The Impact of Blended Learning Technologies on Student Performance/Learning in Biomedical Science Higher Education

by

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ABSTRACT

This study examines the benefits of learning innovations in e-learning (asynchronous classrooms only) and blended learning (asynchronous virtual classrooms plus traditional learning) compared to traditional learning (classroom lectures). It specifically investigates effects on student satisfaction, retention, progression and achievement. We focussed on core biomedical science modules at London Metropolitan University: and four such modules were electronically supported using a learning and content management system programme.

The collaborative learning intervention (N = 193, 71 males, 122 females), showed there was no significant change observed in performance across pre-intervention and post intervention modules over five years, with the exception of the 2010 cohort (p = 0.008) where students responded positively to the intervention. Interestingly, the quality of student online posts and final group grade for coursework revealed a strong positive relationship (r = +0.69, p < 0.0001, 42% improvement). We determined that tutors enhance work quality via moderation of online posts. The availability of personalised, timely and iterative feedback is likely to be responsible for this difference.

Gender differences were apparent. There was a strong positive correlation between overall group rating and individual rating in male students only (r = +0.81**, p < 0.0001, 65% of predictions correct) and with males’ personal expectation (r = +0.5**, p < 0.0001) (Table 4.4). Males’ mean self-rating was 9/9 and females 7.9/9. Interestingly, 52% of females were likely to predict their final grade accurately, appearing to base this judgement on their interaction with the work and results self and peer assessment. The judgement of male students appeared to be based solely on self-belief that out stripped attainment with correct predictions in 25% of cases. The mean coursework pass mark for the post intervention module increased compared to previous years. Student self-evaluation showed that >80% enjoyed the collaborative learning work elements.

For an optional formative assessment intervention, impact was evaluated over five years. This study identified a significant difference between the intervention cohorts and the non-intervention year group, who were educated traditionally. When the post intervention groups were compared to the control, highly significant p values were obtained (p = < 0.0001 to < 0.00001). Additionally, students who were ‘quiz avoiders’ attained lower grades. The control group (N = 190), attained a mean mark of 55.3%, within this group, quiz avoiders achieved marks ranging from 34.4-42.6%. Quiz takers performed better than the control group with the mean marks ranging from 59.2-61.2%. Thus, blended learners’ achievements significantly improved (p = 0.0001), compared with those pre-intervention and those not engaging. In terms of self-evaluation, 60% of students rated the formative assessment (online quizzes) as ‘useful’ or ‘very useful’.

Web-based collaboration improved academic performance and student satisfaction. Comparisons between pre-intervention and intervention groups were significantly different to the fraction of final exam first sit passes (p = 0.048). The intervention group showed the improvement. Interventions were applied at specific time points so that intra-annual comparisons could be drawn. This study detected profound differences: the mid-year exam (pre-intervention) was compared to the final exam (post-intervention) and showed a significant first sit performance (p = < 0.0001). Interestingly, 70% of students stated they would like the intervention (BB Collaborate) in more of their modules.

We have shown, for the first time, that longitudinal studies over five year of large cohorts, there is a consistent significant improvement in student performance and engagement-using reward based formative assessment (Jacoby, et al., 2013 – incorporates data from this thesis).

These interventions have subsequently been incorporated into the successful London Metropolitan University biomedical science course and in combination led to enhanced retention, progression and achievement over the study period. Furthermore, the practices illustrated are applicable to a modern higher education environment and are likely to enhance many similar course routes across the sector.
Declaration

Whilst registered as a candidate for the Doctorate in Biomedical Science, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of Sheelagh Mary Bernadette Heugh and have not been submitted elsewhere for any other academic award.

Sheelagh Heugh

December 2014
Dissemination

Using e-learning to engage with diversity in Health & Human Sciences

Presented at LondonMet L&T Conference - 8 July 2008


Postgraduate distance learning provision in biomedical science. Talk presented at LondonMet L&T conference – 6th July 2010

Transforming learning through connecting research and teaching. Panel member at LondonMet Learning & Teaching Conference - 10 July 2012


Student tutorials – enhancing engagement. Talk presented at BlackBoard pilot meeting review, London -17th June 2014

Bridging the gap: bringing virtual students into the physical class. Talk presented at LondonMet L&T conference - 8th July 2014.


Examples in appendix A
Acknowledgements

Sincere thanks to my principal supervisors: Dr Roz Gibbs and Prof Graham Mills, for the much-valued guidance and encouragement; Prof Annie Bligh for her encouragement to start my Professional Doctorate and at the end to complete it. Dr Julie Evans who also gave valuable guidance, encouragement and the many hours of time so generously given in an act of true friendship. With thanks also to my colleagues at London Metropolitan University William Armour, Dr Simon Dryden, Dr Una Fairbrother, Prof Jameel Inal, Shara Lochun, Dr Paul Matewele, Dr Samir Nuseibeh, Prof Eileen O’Keefe, Sandra Sinfield, Dr Dominic Spillane and Dr Dan Stratton for reading and critiquing this work. Their timely corrections and advice for improvement has helped develop this work. The tutors who engaged with the research and implemented it with the students over the research period, Roberta Freezor, Sean Frost, Ahmad Haidery, Dr Ken Hudson, Dr Samireh Jorfi, Juli Le Page-Pezet and Dr Taru Shah to name a few. I also wish to thank the students who participated for their time and active engagement; especially those who volunteered to take part in interviews.

Thanks are also due to my friends and family who have accompanied me on this journey: to Una and Dominic, for being so truly supportive of me every step of the way, and lightening my summer load; to Steve for trying his best to understand the extra to work that I had to undertake to complete this work.

Also in remembrance of my lovely Gran Ellen and Auntie Mary Dempsey, David and Diane Gurling who would have all loved to see me reach the end of this journey and I hope I live up to their expectations and belief in me.

And finally, but by no means least, my heartfelt gratitude to my Father “Mike” Heugh (1922-1992) for filling my world with love and support, and instilling the values that have formed my adulthood, along with my Mother Kathleen, they always encouraged me to try my very best, engendering within me the value of a good education and worked so very hard to provide the opportunities for me to acquire it. I am also grateful to my brother John, sister Lorna, nephew Jacob, niece Jasmine and their families, for just being there for me whenever I needed them.
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### Abbreviations

<table>
<thead>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>DfEE</td>
<td>Department for Education and Employment</td>
</tr>
<tr>
<td>DfES</td>
<td>Department for Education and Skills</td>
</tr>
<tr>
<td>HCPC</td>
<td>Health Care Professions Council</td>
</tr>
<tr>
<td>HEFCE</td>
<td>Higher Education Funding Council England</td>
</tr>
<tr>
<td>HESA</td>
<td>Higher Education Statistics Agency</td>
</tr>
<tr>
<td>IBMS</td>
<td>Institute of Biomedical Science</td>
</tr>
<tr>
<td>LondonMet</td>
<td>London Metropolitan University</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-Operation and Development</td>
</tr>
<tr>
<td>QAA</td>
<td>Quality Assurance Agency</td>
</tr>
<tr>
<td>SHS</td>
<td>School of Human Sciences</td>
</tr>
<tr>
<td>UCISA</td>
<td>Universities and Colleges Information Systems Association</td>
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Chapter One: Introduction

“Universities today face what may be their greatest challenge as they face globalization, expansion, and economic uncertainty, overlaid by emerging technologies that enable the technologically savvy student body to interact in new ways with content and with each other. This confluence of factors requires the academy to rethink and restructure, both what and how they teach and research, and how they intersect with society” (Seimens & Matheos, 2010, p. 4).

1.1 Study purpose

The purpose of this study is to elucidate effects of integrated technology-based educational activities on student satisfaction, retention, progression and achievement. LondonMet uses a virtual learning environment “WebLearn” Blackboard™ technology is used to complement face-to-face teaching, delivering the learning objectives; via a novel, highly interactive module design. Whilst creating blended strategies to enhance the student learning experiences, as an instructional designer, it became evident that the various technology supported interventions generated different responses from students. Some students fully engaged with each intervention and embraced the use of technology, whilst others showed much less enthusiasm, or did not engage at all. These observations fuelled this investigation into why students responded with markedly different levels of engagement, to the use of technology including which factors were driving their motivation for learning. From a University based academic viewpoint, there is an institutional emphasis, and increasing cultural drive to utilise technology for supporting and enhancing student learning. In the light of my observations, and since academics are increasingly devoting more time and money to the creation of blended
strategies, with the aim of enhancing student learning experience, it becomes imperative to address the question: When using technology (designed especially to support student learning including development towards graduate status and personal attributes expected by prospective employers), what are the benefits for those students who embrace it compared with others who do not engage? This study will address this fundamental question in addition to making a unique contribution to the literature surrounding blended learning interventions in teaching and learning in higher education. Today’s graduates will be our future employees/employers or leaders influencing our lives at all levels (Haigh & Clifford, 2010; Davis, 2003). So our course aims are to produce outstanding, employment-ready graduates as an output from our Institute of Biomedical Science accredited programmes, which blend academic knowledge with appropriate personal attributes required in the workplace.

1.1.1 Biomedical science cohort

This study focuses on biomedical science students. Due to the highly specialised nature of the profession, graduates must possess certain attributes in order to be employed as a biomedical scientist. The Institute of Biomedical Science (IBMS) in addition to the Health Care Professions Council (HCPC) and the Quality Assurance Agency (QAA) directly regulate these for higher education. In the UK, the QAA provides precise definitions pertaining to graduate attributes. At the very least, the degree obtained by the graduate must be of an integrated nature. “Integrated” refers mainly to the presence of an integrated component, which is typically pathobiology (QAA, 2007). The integrated degree must be either approved by the HCPC or accredited by the
IBMS. A degree that is both approved by HCPC and IBMS-accredited is desirable. Furthermore, the graduate must demonstrate knowledge and understanding of subject areas that make up the realm of biomedical science. At the basic level, the graduate must possess knowledge about the following areas, as enumerated by QAA (QAA, 2007a):

1. biochemistry,
2. cell biology,
3. genetics,
4. human anatomy and physiology,
5. immunology,
6. microbiology,
7. molecular biology.

The biomedical scientist is expected to be involved in clinical/laboratory investigation. Hence, a graduate must also possess the knowledge and understanding of disease processes. Such processes include the following (QAA, 2007):

1. cellular pathology,
2. clinical biochemistry,
3. clinical genetics,
4. clinical immunology,
5. haematology,
6. medical microbiology,
7. transfusion science.
The above terms have precise definitions as laid out by the Quality Assurance Agency for higher education. Despite the standardisation the field is widely regarded as a dynamic one as new biomedical developments often give rise to new specialisation areas.

The generic skills expected from a biomedical science graduate are stated (and reproduced below) from the up-to-date standardised definition of the field of biomedical science (QAA, 2007) (Table 1.1).

Table 1.1 QAA benchmarks for biomedical science (QAA, 2007).

<table>
<thead>
<tr>
<th>Threshold standards</th>
<th>Typical standards</th>
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<tbody>
<tr>
<td>On graduating with a bachelor’s degree with honours in biomedical science, students should be able to:</td>
<td></td>
</tr>
<tr>
<td>access biomedical science information from a variety of sources and to communicate the principles in an appropriate manner</td>
<td>access and evaluate biomedical science information from a variety of sources and to communicate the principles both orally and in writing (for example essays, laboratory reports) in a way that is well-organised and topical</td>
</tr>
<tr>
<td>have an ability in a range of practical techniques relevant to biomedical science including data collection, analysis and interpretation of those data, and testing of hypotheses</td>
<td>demonstrate ability in a range of appropriate practical techniques and skills relevant to research in biomedical science, including the ability to place the work in the context and to suggest lines of further investigation</td>
</tr>
<tr>
<td>have an understanding of the explanation of biomedical concepts at all levels of biological organisation ranging from molecules to intact organisms</td>
<td>have a secure and accurate understanding of the explanation of biomedical concepts at all levels of biological organisation ranging from molecules to intact organisms</td>
</tr>
<tr>
<td>plan, execute and present an independent piece of work (for example project) within a supported framework in which qualities such as time management, problem-solving and independence are evident</td>
<td>plan, execute and present an independent piece of work (for example project), in which qualities such as time management, problem solving and independence are evident, as well as interpretation and critical awareness of the quality of evidence</td>
</tr>
<tr>
<td>have some understanding of ethical issues and their impact on advances in biomedical science</td>
<td>construct reasoned arguments to support their position on ethical issues that impact on advances in biomedical science</td>
</tr>
<tr>
<td>record data accurately, and to carry out basic manipulation of qualitative and quantitative data (and some statistical analysis when appropriate)</td>
<td>apply relevant advanced numerical skills (including statistical analysis where appropriate) to data</td>
</tr>
<tr>
<td>have developed basic strategies to enable them to update their knowledge of biomedical science.</td>
<td>have well-developed strategies for updating, maintaining and enhancing their knowledge of biomedical science.</td>
</tr>
</tbody>
</table>
This chapter aims to explain why the research documented in this thesis is: a) relevant and important, b) provides a background to, and the motivation for the study, c) outlines the research objectives and questions, d) give an overview of the conceptual framework and methodology, and e) present a thesis organisation overview.

1.1.2 Background to the research

The paradigms of higher education in England are continually shifting. One of the most significant recent changes facing providers of higher education occurred in 2012, when universities were allowed to set their fees and now have to attract students in an open marketplace. In the same era, the English government stated that higher education institutes should offer ‘Opportunity, choice and excellence in higher education’ (HEFCE, 2011).

‘Widening participation... is vital in creating a fairer society, securing improvements in social mobility and supporting economic growth .... A diverse student population is essential to vibrant intellectual enquiry and a resilient knowledge economy. It encourages a higher education offer that is socially and culturally diverse, and more representative of local communities. The availability of local provision, including through further education colleges, will continue to be very important. It is also essential that the principle of opportunity extends to postgraduate taught programmes and research students, and that study in England remains open to overseas students at all levels’ (HEFCE, 2011, para.10 and 11).

