSSION COLLECT FURTHER INFORMATION AND GO TO SHEET 5

EXAMPLE ONLY

Appendix D – Learning Workshop Workbook – Example Sheets and Learning Objectives (Cont'd.)

SHEET 10 – ACCELERATING PLANNING APPROVAL DILEMMA

- Obtaining planning approval is moving slowly and the client offers to provide funds to speed things up, you are asked to advise
- The planning advisor suggests the payments might be used to compensate neighbours
- If you feel the funds could be used (YES) **GO TO SHEET 19**
- If you feel the funds should not be used 9no) **GO TO SHEET 16**

DECISION

EXAMPLE ONLY