In 2008 there were 1,066,600 student enrolments in 2008, 772,000 were domestic students and 294,000 were overseas students, 69 % of these are full time and the majority 94 % attended public universities (HEFCE, 2010).
Australian government targets state by 2020, 20 % of higher education enrolments at the undergraduate level will be of people from a low socioeconomic background and by 2025, 40 % of all 25 to 34 year olds will hold a qualification at bachelor level or above (HEFCE, 2010). More ambitiously the 2020 target for the UK was 50 % of 18-30 year olds to participate in higher education. A target hard to achieve, unless the cost implications for the providers of this higher education diversity are recognised and monies are provided to offset the extra costs involved in the support of these more resource needy students (needs ranging from financial to psychological) and the burden not left in large part, to be shouldered by the ‘modern universities’. However, it is this sector that is pioneering new methodologies and leading in developing new ways to learn. This sector is responsible for educating the most diverse range of students that reflect the ethnic and social mix in the area that they are located.

“Widening access and improving participation in HE are a crucial part of our mission. Participation in HE will equip our citizens to operate productively within the global knowledge economy. It also offers social benefits, including better health, lower crime and a more tolerant and inclusive society”. (HEFCE, 2002, p. 11).

1.1.2.1 Technology in higher education

This thesis explores the development of initiatives to improve student satisfaction and success. The study specifically examines initiatives designed to increase the attractiveness of biomedical science at London Metropolitan University and to meet the institute’s aim to deliver "affordable, quality, education'. The perpetual deliberations concerning academic success or failure
amongst university students have been the subject of many debates some of which have lead to the enhancement of teaching. The primary drivers for such innovations in education are; the desire to enhance the learning experience, the desire to enhance quality and the desire to act as a motivator to improve academic performance of students. As a consequence, lecturers are under constant pressure to find ways to stimulate students with the aim to improve the retention, progression and final achievement rates for their courses. Historically these innovations have been decided upon in a haphazard manner, often based on anecdotal evidence, prior practice, and even best guess (Danielson, 2008).

Current educational research involving observing student/teacher interactions has been evaluated within this thesis in an attempt to provide both qualitative and quantitative information with respect to the effects of classroom activities on student achievement. Many of the strategies used since 1963 have been based on Carroll's model, which focuses attention on direct observations of classroom interactions between the educator, and those being subjected to various educational delivery methods (Huiitt, 2003). Educational psychologists have analysed these dynamics and rationalised them, and many statisticians have tried to predict outcomes in relation to delivery methods (Minnart & Janssen, 1999; Adams, et al., 2010; Beutelspacher & Stock, 2011). The main effectors were identified as the learning environment and quality of both parties (teachers and students). Thus it appears that it is essential to respond to these results by improving the educational environment and the input from the educator.
The last three decades have seen an explosion of technological teaching tools, interactive animations, Podcasts (Chan, 2010; Anderson, 2007; Luna & Cullen, 2011), digital microscopy, interactive computer marked assessments (Laurillard, 2007), and the impact of internet has promoted the appearance of virtual learning environments or e-learning platforms to support blended learning in enhancing educational delivery (Nagi & Suesawaluk, 2008; Obadara, 2014). Given the burgeoning use of modern technology for the delivery of information, enhancement of achievement, improvement of skills, and evolving technological advancements constantly responding to the needs of modern society, higher education should be leading the way and producing the next generation of graduates fit to enter a technology driven future (Nagi & Suesawaluk, 2008; Seimens & Matheos, 2010).

Technology-enhanced education is receiving a growing degree of interest in an increasingly competitive marketplace where universities aim to: 1) capture a larger student base; 2) remain competitive; 3) maintain their viability in the face of economic instability and globalisation, and 4) seek to modernise traditional teaching approaches in response to a globally technologically mobile world (Siemens & Matheos, 2010). London Metropolitan University typically has a diverse student population where asynchronous learning opportunities have a particular advantage.

1.1.2.2 Benefit to university sector of adopting blended learning

Higher education in the UK is an important international brand. “There are few sectors of the UK economy with the capacity to grow and generate export
earnings as impressive as education ..... Our universities, colleges, awarding
organisations and schools are recognised globally for their excellence." (HM
Government, 2013). This statement implies that the government sees the UK
Higher Education sector as an area for growth, in 2010 almost 300,000 student
visas were granted to UK Universities, Colleges and private Schools generating
billions to the British economy (Immigration Matters, 2011). To maintain their
appeal UK universities need to utilise technology to appeal to the widest
student audience and enhance the students learning opportunities. The
government statement (2013) does seem a contradiction to the change in
student visas, which almost decimated the UK higher education sector.
Stopping the right to work for up to two years after completing studies also
decreased the appeal of studying in the UK, returning home with a degree, or
postgraduate award and enhanced work skills was a highly desired attainment.

To continue to succeed, universities need to achieve government targets for
academic standards, to increase student success and participation rates, (often
referred to as retention, progression and achievement). They need to be able
to attract new students and enhance their employability. This is particularly
important in relation to under-represented groups described as ‘non-
traditional students’ and ethnic minorities (referred to as educating the
masses) (Holley & Oliver, 2010; Connor, et al., 2004).

Principle 3: “Everyone who has the potential should be able to benefit from higher education. No one should be put off from studying in higher education because they cannot afford the cost of living while they are studying. HEIs will be evaluated on how well they are doing in providing fair access to all” (Browne, 2010, p. 4).
University administrators and lecturers view blended learning as a promising strategic tool to develop the change required to attract more students, expand their market share, enhance their public profile, and offer increased choice and flexibility than traditional campus-based delivery. Empirical evidence supports the view that blended approaches to learning attracts more students and receives more positive feedback from students (Beutelspacher & Stock, 2011; Salamonson & Lantz, 2005; Uğur, et al., 2011). The two principal reasons are:

(1) time-poor students who face increasing pressure to work and study have an increased element of choice and flexibility (Graham, 2006).

(2) student expectation in this tech savvy world, is that their day to day technological devices will also feature in their classes and blended approaches to educational delivery satisfy this expectation (Ross & Gage, 2006).

Blended learning helps increase efficiency and even-out the standard of delivery to large numbers of students as well as enhancing the potential of attracting a larger number of students.

(1) Current technology and virtual learning environments provide a wide range of options for the delivery of content, and providing better value for the students as this can be manipulated into developing individual learning pathways, therefore supporting students with different learning styles (Ross & Gage, 2006).

(2) Developing practical competencies that may either, not be possible or practicable for the university. For example, practicing laboratory skills
via a virtual laboratory to develop or enhance skills such as virtual human dissection (Sancho, et al., 2006).

(3) The utilisation of web-based learning tools in an engineering education institution addressed the disparate backgrounds, subject content experiences, and personal goals of students. Through Moodle virtual learning environments the learning modules have been made visually appealing and interesting to learn for a diverse population of students. Teachers have also become more engaged through the use of online social networking as a virtual delivery method of learning content (Uren & Uren, 2009).

1.1.2.3 Is blended learning a cure all?

Many universities have tended to see ‘flexible delivery and blended learning’ as a ‘cure all’ for the problems that accompany more diverse student bodies that have been facing higher education since the late 1990s. The prominence of technology solutions in education may be a response to: “mass education” (Holley & Oliver, 2010), teaching more diverse student cohorts, student demand for convenience (study versus work/life balance) (Holley & Oliver, 2010), employer demand for ‘on-the-job training’, the promotion of ‘lifelong learning’, or to the emerging constructivist educational theories related to teaching and learning (Schuetze & Slowey, 2002; Holley & Oliver, 2010). An article in ‘The Guardian’ “Get a Degree by Blended Learning...Blended learning is booming as higher education becomes more demands focused” supports the student and employability (Tobin, 2011). The article suggests that blended learning is attractive to students, enabling them to juggle their studies and
other work/life commitments. As purported in that article, the concept of blended learning has inflamed universities' interest and they are now investing considerable time and effort into its implementation (Bonk & Graham, 2006; Bonk, et al., 2006; Graham & Robison, 2007). The term ‘blended learning’ is defined by Tobin as “courses that mix classroom-based education with distance learning, often via online features that allow students to receive tailored help from tutors, such as online forums, video conferencing and internet telephony technology such as Skype” (Tobin, 2011; Harrison, et al., 2014). The precise definition of the term blended learning is not as simple as that expressed by Tobin (2011) there is a lack of consensus on the definition as Driscoll (2002) observed, ‘blended learning’ “means different things to different people”. Blended learning has been defined as a mixture of traditional learning and online learning (Williams, 2002; Osguthorpe & Graham, 2003; Sharma, 2010). Also defined as the integration of e-learning tools such as virtual learning environment with face-to-face learning (Welker & Berardino, 2006; Sharpe, et al., 2006). The aim of this type of learning is to join the advantages of face-to-face classroom learning with the advantages of e-learning to enhance the learning environment (Bleed, 2001; Garnham & Kaleta, 2002; Margaryan, et al., 2011). In the current study the blended learning takes the form of a combination of the traditional classroom (face-to-face) delivery and the asynchronous virtual classroom, where students have to attend some lectures in the classroom and undertake other lectures and activities through an asynchronous virtual classroom tool (Margaryan, et al., 2011).
The literature indicates that the vast majority of implementations do little, or nothing, to enhance teaching practices, but are seen as just “stretching the mould” (Collis & van der Wende, 2002) by using virtual learning environments technology as a PowerPoint slide repository or administrative area for module books, assessment rubrics and general study resources.

The critique against virtual learning environments-based delivery of learning modules has gone as far as gathering actual evidence on the ineffectiveness toward enhancement of the learning process and experience. For example, Hsu and Hsieh (2011) conducted a quasi experimental study among nursing students. The study was meant to compare the performance between an experimental group exposed to blended learning strategies and a control group subjected to traditional learning methods. Using different quantitative instruments, Hsu and Hsieh (2011) found no substantial evidence for the effectiveness of the blended learning model applied to nursing education.

Nevertheless, the opportunity for virtual learning environment technology as a means for the personalisation of the learning experience is considerable. Diverse subject mastery and prior educational backgrounds have been difficult issues to address using traditional, monospecific-learning models that impose synchronicity. Virtual learning environments can accommodate flexibility of pacing for the learner. A fast learner is expected to finish an entire module in the same time period as a slow learner. Yet through virtual learning environments the two kinds of learners are not pressured to finish the module at the same. Flexibility is key to virtual learning environments as applied to
administering a blended learning approach. Moreover, utilisation of virtual learning environments could also address the mastery of diversity of content among a diverse cohort of learners. For instance, a student who does not have a strong background in algebra might choose to take a supplemental tutorial first before proceeding with the formal module which pre-requires algebra. In that way, the learning experience becomes individualised according to the actual needs of the learner. As a support mechanism, the virtual learning environment’s capacity to integrate personalised learning profiles, more easily provides for the diversity of learners. Not only background, but also learning styles are widely disparate in a cohort of students. By catering to a variety of learning styles, the virtual learning environments also becomes more engaging especially to those who are not so adept at traditional classroom-based teaching (Mitchell & Forere, 2010).

1.1.2.4 Blended learning and the global curriculum

In chapter two of this thesis, the issues related to defining blended learning are further discussed and the definition of blended learning that is used in the remainder of the thesis is formulated (section 2.6).

A search of universities’ institutional teaching and learning documentation provides substantial evidence of the growing popularity of blended learning. UNESCO state the curriculum can be designed and adapted to provide a more inclusive environment for the education provider or for the lecturer to adapt their materials for individual learners or to local requirements (UNESCO, 2003; UNESCO, 2005). Blended learning or distance learning does help in the
reduction of physical barriers (distance, student mobility, even excluded students) to learning and participation (UNESCO, 2002; UNESCO, 2003; Bonk & Graham, 2006; Garrison & Vaughan, 2008). Blended learning can offer flexible learning opportunities to individuals’ widening access to education, free up time and remove location constraints (UNESCO, 2005; UNESCO, 2002; Wu, et al., 2010). The influences from the paragraph above can be seen in the quotations in table 1.2, which are representative of what can be found, and clearly shows that universities worldwide are making a considerable investment in the implementation of blended learning as an institutional strategy.
Table 1.2 Examples of strategic statements from higher education institutes around the world.

<table>
<thead>
<tr>
<th>Country</th>
<th>Strategy</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>Vision. Each programme will define and embed into a research-led curriculum and appropriate blended learning approach which supports learning, enhances the student experience, and inspires student to reach their full potential so they can have an impact on our global and digital society.</td>
<td>(University of Leeds, 2005, p. 2)</td>
</tr>
<tr>
<td>USA</td>
<td>Blended learning allows MIT to integrate a rich array of learning opportunities – distributed and convenient – triggered by many needs and situations. Learning becomes the mutual responsibility ....... as learning architects and curators of sources and resources. Individuals will see work as learning how to address unique situations, recognize where to turn for learning, support and advice; and formally or informally share that knowledge widely with others. ...... MIT will be known as an exceptional place to develop outstanding skills and abilities through a range of blended experiences.</td>
<td>(Massachusetts Institute of Technology, 2012, p. 1)</td>
</tr>
<tr>
<td>Australasia</td>
<td>Universities globally are addressing the challenges of making learning and teaching more accessible and more flexible. The push towards greater flexibility of learning, supported by existing and emerging technologies,........UWS there is a strategic and systematic approach to combining times and modes of learning, integrating the best aspects of face-to-face and online interactions for each discipline, using appropriate ICTs.</td>
<td>(University of Western Sydney, 2014, para 1)</td>
</tr>
<tr>
<td>Europe</td>
<td>B-Learn project is designed to offer a number of tested ways that integrate traditional learning methods with methods offered by new technology. Blended learning allow to benefit from good sides of both traditional and new ways of learning, make innovation in otherwise traditional university teaching easier and acceptable. Integrating research and practical examples offers a good bases for initiating change in universities that by definition are based on research.</td>
<td>(University of Tartu, 2005-7, para 2)</td>
</tr>
<tr>
<td>Asia</td>
<td>Flexible study modes provide an alternative to traditional face-to-face learning and teaching, and allow you to study wherever you may be. As AeU is endorsed by 33 ACD member countries, providing alternate modes of study is important for us to reach out to students around Asia and beyond. Blended learning is a combination of face to face tutorials and ODL which are applied in an interactive learning environment. Blended learning gives students and tutors an environment to learn and teach more effectively.</td>
<td>(Asia e University, 2014, para 1)</td>
</tr>
<tr>
<td>Africa</td>
<td>According to the Institutional Quality Assurance Manual, Section 3, blended learning is accepted at the UFS as a teaching-learning strategy for both on-campus and off-campus academic programmes. On-campus teaching and learning (utilising different innovative approaches, strategies, and methods) are at the core of operations at the UFS. A blended learning model is one that incorporates a variety of delivery styles and accommodates different student and organisational needs to achieve the most effective learning.</td>
<td>(University of the Free State, 2000-14, p. 1).</td>
</tr>
</tbody>
</table>
1.1.3 Aims

In the light of the current literature it is essential to understand the role of blended learning in reaching more diverse audiences. The efficacy of such an approach needs to be formally analysed in a real world situation. The research described in this thesis investigates and evaluates the capacity of blended approaches to improve student retention, progression and achievement on a specific module entitled “haematology and transfusion science” module (code BM2006N). In science and engineering education, blended learning can and has been used to deliver quality learning experiences as described in section 1.2.1. The study examines the use of technology in supporting effective teaching practices to achieve quality-learning experiences in line with published literature (Garrison & Kanuka, 2004; Garrison & Vaughan, 2008; Cooner, 2010; Kerres & Witt, 2003; Singh & Reed, 2001). This study uniquely analyses large numbers of students in cohorts over periods of up to five years, providing a rich source of data to enable meaningful analysis of blended learning interventions. The study has generated reliable statistics, and is well powered to detect the effect sizes through the generation of clean data with well defined mu 0 (known mean) and mu 1 (expected mean), alpha value 0.05 and with sample sizes of between 120 -1363 we attained a typical power 99-100% (http://www.statisticalsolutions.net/pss_calc.php).

1.2 Design of blended learning sessions for improved delivery

Efficient use of blended learning tools requires both the student and academic alike to allow students to acquire new knowledge and skills. Instruction and support to guide students in the use of the blended learning events requires
more work and provision of detail than for face-to-face events. Students come to university with many years of experience of didactic teaching where they are not required to critically discuss or reflect on their learning (Paul, 1992), for example, in face-to-face tutorials it is easier to engage students in discourse and to draw out these activities with the students but this needs more guidance and moderation, within an online forum, by the academic (Veerman, et al., 2001; Zhu, 2012). For effective implementation of blended learning interventions, academics and students are usually faced with a steep learning curve (Duffy & Kirkley, 2004). Academics need to research which tools are available; how they can contribute to student learning, and meet the module outcomes: how to integrate the tools into the curriculum; what training and instruction is needed to enable students to successfully engage with the interventions; as well as evaluating the pedagogic advantages/disadvantages of those activities (Welker & Berardino, 2006; Park & Bonk, 2007); does the deployment of the intervention affect the assessment? Garrison and Kanuka (2004) say: “Blended learning is inherently about rethinking and redesigning the teaching and learning relationship”, supports this. To ensure the best engagement, academics need to identify whether the technology is both accessible to the students and is supported by technicians. Using technology to enhance learning requires significant module/course redesign, the creation of new learning activities and review of the reassessment strategies these challenges are highlighted by the SLOAN Consortium (SLOAN, 2012).
1.2.1 Aims of study with respect to design of blended learning

This study intends to contribute to the body of knowledge concerning increasing student engagement using blended learning interventions. This in turn, highlights the design required to increase interaction, to select appropriate assessment methodologies/tools, to ensure and evaluate quality, and the level of academic support required (Figure 1.1). To understand the fundamental question is how blended learning technologies can support and enhance student engagement and performance. To do this one must gain an understanding of the student cohort including demographics, along with their technological commitment – especially as prior practices and experiences shape an individual’s response to new tasks (Thornton, 2008; Sharpe, et al., 2006; Bersin, 2004; Bonk & Graham, 2006; Garrison & Vaughan, 2008; Oliver & Trigwell, 2005).

A review of the literature related to blended learning in higher education reveals that the literature is dominated by research into the student perspective, such as that by Salamonson and Lantz (2005), Adam and Nel (2009), Mitchell and Forere (2010), and Lust et al (2011), but often omitting student demographics, learning preferences and effect of blended technologies on achievement.
Figure 1.1 Factors considered when using blended learning be used to enhance student learning? Research can identify a web of interconnections outlining the areas for consideration when developing a blended learning environment.

1.3 Definition of terms

1.3.1 Electronic learning (e-learning)

E-learning is defined as education that is primarily delivered through electronic information and communication technology. The role of facilitator and learner are intact, but the mode of exchanging information and engaging the learning process is mediated by electronic technology. Knowledge is packaged in different forms, such as images, video, audio, and other electronic formats (Oliver & Trigwell, 2005; Graham, 2006).

Although not a necessary feature, e-learning is particularly suitable for remote learning without face-to-face contact – ‘distance learning’ (Moore & Kearsley, 2011). E-learning could nevertheless also take place in the classroom setting. But its suitability for distance education is its reliance on telecommunication in order to bridge the interchange between facilitator (teacher) and learner.
(student). Hence, wherever the teacher or student may be the delivery of knowledge is made possible at a distance. E-learning is an efficient means for implementing blended learning, which combines face-to-face and virtual learning modes (Clark & Mayer, 2011; Tavangarian, et al., 2004).

Electronic media is a technological leap that revolutionised many human activities. Education is one of those activities. In essence, e-learning is the evolution of education induced by the emergence of electronic means of exchanging information. Classroom-based learning is as much a radical evolution from the informal family-based apprenticeship. In the same sense, e-learning is anticipated to evolve in the future if and when a “game-changing” technology would come along. If such technology is not electronically based, then the term “e-learning” also ceases to be a description of education mediated by that technology (Tavangarian, et al., 2004; Clark & Mayer, 2011).

1.3.2 Asynchronous virtual classroom
The asynchronous virtual classroom is a learning platform where the teacher and the student are not engaged in the learning exchange at the same time. The teacher creates the learning material at a certain time while the student accesses the material later. This is the reason why it is described as “asynchronous.” The platform is typically online, hence the term “virtual.” These two fundamental features make the asynchronous virtual classroom diametrically different from traditional classroom. Face-to-face interaction is not a requirement because both parties of the information exchange do not
have to be at the same place and time (Swan, 2009; Coppola, Hiltz, & Rotter, 2002; Swan, et al., 2000).

There are situations wherein the asynchronous engagement is supplemented by synchronous modes, such as teleconferencing or video chat. Moreover, the dialogue is not limited between teacher and student. Communication between students is also made possible through forum or discussion boards. In today's online social networking systems, the participants could provide their comments to another's output. The asynchronous virtual classroom is truly a reflection of the shift from teacher-centred to student-centred education.

1.3.3 WebLearn

Virtual Learning Environments, Learning and Content Management System programme like WebLearn (the LondonMet name for Blackboard™) act as a means to deliver subject matter, delivering assessments, electronic communication, to students via the university intranet or internet (Dillenbourg, et al., 2003). WebLearn also increases the efficiency of tracking and monitoring the delivery of learning modules. The software provides an automated tracking feature that eliminates the bookkeeping tasks from teachers/facilitators/trainers. Hence, they could focus more on the task of content generation and delivery. Many universities operate their own flavour of the course management system. The most common ones at present are Moodle™, WebCT™ (bought out recently), Desire2Learn™, and Blackboard™ (Dunn, 2012). Having a course management structure also facilitates student
registration of modules, which are required in their curriculum, and on the basis of their eligibility to take any particular course.

1.3.4 Traditional learning
The simplest definition of traditional learning is face-to-face learning, lecturer in the lecture theatre with students, and relies on the instructor for delivering the lecture material and discussing the topics (Bereiter & Scardamalia, 1993; Tynjälä, 1999; Biggs & Tang, 2011). Traditional learning is characteristically synchronous because the student and the teacher have to be at the same time and place for the learning exchange. The teacher is considered as the “expert” who transfers knowledge to the students. The effectiveness by which students have imbibed the knowledge is assessed using written and/or oral examinations. The assessment is quantified by means of a standardised grading system. The teacher traditionally used a board to write on, and there was no electronic equipment that supplemented the teacher's delivery of the instruction material, which over the years has moved to electronic projection of slides, PowerPoint and video. Textbooks are typically assigned by the teacher as a reference for the content used by the teacher. The students, on the other hand, jot down notes during lectures and organise the information in accordance with that prescribed by the teacher. Hence, the knowledge gained by the students is in most cases the kind of understanding that the teacher has on the lesson topic.
1.3.5 Student achievement

Student achievement is associated with student performance, which is generally assessed by means of examinations that are based on the content provided by the teacher. However, in outcomes-based education the performance is measured through competencies/fitness to practice (Davis, 2003). Student assessments (for example essays, exams, coursework) are administered to gauge the depth of knowledge and understanding of the basic content, skills, and ability related to the profession that the degree qualification represents.

According to Universities UK (2007), the honours degree is the most distinguishing core feature of the higher education system in the UK. The honours degree classification system serves to quantify the performance of undergraduate students enrolled in honours degree programmes. Nevertheless, the same nomenclature is being utilised to any honours degree in the UK (Universities UK, 2007). Generally the honours classification scheme refers to four distinct levels: third-class honours, 2:2 second-class honours (lower division), 2:1 second-class honours (upper division), and first-class honours.

1.3.6 Student attitudes

Results from Hong et al. (2003) indicate that students have a positive attitude toward using the virtual learning environment to support their learning. Students', who possess better basic computing skills, favoured using the virtual learning environments for learning (Hong, et al., 2003). The students’ gender
and ethnic background influence potentially influence their engagement toward learning and response to different teaching methods. Gender roles are imposed by society. Employment expectation is a key outcome of defined gender roles. Ethnic background is another variable that may be linked to questionnaire responses among students. Data on student attitudes gathered through the questionnaire could reflect the impact of gender and ethnic background. Diversity of learning styles may have weight upon the choice of a particular teaching method. Some students may thrive better with traditional methods, whereas others notice improved performance with alternative or blended methods (Bonk & Graham, 2006).

1.3.7 Subject specialisms studied at London Metropolitan University

London Metropolitan University is a post ’92 university with a mission statement that commits it to widening participation. Cohorts have a diverse character but reflect the ethnic mix of the local community. The university offers an IBMS accredited biomedical science degree programme, which is highly attractive to students who have a clear aim to be employed in a science environment post-graduation. It is essential that students pass their core modules to enable them to complete their accredited degree in biomedical science.

Human Structure and Function (BM1006N) is a core certificate level module and Haematology and Transfusion Science (BM2006N) is a core intermediate level module for the BSc biomedical science degree accredited by the Institute of Biomedical Science, and they are optional modules for several other
biological based degrees in the university. BM1006N consists of human anatomy and physiology and is the basis for many of the biological science BM2006N module consists of material covering haematology, transfusion science and associated immunology. Over the period of the study, this area is developed into the study of blood science and expands to embrace the area of clinical biochemistry reflecting the changes seen within pathology as a result of automation.

1.4 Research objectives and questions

This study aims to identify factors that predispose student to effectively use technology together with face-to-face teaching as is implemented in blended strategies. With this aim in mind, the following objectives were deemed appropriate:

- To identify the uses of blended learning models within higher education current practice;
- To identify the strengths and weaknesses of each blended learning model to determine expanded use in future practice;
- To establish which teaching tools (tools including face-to-face teaching and technology) are being used to enhance student learning and experiences within higher education;
- To determine whether there is a correlation with demographic groups of students and either increased, or decreased use of technology together with face-to-face interaction. This will assist the creation of blended strategies;
Achieving the above-listed objectives requires that this study address the following research questions:

1) What major factors predispose a student to using technology to supplement their face-to-face teaching? How will we respond to this answer?

2) Is there a case for extending the use of blended strategies in higher education and London Metropolitan University?

3) To which of the implemented blended teaching strategies do students respond most positively?

1.5 Overview of conceptual framework and methodology

To design a study that adequately addresses the research questions demanded the formulation of an appropriate conceptual framework and methodology, both of which are briefly described below:


The methodology used mixed methods, two-phase methodologies, to develop the research model and to answer the research questions. In the first phase, analysis of the interactions within the virtual learning environments, and student questionnaires were used to collect data. The data was analysed using a variety of statistical methods. In the second phase, interviews were undertaken with student focus groups to discuss items arising from the quantitative outcomes. The qualitative data supported quantitative results and enabled the elaboration of the quantitative results. This study will evaluate effectiveness of blended learning in the context or retention, progression and achievement in the following ways; student performance, engagement and satisfaction (Ohara, 2004).

1.5.1 Mixed methods

Mixed methods research is the triangulation research methods: the intellectual and practical synthesis of information crossing the important aspects of traditional quantitative and qualitative research. This third paradigm choice aims to provide informed, complete, balanced, and more complete research outcomes (Symonds & Gorard, 2008). Mixed methods research partners with the philosophy of pragmatism either qualitative or quantitative methodologies.
(see figure 1.2 left, right, respectively); follows the logic and fundamental principles from qualitative or quantitative research that create testable, usable and well founded research findings developed points of view, data collection, and analytical techniques from each area evaluate the research question(s) (Johnson, Onwuegbuzie, & Turner, 2007; Symonds & Gorard, 2008). The paradigm of these complementary mixed methods for research also can generate further important research questions and then provides improved, fuller research findings and outcomes to enhance understanding (Symonds & Gorard, 2008).

“Mixing methods is wrong, not because methods should be kept separate but because they should not have been divided at the outset”

(Gorard, 2007)

Figure 1.2 Graphic of the three major research paradigms, including subtypes of mixed methods research taken from (Johnson, Onwuegbuzie, & Turner, 2007) The qualitative (left) – quantitative (right) continuum of mixed research leads to several overlapping groups of mixed methods forms. There is an overlapping area for “pure” mixed methods (center), which spreads outward in both directions to cover the region before pure qualitative or quantitative methods.
1.5.2 Focus groups

When there is a triangulation of research methods, as a means of demonstrating validity, focus groups are often employed (Wilson, 1997; Hackman, 2012). There is a shift from a traditional style of research, towards a collaborative approach; in this work students and tutors were included as active research participants (Hackman, 2012). The particular benefit of using focus groups in this study was the ability to bridge the knowledge gap that existed by triangulating between the quantitative and qualitative findings and the student and tutor views in terms of feelings (satisfaction) and engagement (Webb, 2002). When initiating focus groups to evaluate research there are factors to be considered when planning their use; ethical concerns, budget issues, and time constraints. The ethical considerations in focus groups are similar for all qualitative research (Allmark, et al., 2009; Karnieli-Miller, Strier, & Pessach, 2009), but in addition issues concerning invasion of privacy need considering when recording is the primary means of data collection. To protect the participants only the research staff accessed the recording, participants signed a form indicating they were happy to participate and the material generated would be anonymised and analysed by the psychology student conducting the session (Morgan, 1997).

There are various definitions of a focus group, but Wilson (1997) states that the common elements include:

- a small group of 4-12 people;
- meet with a trained researcher/facilitator/moderator;
- for 1-2 hours;
• discuss selected topic(s);
• in a non-threatening environment;
• explore participants' perceptions, attitudes, feelings, ideas; and
• encourage and utilise group interactions.

(Wilson, 1997)

A unique ethical issue that occurs in focus groups is the fact participants’ responses are shared with other group participants as well as the researcher and issues of privacy can limit the kinds of topics that the researcher can pursue (Allmark, et al., 2009; Hackman, 2012). Researchers are required to protection of participants, and insure that all the participants truly belong to the shared milieu during each discussion (Morgan, 1997; Karnieli-Miller, Strier, & Pessach, 2009).

Focus group framework (based on Morgan, 1997):

1) use homogeneous strangers as participants,
2) rely on a relatively structured interview with high moderator involvement,
3) have 6 to 10 participants per group,

and 4) have a total of three to five groups per project.

Morgan (1997) states “in reality, most projects have some elements that require special attention, and it may be relatively rare for a project to match all four of these criteria” (focus groups used in chapters 5 and 6)

1.5.3 Ethics and power relations in focus group research

A potential source of conflict was the relationship between the student or
tutor, as research participants and the researcher, so to negate this research associates were used (MSc psychology students). This was to avoid a situation where the researcher could be viewed as a potential threat to the research participants (a power relation conflict) (Webb, 2002; Karnieli-Miller, Strier, & Pessach, 2009). This is because the student or tutor may feel they cannot be blunt about their views and opinions directly to the researcher. There is a concern with focus groups (and other research formats) that an insider-researcher may to hold inherent biases and preconceptions about the research questions, potential results and solutions (Webb, 2002). This risk is present in all forms of research and researchers generally do not set out to be dishonest. It is crucial for the researcher to remaining aware of the potential introducing bias (Webb, 2002).

Participant safety: The risk of harm to and anonymity of participants and the preservation of the confidentiality of data collected in the focus group is fundamental to ethical processed in research. Students and tutors who participate signed consent forms and had the study explained – they also volunteered.

Data safety: Data collected must be stored securely during the research period and all recordings and transcripts destroyed on completion.

The researcher undertaking focus group needs to be aware of bias versus rapport with the participants. Bias in a focus group means taking care not to lead the participants respond to the research questions in such a way that the findings confirm the researchers views rather than eliciting the true responses of the participants (Karnieli-Miller, Strier, & Pessach, 2009). Due to the power
relationship between the researcher and the participant; participants may wish
to please the researcher, defer to their expertise, or seek their approval. That
said, there is a fine balance to be made as it is still important for the researcher
to build an environment of empathy and rapport creating a positive
relationship with the participants to obtain high quality unbiased responses
(Karnieli-Miller, Strier, & Pessach, 2009).

1.6 Thesis organisation

The remainder of this thesis consists of seven chapters:

Chapter Two extends the ideas presented in chapter one by describing, in more
detail, the background literature and giving further insight into the study
motivation and rationale.

Chapter Three explores the demographics of the students participating in the
study compared with national and international student demographics in
higher education.

Chapter Four investigates the impact of collaborative learning, group work,
individual grades, supported by online communication space and tutor
guidance.

Chapter Five explores formative assessment impact on student learning,
student engagement, and effect on performance.

Chapter Six investigates the use of web-based collaborative tools (Blackboard
Collaborate™).

Chapter Seven provides conclusions, future work and reflection of the work
undertake in this thesis.
Chapters 4-6 present the quantitative results obtained by using a number of statistical methods on the virtual learning environments analytics and survey data relevant to each intervention. Statistical methods include; descriptive statistics, Tukey’s HSD (honest significant difference) test, paired t-test, and regression modelling. On the basis of quantitative results, a small subset of participants was selected from the pool of students analysed in the quantitative sections, and three thirty-minute semi-structured group interviews were conducted.

Chapter 4, 5 and 6 presents the quantitative findings of the research in which the questionnaire or interview data was analysed to enrich and add to the understanding of the quantitative results.

In the final chapter, the study findings are summarised, and the findings for each of the research questions are made explicit. The findings are discussed in terms of connection to existing literature and the conceptual framework. Recommendations are then made in the form of principles to inform others of effective blended teaching practices.
Chapter Two: Blended learning in higher education: what does it mean?

“Blended learning, which is usually viewed as a combination of face-to-face and online delivery methods, can influence students’ perceptions of the learning environment and, subsequently, their study experiences, learning outcomes, and ultimate academic achievement” (Poon, 2013, para 1).

2.1. Introduction

This chapter elaborates on the study context, motivation, and rationale that were briefly outlined in chapter one. The aim of this chapter is to review the literature around the concept of blended learning in the context of higher education. As an emerging paradigm, the utilisation of blended learning is explored through the shifts and transformations within pedagogical/teaching/learning/knowledge construction. A common misconception is that blended learning is the same as distance learning, also that the inclusion of blended learning leads to a loss of emotional connection between teacher and student. The characteristics of blended learning in the terms of a framework for: the integration and development of a ‘community of practice’, the design of hybrid e-learning environment, and forming a cognitive apprenticeship for the learner. ‘Hybrid’ in terms of blended learning is the integration of different ‘mixed delivery’ models of teaching/learning/knowledge construction rather than different delivery modes such as face-to-face and online instruction. The history of ‘blended learning’ has developed out of the ability to support the face-to-face teaching with the use of technology in educational settings. So historically blended learning is considered to begin with the technology based training approaches made possible by mainframe computers in the 1960s and 70s, Today ‘technology’ used in relation
to blended learning usually refers to digital technologies. The definition of ‘blended learning’ is a subject of debate, with different definitions in different paradigms. There are a few review papers in the arena of ‘blended learning’ by Vignare et al. (2005), Torrisi-Steele (2013) and Drew, et al. (2013) reveal other relevant areas, which expanded the themes to be explored. This study is pinned at a moment in time where pivotal changes abound.

2.1.1 Aims

The aim of this chapter is to: review the changes in technology that have enhanced the development of blended learning opportunities, determine and implement the appropriate methodology, review the vast array of published material associated with blended learning or hybrid learning in either university or higher education. This will enable a clearer a redefinition of blended learning posited later in this chapter (see 2.6.2).

2.2 Historical background for the technical development behind blended learning

Blended learning has co-evolved with the advent and developments within computing technology, whose beginnings stem back to the 1960s but the concept of a ‘wireless university’ was proposed by educationalist John Stobert in 1926 while working for the BBC (The Open University, n.d). During the 60s the most rudimentary computers were developed. The mainframes during that time were put to good use when instructor-delivered training was substituted by computing technology. The primary motivation for the shift was scale. Technology-based training offers a much higher capacity than those administered by instructors. The
The number of trainees/learners who could be accommodated by technology-based training was substantially higher. Hence, technology transfer was more quickly diffused and widespread.

The first educational system was the Programmed Logic for Automatic Teaching Operations, abbreviated as PLATO. The “first virtual community” was instigated in the 1960s by Professor Don Bitzer at the University of Illinois to provide a training system - PLATO (Wolley, 1994). PLATO was initially developed in response to increasing student numbers requiring education. PLATO featured the first versions of chat rooms, e-mail, instant messaging, gaming programmes and other tools we are familiar with used in today’s technological era. PLATO became commercially available in the mid 1970s (now PLATO courseware) with in excess of 3,500 hours of training materials across more than 100 subject areas available by 1976 delivered using text, graphs, drawings, and coloured photographs (Figure 2.1) and PLATO learning/courseware is still available today (Smith & Sherwood, 1976). PLATO and similar teaching platforms represent the beginning of the evolution of the use of digital technologies for teaching and learning (Bersin, 2004). PLATO has gone through a long list of revisions and improvements since it’s nascent to the now developed version (http://www.plato.com). In the present higher educational setting PLATO has been actively utilised in delivering standards of the UK General Medical Council (Brown and Bullock 2014).
Due to the limitations that PLATO had in regards to human-computer interfacing, especially amongst those who were not computer-literate, another wide-reaching communications technology became integrated with education. ‘White Heat of Technology’ era proposed by the then Prime Minister, Harold Wilson in 1963 lead to the a period of concept development of University of the Air project, Open University TV was launched in 1969 (The Open University, n.d). Since then the Open University has served as a reliable method of transferring academic knowledge to the masses via broadcasting. During this period satellite feeds have gradually became popular in the 1970s for example EDUSAT. EDUSAT has been used in India since the 1970s utilising Conventional and Interactive Radio and Television (live broadcasting, phone-in, video on demand), Exchange of data, video conferencing, Audio conferencing and computer conferencing, and web-based education to deliver learning and teaching materials (Pallai, 2013). The shift to live video feeds largely addressed the acceptance of the new learning technology amongst those who were not adept at computers. Learners need not have

Figure 2.1 Schematic for PLATO system (Thompson, 2010).
knowledge about computers in order to be engaged in the learning experience. However, satellite technology is more expensive because of the costs entailed in broadcast communication (Pallai, 2013).

From the prototypical system explored by the ARPANET (Advance Research Projects Agency Computer Network), the true emergence of the internet was kicked off in 1982 with the standardisation of the Internet Protocol TCP/IP. This paved the way for real internetworking of computers, as we know it today.

During the 1990s the world wide web (www.) has grown tremendously while the price of personal computers dramatically went down to levels, which are affordable by the masses. This accelerated the uptake of computing technology. The parallel development of the personal computer made the possibility of networking even closer. With the emergence of personal computers from the 1980s to the mid-1990s the wider population was able to access to computer based educational content (Holmes & Gardner, 2006). As with all technology mass production allowed the price drop and technical developments in the 1990s made it possible to produce highly interactive and media rich computer based educational content. Also during the 1990s the world wide web was developed by Tim Berners-Lee with Robert Cailliau from Tim’s ENQUIRE 1980 software as a web of ‘hypertext documents’ that can be browsed (Berners-Lee & Cailliau, 1990), from this the internet as we know it today was born. Highly portable ‘CD-ROM’ technology emerged in the mid 1980s allowing media rich digital delivery of interactive multimedia educational materials through the integrating of high
quality audio and video, images (2-d, 3-d, 4-d), animations and text along with the capacity to support user interaction (Bersin, 2004).

Within a decade billions of homes around the world adopted the personal computer, use of CD-ROM and became connected to the world wide web. Initial limitations of CD-ROM-based educational courseware were 1) prohibitive developmental, maintenance and distribution costs and 2) tracking who was using the materials, how well they were doing, and what was being completed of the course (Bersin, 2004). The increased presence of networks allowed tracking of learning activities through the implementation of learning management system (LMS) software. Early forms of LMS software simply stored and track users’ CD-ROM data.

The prospect of learning through the internet has now emerged as a real alternative to expensive satellite-based technology used heavily in India since the 1970s (Pallai, 2013). The internet was now on the verge of revolutionising education. The possibility of delivering knowledge across space and time in a more affordable manner was opened and as they say “the rest is history”.

The development of online tools has accelerated. The internet has served as the backbone upon which further improvement of tools were built. The throughput of communication from one computer to another was the issue through the 2000s. By addressing speed and bandwidth a number of learning management systems became possible (Bersin, 2004). Video of lectures, which includes live and recorded forms, was easier to transfer (The Open University, n.d). Online access
tools also boomed throughout the decade. Protocols improved considerably to allow faster and more reliable teleconferencing, videoconferencing, sharing of files, and so forth (Boulos, Maramba, & Wheeler, 2006). Due to improvements in the networking capability of computers, the emergence of virtual learning came along. The preponderance of learning management systems originated from the effort at integrating computing technology for enhancing educational systems. The primary objective was to enhance many features of the usual teacher-student relationship within the classroom setting leading to learning environments such as: Virtual Learning Environment, Managed Learning Environment and Personalised Learning Environment.

The 2010s saw the development in the hardware aspect of the online learning system, and opportunities for blended learning (Bersin, 2004; Ofcom, 2014). The personal computers improved in both portability and data storage capacity. Apple Inc. and Samsung largely paved the way for the design and development of tablet technology, smartphones, and other hand-held telecommunication hardware. The connection of such devices to the internet was also made more convenient as time has passed 16% of UK homes in 2004, 77% in 2014 (Ofcom, 2014). Human-computer interaction progressed substantially, 44% of adults in the UK own a table device by 2014 (Ofcom, 2014). Website management also became easier as templates became available for the novice users. Computer literacy has also gone up to the highest levels to date. The generation born into the internet were exposed to modern information and communications technology. Thus, the problem of technology acceptance has slowly become less of a problem. Further
technological progress in telecommunications has paved the way for even more interactive versions of virtual learning environments.

2.3 Literature review methodology

The use of web-based search databases now makes it easier to conduct extensive literature search over the days of traditional libraries only have limited storage capacity to hold a vast array of knowledge and information sources by reviewing microfiche and library catalogues. Extensive collections of published articles and books usually turn up as search results through the different search engines. Some full-text articles have readily downloadable versions, but for many others that are not freely downloadable, a consultation with academic databases is necessary, the university providing access to some of these databases. Electronic books that can only be viewed online may also be accessed through the university account. Most of the search engines provide bibliographic information in the most common citation formats, such as APA, Chicago, Harvard and MLA. The appropriate citation format to use can be selected quite easily. The bibliographic information can then be incorporated into any document bibliography.

2.4.1 Methodology

Searches were conducted using five different search engine tools to reveal as many papers in the arena associated with blended learning, Web of Knowledge (WoK), ScienceDirect, Wiley Online Library, ERIC and Google Scholar. Thomson Reuters’ Web of Knowledge is an online academic citation index including multiple database access and ‘covers over 12,000 of the highest impact journals worldwide, including Open Access journals and over 150,000 conference proceedings’
(Thomson Reuters, n.d; Torrisi-Steele & Drew, The literature landscape of blended learning in higher education: the need for better understanding of academic blended practice, 2013). ScienceDirect includes journal articles and book chapters from c. 2,500 journals and c. 26,000 books (Elsevier, n.d), Wiley Online Library includes 1,500 journals, over 15,000 online books, and hundreds of reference works, laboratory protocols and databases (John Wiley & Sons, n.d), ERIC (Institute of Education Sciences) includes c. 900 journals and c. 500 non-journals (publishers and web sources) (Institute of Education Sciences, n.d), and Google Scholar searches: “articles, theses, books, abstracts and court opinions, from academic publishers, professional societies, online repositories, universities and other web sites” but no details of volume of resources available (Google, n.d). Firstly a review of all publications citing ‘blended learning’ as a key term was conducted using Web of Knowledge (Science) for all articles up to July 2014. From these original searches it became evident that there was a need to mine further into the literature to investigate the relevance of the materials retrieved. To the key words “blended learning’ with the Boolean term &, “medicine’, ‘nursing’, ‘business’, and ‘engineering’ (Table 2.1).

2.4.2 Results of literature review
An extensive literature review reveals the striking increase in published literature discussing blended learning as a tool in science teaching at FE and UG level, over the last 14 years. Analysis reveals a striking 140-fold increase between the year 2000 and 2013, signalling the burgeoning interest in the topic in the further and higher education sector Figure 2.2.
Figure 2.2 A graphical illustration of the number of publications discussing blended learning as identified using Web of Knowledge (science) search tool (Thomson Reuters, n.d). There were 1,452 publications up to 1999 and as of the 31st June 2014 there were 675 publications already for the year.

For the first 6 months of 2014 there are more publications than for the whole of 2011.

The preliminary searches suggest that the level of application of blended learning in the medical sciences is considerably lower than levels of application in engineering and business education Table 2.1. The variations are too great for further reliable statistical analysis. It becomes evident that to rely on only one database search would miss a rich source of literature, but the relevance and quality can vary, for example Google Scholar often has multiple incidences of articles and the quality/relevance can differ under the search Boolean. The literature review conducted in the research is mainly sourced through Web of Knowledge (Science) and ScienceDirect using the keyword ‘blended learning’ alone. For the most articles published since 2010, ScienceDirect returns 3,793 respectively as of 1st July 2014.
Table 2.1 Results from literature search, Web of Knowledge (Science), ScienceDirect, Wiley, ERIC and Google Scholar for “blended learning” with the Boolean term &, “medicine”, “nursing”, “business”, and “engineering”

<table>
<thead>
<tr>
<th>Key words and Boolean terms</th>
<th>Web of knowledge</th>
<th>ScienceDirect</th>
<th>Wiley</th>
<th>ERIC</th>
<th>Google Scholar</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘blended learning’ &amp; ‘medicine’</td>
<td>83</td>
<td>866</td>
<td>5,402</td>
<td>4</td>
<td>18,900</td>
</tr>
<tr>
<td>‘blended learning’ &amp; ‘nursing’</td>
<td>117</td>
<td>529</td>
<td>3,037</td>
<td>12</td>
<td>16,600</td>
</tr>
<tr>
<td>‘blended learning’ &amp; ‘business’</td>
<td>73*</td>
<td>1,376</td>
<td>8,083</td>
<td>116</td>
<td>21,400</td>
</tr>
<tr>
<td>‘blended learning’ &amp; ‘engineering’</td>
<td>142</td>
<td>1,552</td>
<td>6,035</td>
<td>61</td>
<td>18,100</td>
</tr>
</tbody>
</table>

Table 2.1 Search data demonstrates that there is more literature published between 2010 and July 2014 in the areas for blended learning associated with either business or engineering (except *) the % increase ranges from 12-2800% depending on search tool used.

2.4.3 Design of blended or hybrid e-learning

Founded within a heritage of digital technology for learning, blended learning embodies the ideas encountered in its history: technology for enhancing learning, delivering large-scale education, and flexibility of access. There are many definitions, names and varieties of blended learning that are used in various educational institutes; but one focus in this study is the hybrid approach to teaching and learning that combines face-to-face sessions or classroom instruction in conjunction with the use of online instruction in higher education. However, unlike earlier ideas of multimedia, online learning, and e-learning, the concept of blended learning alludes to a harmonious, rather than competitive, relationship between face-to-face strategies and educational technologies. In blended approaches, the value of both technology and face-to-face teaching is recognised, and so the question surrounding blended strategy implementation is not ‘should technology be used rather than face-to-face strategies?’ or ‘can technology
replace face-to-face strategies?’ but rather, ‘how can technology best be used together with face-to-face strategies for the best learning outcomes’.

Despite the various terms given to blended learning such as; mixed methods, hybrid learning, combined learning, mixed mode instruction and so forth, blended learning is still best defined loosely as, ‘learning, which combines online and face to face approaches’ (DET, 2003). This definition does not account for the proportion or the extent to which, these approaches are integrated and in this context refers to integration of different teaching/learning /knowledge construction models rather than different delivery models such as face-to-face and online. Hence, the concept of blended learning lies at the nexus of face-to-face strategies and new technologies and the need to consider the learner aspects in relation to design and implementation.

2.4.4 Developing a community of practice

Whilst attaining currency throughout our lives, all our acquisition of knowledge is what is currently termed ‘blended learning’. No learning is undertaken without inter-dependent activities effecting our understanding and application of our learning. This acquisition of knowledge construct is defined as community of practice, when learning is becoming, when knowledge and person learning are not separated, then the practice is also about us being enabling and as such becoming (Wenger, 1999). Traditional teaching strategies often focus on an individual’s acquisition of factual and conceptual knowledge in isolation, whereas the context in which knowledge can be utilised and applied with is life’s learning processes (Collins, 2006). The gap between factual knowledge, expert processes, and
contextual learning has led to the study of pedagogical models that with blended techniques can provide students with an enhanced understanding of expert practice and processes (Johnson & Brierley, 2007; Littlejohn & Pegler, 2006). Even a century ago Sir William Osler (1913) stated when discussing the training of medical students that there was “too great a reliance on lectures and on students’ capability of memorising a growing number of items of knowledge” (cited in Wood, 1994), and our community of knowledge has expanded exponentially in all areas since this point.

Community of practice is founded on the principle that learning is a "process of being active participants in the practices of social communities and constructing identities in relation to these communities" (Wenger, 1999). This learning construct is particularly relevant to biomedical science as it is based on practitioners with similar professional and disciplinary backgrounds developing a shared repertoire of resources, experiences, tools, and ways of addressing recurring problems (Wenger, 1999). The community of practice model provides a scaffold for professional development, advocating relationship building, collaborative learning (CL), sharing of knowledge (as with PASS – Peer Assisted Student Support) and sharing best practice (Buysse, et al., 2003; Schlager & Fusco, 2004; Chan, 2010), all developing qualities highlighted as important as graduate attributes (IBMS, 2010; IBMS, 2011; QAA, 2007).

2.4.5 Formation of a cognitive apprentice
Blended learning can vary substantially from full incorporation into a course; regular online assessments and summative assessments as well as study materials
for students to read on a daily, if not weekly basis; to less interactive and optional
blended methods that rely on the availability of such resources and upon
individual learner motivation. Collins, et al. (1987) published their theory of
combining six teaching methods — modelling, coaching, scaffolding, articulation,
reflection and exploration. These methods enable students to develop cognitive
and metacognitive strategies for “using, managing, and discovering knowledge” -
the combination is termed cognitive apprenticeship (Collins, 2006; Dennen, 2004).
The definition also fails to emphasise any added value brought about by
collaborative or peer-assisted learning. Learning activities driven by groups of
learners, rather than the instructors (lecturers or tutors) can be conducted within
a virtual environment. These elements of blended learning can also be utilised to
enhance distance-learning delivery of materials to learners. Within the virtual
learning environments environment, it is possible to create instructional pathways
that can be personalised to the learners, needs, wants and interests – Personal
Learning Environments with individualised learning pathways (Dabbagh &
Kitsantas, 2012; Johnson & Brierley, 2007).

2.4.6 Blended learning constructs
The majority of blended learning that is supplementary and occurs in HE is found
to be more effective than only face-to-face, online instruction or distance learning;
this is supported by numerous studies in several countries (Means, et al., 2010;
Sitzmann, et al., 2006). A meta-analysis of 96 studies from 1996 to 2005 by
Sitzmann et al. (2006) found that blended learning, they termed as ‘web-based
instruction supplementary’, when compared to face-to-face, was a more effective
method of delivery. Blended learning was found to best support ‘declarative
knowledge’ and procedural learning by 13% and 20% respectively better than face-to-face alone. Declarative knowledge can be defined as the abstract acquisition of knowledge where students to ‘describe a rule, fact or concept’, in contrast to ‘procedural knowledge’, which enables the student to ‘apply that fact or complex context and processes’ demonstrating deeper thinking or critical analytical skills. This study will aim to review if possible is this by virtue of being web-based or by being normal revision?

Active learning requires the use of all the senses, to confirm and reinforce the transfer information to the long-term memory, we remember 20% of what we read, 30% of what we hear, 40% of what we see, 50% of what we say, 60% of what we do, and 90% of what we read, hear, see, say and do (Buzan, 1995) – so building in as many activities in the blended learning environment will promote learning. Buzan also states that without revision we loose 95% of info in 3-4 weeks (1995) but can revision have to be virtual? Collins (2006) asserts that the process of shift between declarative knowledge to procedural knowledge forms the learner’s cognitive apprenticeship where the knowledge is being used and applied by practitioners to solve problems and carry out tasks. In addition, Means et al. (2010) analysis of over one thousand studies (1996 to 2008), were reduced to 50 meta-analysis studies of online instruction, blended learning and face-to-face; and revealed that blended learning had positive effects on learners, and was associated to providing learners with additional asynchronous learning time and instructional methods. The positive effects were not attributed to the blended learning mode, but its implementation. This study needs to evaluate does blended
learning challenge learner autonomy? As in HE previously the student is supported to organise this for himself or herself?

In a study based in Croatia was conducted on two groups of medical students undertaking problem-based learning (Taradi et al. (2005)) (PBL – use of a problem case or scenario to define and deliver learning objectives):

1) (n = 84), face-to-face traditional PBL.

2) (n = 37), PBL was combined with web technology (WBL-PBL).

WBL-PBLT methodology allowed learners and faculty members to collaborate and communicate online through: forums, chat and e-mail. Learners were also able to take quizzes, several self-assessments, access online tutorials, and study online as well as face-to-face.

The summative assessment grades, when analysed produced no significant difference between blended learning and face-to-face learners (Taradi et al., 2005). Other interesting positive results were found. The intervention group achieved marks that were significantly better than those who undertook only traditional learning \( (t = 3.3952; \ p = 0.0009) \). They reported greater satisfaction (intervention group scored 4.54 ± 0.10 out of 5, as opposed to control group who scored 3.56 ± 0.18 out of 5 for satisfaction). These scores are significantly different and tutor/student Interactions were exceptionally high \( (p = 0.0001) \) when compared to learners that only had face-to-face. The mean grade of the intervention group fell at the 76\(^{th}\) percentile of the control group, therefore, exerting a “medium” size effect, indicating the intervention group learning collaborative environment was positively affected by the use of technology. The
summative assessment grades, however, when analysed produced no significant difference between blended learning and face-to-face learners (Taradi et al., 2005).

Furthermore, a study by Yu et al. (2010) showed that although there was no statistical significant difference in the summative grades by students using web based instruction or non-web based instruction, ‘low achieving’ learners, however, the students performed better in their retention test 5 months after the initial learning of the problem-solving material. Yu et al. (2010) suggest the ‘delayed rate’ of improvement, this may be the result of learners internalising and mastering the problem-solving process. O’Toole and Absalom (2003) studied 176 final-year undergraduate teacher education students to determine the effects of blended learning they observed: 20% of students – attendance at lectures correlate to attainment, whereas for 25 students who attained zero they had only cursorily utilised the virtual learning environments, and if they has relied solely on information technology and communication approximately fifty per cent of students would have failed their module. The construct of the hybrid is vital to the enhancement of student attainment.

Other studies have also revealed that blended learning tools can be used to increase learner peer collaborations, active learning and to facilitate different learning styles (Attwell, 2007). It is argued that everyone has different styles of learning and they approach learning in different ways, but these all focus on learning, not development (Kolb, 1984; Coffield, et al., 2004; Honey & Mumford, 1992). Kolb’s (1984) model, which dominates experiential learning theory, is based
on a four stage learning cycle (Figure 2.3). Linked to learning theories are models of learning styles (Honey & Mumford, 1992). This would seem to be obvious, but theories and classifications do not reflect that learners may use different learning styles and different aptitudes in different circumstances and in response to different learning outcomes (Attwell, 2007; Kolb, 1984). Kolb highlights the limitations of his Learning Style Inventory pointing out that it only represents ‘elementary learning orientations’ in that it is not inclusive of the development of the learner (Kolb, 1984) see figure 2.3. In practice, it is likely that learners will have preferences for different pedagogic approaches, and virtual learning environments can be used to enhance or restrict certain pedagogic approaches to learning (Attwell & Hughes, 2010).
Figure 2.3 The Kolb learning cycle involves four processes that must be present for learning to occur: Diverging (concrete, reflective) – employs innovative and imaginative approach to doing things. Assimilating (abstract, reflective) – collates different observations and thoughts into an integrated whole. Converging (abstract, active)- practical application of ideas and solving problems. Accommodating (concrete, active) – uses trial and error rather than thought and reflection (Kolb, 1984).

A review of masters level students on a public health course in the USA who were already medical doctors and learners from other health related subjects, observed the face-to-face interactions in conjunction with seminar blogs and found that although 15% of learners had no prior experience with the software, 64% reported they were interested in using it for current study and for future employment as it enriched their development and inter-collaborative skills (Goldman, et al., 2008). Learners were able to engage in deeper learning. Socially blended learning tools (such as Quickstart, Facebook, Twitter, or Skype) helped reduce the alienation felt by non-traditional students at the beginning of university, through short message service text messaging to discuss their activities and weekly online tasks. It was observed that learners bonded extremely quickly and formed valuable friendships.
(Holley & Dobson, 2008). As with previous studies looking blended innovations, enhancement of student satisfaction was evident, but the effect in relation to student achievement is not clear.

Hadley and Puddicombe (2007) conducted a study at North Bristol NHS Trust, investigating the use of a managed learning environment called Beacon Online to support face-to-face sessions for eleven participants from mixed healthcare backgrounds. Findings highlighted that this system allowed learners to catch-up on missed work and information; learners were able to re-visit material at their own pace and as often as they wished. Financially the managed learning environment reduced the costs of copies for course material and administration because it could be used for subsequent courses; it was believed to potentially lower cost developments.

Typically many studies had noted that learners benefited from blended online instruction when learners gained increased control of their learning and had the opportunity for reflection (Means, et al., 2010). Geraldine Torrisi-Steel (2011) highlights blended learning can help meet the pedagogical challenges facing higher education institutions to satisfy today’s ‘knowledge driven society’ and provide a high quality learning experience (see figure 2.4). Learners were also found to take a more empowered role as the tutors explained less and generally participated less during online discussions (Mentzer, et al., 2007; Chan, 2010). This theme is expanded in chapter seven where we discuss investigating individualized learning.
Overall, a blended approach in the majority of studies is almost always preferred to singular approaches of face-to-face, online instruction or distance learning, as blended learning is adaptable to learner needs. Blended learning is not restricted by time as with seminars and lectures as it can offer both synchronous and asynchronous opportunities for learning. Additional features found within virtual learning environments enabling learners to track their own progress through online assessments, quizzes, extension activities, and collaborate with their peers, given that the settings and conditions are right.

![Figure 2.4 Planning approach for blended learning design (Torrisi-Steele, 2011).](image)

2.4.7 Factors limiting blended learning

There are many factors highlighted in studies that limit the effectiveness of blended learning, which have created scepticism from academic researchers over many years, whom are still not convinced on its effectiveness as an educational tool (Clark, 1994; Hadley & Puddicombe, 2007; Pahinis, et al., 2008). In support of
this, many studies have established that the obstacles to blended learning are: issues of learner access to resources, learner motivation to use additional online learning tools, producing meaningful and beneficial integration of online learning tools into the course, and the reliance on the learner’s prior IT training and competency (Dearnley, et al., 2006; Dantas & Kemm, 2008; Wormald, et al., 2011; Kobayashi & Little, 2011).

Social issues also play an extrinsic but significant component in the uptake/suitability of blended learning in certain groups i.e. non-traditional students, who are described as: ‘being from an ethnic minority group; having a long-term disability; possessing non-standard qualifications on access to higher education; being aged over 25 years on entry to university; or being from lower socio-economic groups of origin,’ (Holley & Oliver, 2010). Since the advent of education for all in the 1960s, Higher education access has shifted from being a privilege to a right (Schuetze & Slowey, 2002). There is record highs of enrolment of UK domiciled students for example, 2,087,615 in the academic year 2009/10 in to higher education institutes published by Higher Education Statistics Agency (2011). However, actual participation in these institutes can be limited by learner educational backgrounds, age; and economic barriers, which require them to work full or part-time (Holley & Oliver, 2010). In turn, this affects the time available to study, even with blended options. A Department for Education and Employment survey with 1,418 responses (46 of which were from academics) carried out at the University of Northumbria found that 40 % of full-time students in employment during term time believed that employment ‘had a deleterious effect on their
academic performance,’ which increased to more than 50 % for students working more than 12 hours per week (Little, 2002).

Holley & Oliver (2010) state that of the students they interviewed two thirds were mature students, or those for whom English is not their first language or who experienced financial hardships, and reported any or all of these factors can affect their performance. In addition, many instructors doubted their learner’s confidence, autonomy and aptitude to learn independently. Moreover, this places blended learning and Padilla-Meléndez’s, et al. (2008) popular notion of learners being ‘digital natives’ in doubt as when under scrutiny has been found not to be the case as learners are not the ‘prolific users of technology’ they are perceived to be (Holley & Oliver, 2010).

In addition, factors such as learner and instructor preference, the hindrance of learner mind-set: learners who prefer or expect traditional teaching methods are found to affect the effective use and delivery of blended learning (Dearnley et al., 206; Holley & Oliver, 2010). The Department for Education and Skills (2002) found that 67% of 16 year olds expected part of their learning and teaching to incorporate e-learning as they had regularly used these tools in and out of classes, but what of the older learners, who fall within the homogenised description of non-traditional students? Dearnley et al. (2006) found that women were more reluctant to use technology than men. Although women are no longer categorised as non-traditional students, in the majority of ethnic groups (as they account for just more than 56% of all higher education institutes student participation) a
reluctance to use technology would be a serious problem in blended learning courses (Table 2.2).

Table 2.2 Students in 2009/10 by mode, level and gender (HESAb, 2011)

<table>
<thead>
<tr>
<th>Gender/Mode</th>
<th>Undergraduate</th>
<th>Postgraduate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time Female</td>
<td>737,125</td>
<td>146,980</td>
<td>884,105</td>
</tr>
<tr>
<td>Full-time Male</td>
<td>596,775</td>
<td>151,275</td>
<td>748,050</td>
</tr>
<tr>
<td>Full-time Total</td>
<td>1,333,900</td>
<td>298,255</td>
<td>1,632,155</td>
</tr>
<tr>
<td>Part-time Female</td>
<td>364,740</td>
<td>163,340</td>
<td>528,080</td>
</tr>
<tr>
<td>Part-time Male</td>
<td>216,070</td>
<td>117,105</td>
<td>333,175</td>
</tr>
<tr>
<td>Part-time Total</td>
<td>580,810</td>
<td>280,450</td>
<td>861,260</td>
</tr>
<tr>
<td>Total Female</td>
<td>1,101,865</td>
<td>310,320</td>
<td>1,412,185</td>
</tr>
<tr>
<td>Total Male</td>
<td>812,845</td>
<td>268,380</td>
<td>1,081,225</td>
</tr>
<tr>
<td>Total</td>
<td>1,914,710</td>
<td>578,705</td>
<td>2,493,415</td>
</tr>
</tbody>
</table>

Meßmer and Schmitz conducted a study in Germany comparing computer literacy and gender (Meßmer & Schmitz, 2004). They stated that differences in competency were only noticed between genders as a ‘generation problem’. There was only a 2% difference in internet usage between male and female teenagers; this difference increased to 18% with age for those aged between 50 to 60 years old. There was also an inverse relationship between education and gender internet usage: the lower the education the higher the gender differences between males and females without vocational training, whereas males and females with postgraduate training differed minutely in computer literacy. These finding were reflected in Ikolo & Okiy’s (2012) study on gender differences and computer literacy in medical students, they identified gender difference in the number of hours students spend with a computer weekly (highest responses 28 (56%) males
11-15 hours, highest response 19 (52%) females 1-5 hours). However, Meßmer and Schmitz stressed that this should not engender a difference between females and males as competencies varied considerably depending on the course. Sometimes females were found to have more similarity with their male peers in for instance, computer sciences, as opposed to archaeology degrees.

Meßmer & Schmitz (2004) also suggested that creating a ‘modular system’ within the virtual learning environments could remove technical barriers, whereby only the tools required for tasks are available, thus making it intuitive and easy to use and providing an opportunity to deliver a personalised learning environment. This presents an opportunity for educators to adapt our pedagogic approaches with the technological tools in the virtual learning environments to learning and support the traditional teacher/student roles to create individualised pathways to suit their individual needs and interests (Attwell, 2007; Dabbagh & Kitsantas, 2012; Johnson & Brierley, 2007; Schaffert & Hilzensauer, 2008). Personalised learning environments encourage learners to participate and engage by providing learners with a variety of tools to facilitate coordination of different learning contexts (Attwell, 2007; Schaffert & Hilzensauer, 2008).

The successful integration and utilization of blended learning is not the sole responsibility of the learners, but also the educational instructors alike. A study into web-based learning at four higher education institutes in South and West England found that lecturers and tutors could also experience ‘technophobia’ and ‘technological illiteracy’ (Salmon & Jones, 2004; Torrisi-Steele & Drew, The literature landscape of blended learning in higher education: the need for better
understanding of academic blended practice, 2013). The same article observed all academic staff, who participated encountered problems in ‘translating teaching materials ... into collaboratively produced WBL’ and had issues with the aspect of time: with regard to preparing web-based learning (WBL) resources, becoming acquainted with the software, and the lack of physical support and recognition of instructors’ increased workload and accomplishments. Simultaneously, ‘managers were confused about whether or not there were funds to ‘buy-out’ staff time’ (Salmon & Jones, 2004). Instructors expressed the need for clearer objectives, established roles and responsibilities, technical support for specialist advice as well as project deadlines. This was believed to move toward less autonomy, more collaboration through sharing of knowledge, skills and practices within higher education institutes and across them to help maintain academic excellence and innovative teaching and learning methods.

Torrisi-Steel and Drew (2013) also indicate that research into understanding the problem with academics adoption of effective blended learning that may affect widespread uptake of the practice in higher education.

In summary, the most overwhelming obstacle to blended learning is learner capability as Holley and Oliver (2010) have demonstrated in their study and the shifting locus of control from the teacher to the learner (Littlejohn & Pegler, 2006). Learners who come from lower socioeconomic groups, with low educational qualifications are most likely to suffer and not successfully learn and complete the tasks provided on Online Learning tools; at which more confident and independent
learners would excel. Therefore, requiring instructors to recognise those learners, who can work online independently, and those requiring greater support and guidance is critical to their success (Littlejohn & Pegler, 2006). As such the limitations of blended learning encompass the structural, operational and social aspects of learning environments, but they could be overcome with forward planning, collaborations, investment in time and money to ensure that an effective learning system is designed and maintained.

2.4.8 Weaknesses in blended learning research methodologies

The differences in findings for the benefit of blended learning range between blended learning significantly increasing summative attainment, to other studies that showed no difference in performance or no statistical significance difference compared to learners exposed to an exclusively face-to-face learning mode (Dantas & Kemm, 2008). These fluctuations are also observed in studies conducted on student experience and are further demonstrated through larger meta-analysis studies (Means, et al., 2010; Wang, et al., 2008).

Many researchers believe inconsistencies in findings/inability to replicate to be due to different research methodologies, and it is most evident in meta-analysis studies that have to exclude the majority of studies due to:

- no use of statistical control in quasi-experimental studies
- no analysis of learning outcomes
- no comparison group that received a comparable treatment
- the use of different learning outcome measures for the treatment and control groups
• research biases that can occur when:
  o retention rates are not reported
  o small sample sizes evaluated
  o when experimenter and instructor are one – ‘the author’s dual roles’

The above were reported in the *Evaluation of Evidence-Based Practices in Online Learning*, by Means *et al.* (2010).

Other practices or methodologies that have hindered the acceptance of blended learning findings are:

• In action research studies: using only one research cohort, which means the anomalous fluctuations cannot be identified. Also asking participants to subjectively quantify the value and usefulness of online learning tools is difficult as their perceptions and opinions can change (Pahinis, *et al.*, 2008).

• One group using a particular format (synchronous/asynchronous) may have an advantage over the other group, as observed between face-to-face learners and online instruction learners in a dental hygiene program study (Garland, 2010).

• Comparing like-with-like for example short WBI course studies are not as useful as there is usually no control group, time to practice and formative feedback included. In addition, lack of comparable instructional methods between groups means they are no longer equivalent and more extensive information on age, student population, the types of courses studied and learner options and controls is required (Sitzmann, *et al.*, 2006).
• Investigation into the attributes within the model that are unique before associating any positive findings to it (Clark, 1994).

• There are confounding variables such as the ‘novelty effect’ of a new model in studies and that must be accounted for, and a study must be conducted over at least 5-8 weeks to indicate if there is any change in participant activity and achievements according to Clarke (1983). These studies should be repeated to check the outcomes were not one off events.

• Finally, there is a need to expand research areas in blended learning as most research is on adults in specialist settings (science, computing); younger learners need to be investigated, so that the effect of learners with prior blended learning experience can be evaluated in the future (an area not addressed in this research).

Also, research needs to determine which tools provide enhancement whilst maintaining the same curriculum, pedagogy for a course and the resource impact for these activities (Nagel, 2009).

2.4.9 Redefining blended learning

‘Blended learning’ has been a commonly used term in the education literature. The term generally refers to the combination to varying degrees of face-to-face learning and another form of learning. The adjective ‘blended’ could broadly be interpreted as ‘mixed’. Hence, any learning methodology that employs other modes in combination with face-to-face interaction could be taken as blended learning. For instance, is a learning method that uses film showing along with face-
to-face learning considered as ‘blended learning’? While some may argue yes, then that would imply that ‘blended learning’ has been in existence for a long time.

The redefinition of the term is meant to delimit its scope. Within this thesis, the term ‘blended learning’ refers to a learning methodology that mixes, at varying degrees, face-to-face learning with any form of distance or virtual learning mediated by electronic technology (see proposed definition in section 2.6.2). The redefinition of ‘blended learning’ also places more emphasis on face-to-face learning as a requisite ingredient in the mixture. Hence, a teaching method that combines virtual learning environments with, say, audio-based learning modules could not be considered as ‘blended learning’. Even if the teacher-student interaction takes place through different media (i.e., electronic versus audio) the missing face-to-face type of learning precludes the ‘blended-ness’ of the approach.

**2.4.10 Definitions in the literature and UK higher education**

The general definition of ‘blended learning’ centres on the notion of combining education with technology. The definition entails in most cases the collaboration of two disparate disciplines, unless the education practitioner is delivering technology-based content already. For example, information technology educators are grounded in education theories but are also considered experts in the area of technology that is suitable for blended learning.

The term ‘blended learning’ actually emerged from corporate usage for more than 20 years based on an etymological study (Sharpe, *et al.*, 2006). The study finds that
the term itself has been a dynamic one, shifting its meaning along. The earliest
definition for ‘blended learning’, according to the study, is the combination of
face-to-face with distance learning in an Open University setting. For the higher
education institutes context, Laurillard (1993) proposed a definition for blended
learning that requires rethinking the approach of teaching at the university in
terms of embedding technology. Many educational researchers regard the process
of blending as a means to enhance the prospects of attaining the learning
outcomes (Bonk & Graham, 2006).

For higher education institutes the technology aspect usually covers digitised
information for educational purposes. Hence, a term such as ‘virtual learning
environment’ or VLE is commonplace in the literature on blended learning. Virtual
learning environments are a learning management systems used by facilitators in
order to interact with learners at a distance (see Appendix B for commonly used
VLEs in the UK). The interaction is usually in, but not limited to, the form of
uploading course materials and content, as well as setting assignments and
coursework (JISC Infonet, 2006). Many higher education institutes in the UK now
subscribe to online databases that provide access to students and faculty
members to various electronic articles and books (Walker, et al., 2014). The
particular situation of the UK is the government’s liberal acceptance of the
presently dynamic reshaping of the educational experience (Loveless, 2006).
Hence, the growing interest in supplementing face-to-face learning with electronic
technology is due to the wide availability of the technology. The typical challenge
that higher education institutes encounter in adopting blended learning
approaches is on how to make electronic technology aligned with face-to-face methods.

Now is the time when the longstanding beliefs and philosophy associated with many features of society, including education, are being re-evaluated. Those elements of society which have been out-dated, and for which a feasible substitute has been identified, are replaced in one way or another. In the case of education, the shift is somewhat gradual. The existence of the notion and practice of ‘blended learning’ is evidence for the gradual shift. The traditional methods are now combined with more progressive, technology-driven ones. But in the far future it is possible that education would become purely technology-driven. In the extreme case of being technology-driven, the physical relevance of a university may cease to exist; universities of the future might predominantly be open and online.

The term ‘blended learning’ has been quite vague. The adjective ‘blended’ could be taken to mean any combination of distinct approaches in general. For instance, a mixture of different pedagogies might already be described as a blended approach. In that sense, blended learning is not really a new concept. Even hybridisation of disciplines into a single learning program in higher education could be considered as blended learning. For example, a course on econo-physics is a combination of the mastery on economics and the technical aptitude from physics. The two disciplines have largely different views of the world. Both have entirely different subjects. But such a description does not seem to be consistent with the reports existing in literature about blended learning.
In order to minimise the confusion arising from vague terminology, Littlejohn & Pegler (2006) proposed a delimited definition of blended learning based on three fundamental elements. Blended learning approach must be adjudged based on the following considerations:

1. To what end is the learning set to achieve?
2. Under what context does the learning engagements proceed?
3. What are the learning and teaching styles to involve?

With the above considerations in mind the definition of blended learning is not as rigid as one would expect from standards. In other words, blended learning is taken as an accommodative approach. It encourages the fusion of different viewpoints and methodology. Consequently, the centre of the learning process has shifted to the learner/student. In the past such a shift would likely have been inconceivable. However, an interesting fusion has been realised from the desire to put the learner at the centre stage of the learning process.

A crucial point of contention in defining blended learning is the notion of ‘combination’. The term ‘blended’ could easily be translated or re-interpreted as a combination or a mixture. But there is some ambiguity in that. Hence, a more precise definition of ‘blended learning’ rests on clarifying the nature of the combination implied. Blended learning is particularly the notion of integrating face-to-face teaching methods with online or web-based instruction in a deliberate and pedagogically designed manner. The term ‘blended learning’ does not merely combine these two methods but rather trade off time allotted for face-to-face interaction with online engagement (Vignare, et al., 2005).
2.4.11 Problems in defining blended learning

Indeed, the term ‘blended learning’ has been a buzzword in educational research literature. However, the term seems to refer to different things to different people (MacDonald, 2007). The ambiguity is anticipated from the fact that educational methods are quite different between disciplines. Due to the variety in the methods, the combination of technology also goes through different routes. The design of learning activities unique to a particular discipline somewhat influences the type of technology or the approach of hybridisation employed. The problem here is the proportion that education and technology gets in the mix we refer as “blended learning.” If educational theories have the bigger weight then the blended learning is characterised as education-focused. On the other hand, if the weight is towards educational technology then such a blended learning approach is technology-focused. The rather imprecise way of defining blended learning as a mix of education and technology allows for vagueness in relation to which element dominates.

The variety that arises from the vague notion of mixing two elements together as a blended approach is captured by the diversity of disciplines. The nuances between disciplines gives rise to the differences in the focus between education and technology. For example, computer science is a discipline that is obviously about computers. Hence, the blended learning that arises in this discipline would most likely be focused on the technology element. On the other hand, the blended learning approach arising from psychology is expected to be education-focused. Psychology is a discipline that is known to put emphasis on learning and educational theories.
Another perceived problem with the definition of ‘blended learning’ is found in the expectation that it is supposed to enhance the chances of attaining learning outcomes. Although the effectiveness of web-based learning has been put into question (Hsu & Hsieh, 2011), the expectation already limits the scope only to those approaches wherein technology could be proven to really enhance the learning experience. The relevant aspect about education that must be clarified in relation to the question of effectiveness is the learning outcome associated with a particular educational level. The outcome is expected to differ between grade school, high school and higher education. In the definition of ‘blended learning’ one must qualify which level is focused on.

2.4.12 Proposed definition of blended learning

To develop a definition of blended learning for this research a synopsis of some thoughts on blended learning were reviewed (see Table 2.3).

To incorporate the pedagogical considerations needed when developing combined taught and electronic learning events a definition was created for blended learning for use in this study:

“Blended learning is the enrichment to learning experiences supported by various strategies combining face-to-face student-centred interaction with web-based technology”.

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Table 2.3 Some current definitions for blended learning in the literature

<table>
<thead>
<tr>
<th>Themes</th>
<th>Definitions</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad definitions</td>
<td>“blended learning as learning using a variety of instructional modalities”</td>
<td>(Singh &amp; Reed, 2001)</td>
</tr>
<tr>
<td></td>
<td>“all learning is blended… [it is] the use of two or more styles of content or context delivery or discovery”</td>
<td>(Bonk &amp; Graham, 2006)</td>
</tr>
<tr>
<td></td>
<td>“spectrum of learning modes that range from the traditional f2f classrooms to fully online degree programs”</td>
<td>(Ross &amp; Gage, 2006)</td>
</tr>
<tr>
<td>Blend of face to face and technology</td>
<td>“blended learning is defined according to the proportion of learning activities that have been moved online rather than in the classroom, reducing but not eliminating classroom time”</td>
<td>(Garnham &amp; Kaleta, 2002)</td>
</tr>
<tr>
<td></td>
<td>“blended courses and programs as having between 30-79% of content delivered online”</td>
<td>(Allen &amp; Seaman, J, 2007)</td>
</tr>
<tr>
<td>Pedagogical considerations with blended learning</td>
<td>“a way of meeting the challenges of tailoring learning and development to the needs of individuals by integrating the innovative and technological advances offered by online learning with the interaction and participation offered in the best of traditional learning”</td>
<td>(Thorne, 2003)</td>
</tr>
<tr>
<td></td>
<td>“the word blended is used to suggest that it is more than a bolting together of disparate technologies with no clear vision of the result”</td>
<td>(Garrison &amp; Vaughan, 2008)</td>
</tr>
<tr>
<td></td>
<td>“Blended learning refers to enriched, student-centered learning experiences made possible by the harmonious integration of various strategies, achieved by combining f2f interaction with ICT”</td>
<td>(Torrisi-Steele, 2011)</td>
</tr>
</tbody>
</table>

As shown in table 2.3 many definitions of blended learning tend to be ‘technocentric’ rather than inclusive of a pedagogic element.

2.5 **Pressures for change within higher education**

The clamour for change within the higher education setting is echoed by Loveless (2006). According to Loveless, the UK government has been quite open with the
prospect of a shift in the way education is administered in the nation. The pressures for utilising blended learning are thus essentially brought about by the dynamics of an evolving society. The shift being referred here is the one in which traditional face-to-face learning is augmented with computer-aided instruction delivery.

But perhaps the larger pressure of the times is the trend toward digitalisation (Torrisi-Steele, 2011). The emergence of better computational equipment has spurred the effort at integrating educational activities with information and communication technology (Walker, et al., 2014). Education technology has been aimed at making learning modules more interactive and visual. The digital culture has been pervasive. Due to such ubiquity the pressure for higher education to change is expected. The information revolution precipitated the efforts of many educational researchers to maximise the use of modern computer technologies toward learning. The dictates of population growth also underscore the constraint of physical structures for education. The capacity of universities, in terms of physical space and even on the number of teachers, cannot be addressed economically by further expanding and building more capacity. Rather new methods of exchanging information, such as podcasting (Chester, et al., 2011), and even social media (Rogers & Lea, 2011), offer cheaper ways of catering to a growing demand without adding substantial physical capacity. The teaching profession is also not as lucrative as other professions. Hence, growing human-resource capacity by hiring more teachers is simply not a viable option to expand. Blended learning tools ease out the backlog in capacity by re-inventing the nature
of educational interaction away from traditional face-to-face. Due to the pressure, classroom instruction will become less and less of a format in years to come.

Globalisation is another force that higher education must contend with. The pressure toward internationalisation justifies the need for traditional teaching methods to evolve. Competition in a globalised world is more intense. Outdated strategies do not anymore fit in a highly dynamic world fuelled by globalisation. Hence, if blended learning has become the trend in some part of the world, the pressure to join the bandwagon is more compelling. Based on literature, blended learning is an innovation that quickly diffuses especially in the presence of the world wide web (Littlejohn & Pegler, 2006). The transfer of information from one university to another on the opposite side of the world was previously unprecedented but now may become commonplace.

2.5.1 Promises and challenges the role of blended learning in higher education

The evolution of the education landscape may be characterised as a paradigm shift from traditional, teacher-centred, face-to-face instruction towards constructivist, student-centred approaches (Lefoe, 1998; Relan & Gillani, 1997; Richards & Nason, 1999). Blended learning has been a statement of promise that higher education will change for the better. Many education researchers have accepted the notion. Blended learning is widely believed to be an enhancement of traditional learning approach. Enhancement is fulfilled through a bigger chance for learners to achieve learning outcomes. However, the implementation of blended learning also encounters various challenges. Given that the notion is at its infancy
(in comparison to traditional education formats), the lack of precedents to blended approaches makes validation a particularly difficult task. The definition of blended learning is also not standardised yet; in fact, it has so far remained controversial (Lam, 2014). Hence, many education researchers define blended learning quite differently from one another. There is yet to be a common vocabulary for ‘blended learning’. The newness of the notion would nevertheless attract many education researchers and professionals to consider its merits. In fact, the interest in blended learning has been increasing as demonstrated through Web of Knowledge and ScienceDirect literature search results.

Another challenge to blended learning is the strong influence of the educational discipline on the adoption of education technology. The challenge here is with the standardisation. The prevailing convention is that blended learning combines face-to-face learning with educational technology. But the balance between these two elements is not particularly the same across disciplines. In the case of higher education institutes, the diversity of disciplines is undoubtedly high especially in large multi-disciplinary institutions. Hence, if a single tool must be developed for the entire institution, then that tool must also be flexible enough to accommodate the differences between disciplines. Uptake of blended learning has been in disciplines that are relatively more ready to make the leap forward. This includes disciplines, which are oriented towards technology, such as those in engineering and the sciences. However, for disciplines that are bound to tradition, such as history, anthropology, and sociology, among others, the uptake of education technology might not be as enthusiastic. In other words, a goal of developing a
truly universal blended-learning platform without regard for the variety in disciplines that exist might not be easily achievable.

In medical education, blended learning has also been difficult to adopt because of the “hands-on” character of many courses. For example, in nursing education the learner requires personal sessions with the teacher on practical aspects such as administering of care. Books alone are not sufficient to teach the practical content of nursing courses. However, blended learning has been designed primarily as a substitute to standard textbook-based lectures in face-to-face learning. Nursing education, on the other hand, employs a lot of nonstandard lectures. Most of blended-learning strategies today also utilise computer-based technology in order to engage students in coursework. It is presently difficult to imagine how this notion of blended learning would really take off in medical education. But technology is continuously developing. So while the future is uncertain about computer technology, there exists a prospect for the development of technologies that are more suitable for medical education in the future.

2.5.2 The study motivation

The adoption of widespread effective blended learning practices is necessary for realising the promise of blended learning as an institutional response to current competitive and tough economic conditions. In addition to commercial drivers within the sector, evaluation of the impact of blended strategies using technology together with face-to-face teaching on the efficacy of student learning just as important. Design, implementation and review of effective blended learning practices needs to be evaluated on a larger scale.
2.5.3 The state of research on blended learning in higher education

The blended learning approach in the medical sciences is assessed through ScienceDirect using the keyword phrase: ‘blended learning’ AND ‘medicine & nursing’. The search resulted in 529 articles since 2010. On the other hand, if the keywords ‘medicine’ and ‘nursing’ were replaced instead by AND ‘business’, the search result increased dramatically to 1,376 a 160% increase. Yet another comparison is made by now using the keyword phrase: ‘blended learning’ AND ‘engineering’, ScienceDirect returned an even larger number of articles, at 1,552 results since 2010 almost a 200% increase. From the ScienceDirect searches employed it is evident that the blended-learning approach is frequently employed in the medical sciences and medical professions (Table 2.1).

The more rapid expansion of blended learning in business education is dictated by demand and readiness on the one-hand; also business schools have more takers worldwide. Distance learning has become the mode through which overseas students are accommodated in business courses offered by the top institutions like Harvard Business School. The preponderance of electronic commerce and online financial trading has also spurred the dominance of blended learning in business curricula. Moreover, in terms of readiness, many business courses are based on reading which could easily be transported online. The assessment also could be easily deployed through the internet because the required outputs from the students are usually in the form of reports/essays. On the other hand, the medical profession requires hands-on experience as an integral part of the learning process. It would be challenging to learn about surgical operation from a
distance. The nursing profession also necessitates a face-to-face interaction with patient especially when care is administered.

The challenge of blended learning in higher education these days is to account for the special considerations of different courses. For example, the design of medical education, the design of blended-learning strategies could not be patterned from those being used by business schools. The material is entirely different in the latter than in the former. Active research in the area of blend learning should focus toward adaptive design, which caters not only to the diversity of courses, but also for disabled learners.

2.5.4 Consideration of special educational needs and disability act 2001 when implementing blended learning technologies

Adjustments in the methods employed in blended learning as far as practicable must be made in accordance with the guidelines promulgated through special educational needs and disability act (SENDA), 2001 “Disabled students not to be substantially disadvantaged”. Most of the blended learning strategies widely used in the UK, and around the world, today make use of computers with keyboard as the standard input and the monitor (and speakers) as standard output. Extra time for activities needs to be built in for students with dyslexia. Blind learners, for example, would not be able to capitalise on opportunities provided by blended learning if provisions are not made for them, keyboards with Braille dots. Online exams usually require visual acuity, and involves answering questions displayed on the monitor so, text-to-talk programmes need to be installed to read questions and speech recognition systems which allow blind people to just speak out their
answers to the online questions. The deaf may also be disadvantaged because computer-based learning tools do not have integrated sign language interpretations for audio, so where practicable subtitles need to be included. There is a lot of room for improvement in regard to compliance with SENDA, 2001. Now that blended learning is being utilised more and more, consideration for disabled students are required to maintain equal opportunities.

2.6 Conclusions

The research outcomes reported in this chapter mainly point at the current ongoing lack of consensual or standardised definition of ‘blended learning’. The interpretation in the literature is toward making the term generalised, accommodating various different types of study and intervention. The proposed definition for the purposes of this research specifically defines blended learning as “... the enrichment to learning experiences supported by various strategies combining face-to-face student-centred interaction with web-based technology”.

Based on the assessment of blended learning in the higher-education setting, a preliminary ScienceDirect search reveals an important fact. The reported application of blended learning which accords to the definition proposed within this thesis in the medical sciences is about five times less popular than applications in engineering and business fields Table 2.1. Lastly, the published research does not consider special needs students as a separate group. There are more of these in post 1992 universities and their needs and responses to blended learning are likely to be strikingly different (SENDA, 2001). Most statements made though relating to the available technology presume that blended learning is widely
accessible across different levels of physical ability. This topic is not one that should be ignored.

Modifications in blended learning strategies are necessitated in order to increase compliance with SENDA, 2001. But the challenge here also reflects the limitations that current computer-based technologies have. The blended learning strategies in common usage today can prove lacking in terms of allowing disabled learners to optimise their learning opportunities through computer-based technology. For example, these technologies typically require keyboard as standard input and the display monitor as standard output. As a clear case of disadvantage, blind learners could not easily key in their responses if Braille is not integrated on the keys and a text to talk programme is not installed. Monitors also could not be made use of unless an alternative information exchange interface is provided, for example, speakers/microphone. Without these peripherals the human-computer interaction for blind persons could not handle the blended-learning strategy. Online assessment tools are also displayed on monitors. Hence, the blind could not possibly respond accordingly unless the questions are projected through audio. Partially sighted students can alter the size of text and the contrast to improve the display for themselves. The deaf may also be disadvantaged if computer-based learning tools are used to supplement blended-learning strategies using audio. Unfortunately, many of these learning tools also do not have integrated sign language interpretations for audio. The increasing popularity of blended learning is even more reason to accelerate the development of a disabled-friendly technology.
Chapter Three Student demographics and degree performance

3.1 Introduction

Identifying the characteristics of the student cohort and how they compare with other institutes is core to being able to evaluate the additional benefits any interventions make, or are the observations made reflecting the same trends appearing nationally. Age, gender, culture, home and socio-economic backgrounds, are all factors that can affect the students rate of success. The typical methods of conducting a statistical study related to demographic variables are descriptive and relational. Descriptive statistics examine the characteristic of the sample in terms of variability. The demographic variables are expected to be a range of values in all dimensions considered. Natural variability is an expected feature of any population. By applying descriptive statistics on the independent variables the observer acquires an overview of the kind of sample being dealt with. This might explain whether or not the outcome of the analysis of the data in relation to the hypothesis is expected of the sample. In a sense, descriptive statistics is a first step of analysis. Visualisation such as charts, histograms, and box plots aid in making an in-depth analysis of the data. Interesting insights could be extracted from the preliminary analysis based on descriptive statistics. For example, if age is skewed to the left then the data could be biased toward the older age in the sample. This could be considerable especially if one could trace that higher education attainment has a generational differentiation, or if some policy only applies to the younger age group. In other words, the data are not entirely representative of the entire sample so that conclusions drawn from the
average/mean value of the dependent variable should be taken with caution. From descriptive statistics, caveat to further analysis can be formulated.

The second category of statistical analysis is relational. In this category, the dependent variable is analysed against the prospective causal/independent variables. In the present study, the higher education attainment, as measured by the degree award mark, is correlated against age, ethnicity, and gender. The relational analysis presumes a statistical model of the possible causation. The degree of correlation quantifies how strong an independent variable determines the dependent variable. In other words, the degree of correlation roughly measures the predictive quality of the hypothetical model. Through this analysis, the observer acquires insight on the determinants to higher education attainment. If indeed such correlation is shown to be significant, then the observer is guided as to which relationship must be further examined. For example, if gender turns up to be the most strongly correlated with higher education attainment, then the researcher might ask whether or not females really do biologically excel in higher education compared to males, if so, for what possible reasons? In other words, the relational analysis becomes a guide for further questions and ramifications for future research. A comprehensive analysis of the data in this study would look at three pairs of independent and dependent variables. Although this may not account for confounding variables effecting outcome, they have not been considered in this study for the sake of simplifying the statistical analysis of the data.
3.1.1 Student cohorts

Identifying the characteristics of the student cohort and how they compare with those in other institutes is core to being able to evaluate the additional benefits of any interventions made. The qualitative description of the cohort features also confirms whether or not the sample is reflecting the same trends appearing nationally. Many factors need to be considered as students are not only recipients for the materials being delivered within higher education to extend their intellectual knowledge base, but they are social and emotional beings, shaped by their age, family circumstances, family experiences, cultural background and heritage. These factors all contribute to their ability to learn, and drivers to perform and often lead them to be termed ‘traditional’ or ‘non-traditional’ dependent upon their circumstances. Kim (2002) determined three criteria for defining students as non-traditional students: age (aged 25 or older); background characteristics (part-time students, single parents, those independent from their parents); and at-risk behaviours (non-completion of A levels, alternative qualifications to A levels, being independent of parents, enrolling part-time, working full-time, having dependents and being a single parent). All of these groupings can add to the confusion it would be more useful to identify groups with shared characteristics: employment (part-time or full-time), education of parents; cultural ‘minority’ rather than broadly categorizing students as non-traditional (Kim, 2002).

Identifying those facets of a cohort that might possibly determine higher education attainment is not a trivial task. But identifying and enumerating these possible determinants serves as a good initial step in formulating hypotheses
about the data. A hypothesis applied on a cohort declares an intelligent guess of what might explain the observation. Higher education attainments are expected to vary between individual students. However, attempting a possible explanation for that variability from a multitude of facets can indeed be confusing. There is the possibility of the confounding of factors. For example, a low higher education attainment may be determined by having a combination of low self-esteem and high exposure to at-risk behaviours. Self-esteem alone does not correlate well with higher education attainment. Similarly, the degree of exposure to at-risk behaviours may not be strongly inversely related to higher education attainment. But a combination of both is predictive. Although the possibility of confounding individual factors exists, the present study has a rationale to neglect such. One is for simplification of the analysis; and the other is the lack of tools that could trace and exhaust all possible confounding among the factors identified.

The last aspect that needs to be stated about student cohorts is the manner by which the sample was constructed. Ideally, if a sample is truly representative of the population then the construction of the sample should be immaterial. The limitation that the researcher currently has in relation to sample construction is accessibility. The researcher has limited access to the higher education institution where this dissertation is written for. There is a risk in this situation. By limiting the sample in one institution only, the curriculum, faculty, and admission policies of the institution might influence the outcome. Compared to another higher education institution, the difference could be considerable. Nevertheless, in order to address time constraints only a single institution is examined. Applying the same study on and collecting data from other institutions could be possible, but
relatively time consuming and would involve ethical considerations to be agreed by each participating university.

### 3.1.2 Higher education attainment and age

Donaldson and Townsend (2007) selected 41 articles to review focused on mature students (aged at or above age 22 years) in undergraduate programmes in the US and contrasted them to traditional students (below the age of 22 years). Donaldson and Townsend’s (2007) study defines the minimum mature age as 22 years, which is lower than 25 years identified in many other studies (Reddy & Moores, 2008). Their research revealed mature students were treated as a homogenous group that faced ‘constraints of time and location’ and did not form part of the main body in higher education. Mature students in HE institutions are not often considered as adding value to the student cohort, so are treated as a heterogeneous group. Even when included in studies they are not considered separately when reviewing engagement theories. Donaldson and Townsend (2007), conclude that there is limited research on mature students in journals of higher education; what work is reported have varying conclusions, often devaluing mature students.

The implication of Donald and Townsend's study is that HE attainment may be influenced by age. The differentiation between mature and non-mature students represents a potential transition that a student experiences upon reaching the minimum age of maturity. Although Donald and Townsend (2007) set this minimum age at a lower value, the marked difference in the responses between those who are above and below the minimum is established. If indeed age were
not determinant of the higher education attainment of students, then the study would have concluded an insignificant differentiation with respect to age about the minimum age of maturity. The possible rationale for setting the minimum age lower than most may be cultural, which is another dimension altogether. In some countries, the typical age of maturity is lower than in most other countries. The reason is that in those countries, children are exposed to the realities of adulthood at an earlier age. But this research into the backgrounds of international students is entirely beyond the scope of the present study.

There are findings that state there is a small correlation between age and attainment. Mature students aged 25 years and above though lacking in study skills are believed to possess better time management; take a deeper approach to studying; and have a greater intrinsic motivation than their younger counterparts, which are perceived to perform a surface approach to learning (Reddy & Moores, 2008). The rationalisation afforded by relating age with attainment is enormous. There are indeed many social factors, which are linked with age. In many Western societies, an adolescent is granted the freedom to decide for his/her own upon reaching 18 years. The setting of transition ages is naturally tied to biophysical changes that human beings encounter as they grow up and age. The development of the brain is key. The accumulation of experiences compounds the necessity of those changes further. In other words, it is reasonable to expect that age should influence many of the aptitudes that students display in the context of higher education. Hence, as a corollary, one should reasonably expect that age; to some extent has a determining factor of higher education attainment.
3.1.3 Higher education attainment and ethnicity

Research looking at a variety of student cohorts; have found that academic attainment is highly stratified between ethnicities (Burgess, et al., 2009; Perry & Francis, 2010). White ethnicities nationally are more likely to obtain a higher degree award than other ethnicities in most subjects. This remains extant even after socio-economic and educational backgrounds have been factored out, as found from studies that compared medical students, whom already share similar previous educational attainment (Woolf, et al., 2011) and was also the case in distance learning degrees from the Open University (Richardson, 2009). Other studies have suggested that non-white ethnicities achieve lower degree awards because they select areas of study that are more challenging and that they are usually less qualified but more proportionately accepted into HE (Derek, 2005), for equal opportunities.

Given black, minority and ethnic (BME) proportions in the population and the requirement of equal opportunities, the UK government should be more proactive in terms of enabling non-whites to level the playing field (Renaud-Komiya, 2012; Melville-Ross, 2009). The government should also reach out further in terms of fortifying or enhancing basic educational programs at the lower grades for non-whites. One potential explanation to the typically lower degree of achievement among non-whites relative to whites is the lack of a strong foundation of the basics (Melville-Ross, 2009). Proceeding to higher education consists of a series of acquisition of academic skills from grade school through high school and college. Non-whites would be at a certain disadvantage if their basic education were not of the same quality as those obtained by whites (Broecke & Nicholls, 2007;
Melville-Ross, 2009). This observation also brings out an economic undertone to the discrepancy. Most non-whites could only afford public education. On the other hand, white families could afford to pay for exclusive schools that offer superior basic educational programmes (Broecke & Nicholls, 2007; Dhanda, 2010). Hence, when a national inventory of academic skills is made, the whites usually perform better in comparison to non-whites. Consequently, the bar for standards is raised. This further makes non-whites fall behind in terms of how much more they need to be trained with in order to keep up (Dhanda, 2010). There is also a phenomenon observed when universities, for example, Manchester where the standard offer is AAB whose BME students graduate with lower degree awards than white students but on entry had equal entry qualifications. This confounds Professor Esmail from Manchester University who was quoted in the Times Higher Education; "We have these really bright students coming to a place such as, yet (they) are coming out with worse outcomes than their white colleagues", “many universities refuse to acknowledge that black and minority ethnic (BME) students achieve lower degrees on average than their white contemporaries” (Renaud-Komiya, 2012). UK universities should be researching into this educational achievement anomaly to enable all student groups an equal opportunity to attain their potential.

Richardson (2010) in another study looking at conceptions of learning and approaches to studying with 1,146 white and 1,146 non-white participants found that the former were more likely to form “meaning-directed learning pattern”, whilst the latter groups to show a “reproduction-directed learning pattern”.

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3.1.4 Higher education attainment and gender

Many studies state there is a gender reversal in attainment between males and females at most educational levels, which is attributed to multi-factorial elements such as changes in family influences to children’s education; changes in society; higher returns in education for females for various reasons and previous parental education (Kipli & Chang). Others suggest the controversial reason for women “over-achieving” to be due to the “feminisation of education” through assessments that favour females such as coursework and or the overrepresentation of female teachers that “emasculate” male students (Martino & Meyenn, 2002; Stone, 2010). In all, there has been an increase in females in HE since the mid-1990s to approximately 55% in OECD countries; thus reversing participation from 1.2 male for every female in 1985, to 1.2 females for every male. With numbers predicted to grow to 1.4 females for every male by 2025 in some OECD countries (Vincent-Lancrin, 2008).

3.2 Methodology

3.2.1 Data collection

Student data for this study was collected from the university student records management system, Software and Information Technology Services - the database used by 70% of universities in the UK and also provides data for Higher Education Statistics Agency (Tribal Group, 2012). This data was sub-divided into further sub-categories, such as: age groups, ethnicities, full or part-time enrolment and gender, then formatted onto SPSS from Microsoft Excel.
3.2.2 Data analysis

The student demographics data from Software and Information Technology Services were analysed for sample characteristics using descriptive statistics, frequencies and graphs, before proceeding to in depth analysis. Explore was used to assess normality, which was set at ‘exclude case pairwise’ only to exclude the sections missing, but to allow all available data to be used. Categories with insufficient data such as the ethnicity, ‘Chinese’, which only accounted for 2 out of 308 cases were collapsed into the ‘Other’ category. Correlations were analysed using Pearson correlation and Spearman correlation, to test the relationship between two continuous data sets such as age and degree grade. T-tests were used to compare males and females for their mean degree grades. One-way analysis of variance (ANOVA) was used to compare the mean degree grades of all ethnic groups. One-Way ANOVA Levene’s statistic was 0.608 which showed that homogeneity of variance was not violated and thus allowed for the post-hoc test using Tukey honest standard deviation (HSD) multiple comparison that showed that there was specific, significant, differences between some ethnicities and their degree awards.

3.2.3 Data interpretation: Regression analysis

Students’ results were analysed with respect to intervention and other parameters including gender, age, ethnicity and compliance with the intervention.
The strength of the relationship i.e. correlation was determined using regression analysis following Cohen’s guidelines:

Small correlations  \( r = 0.10 \) to \( 0.29 \)
Medium correlations  \( r = 0.30 \) to \( 0.49 \)
Large correlations  \( r = 0.50 \) to \( 1.0 \)

To measure the size of the effect we use Eta (\( \eta^2 \))

\[
\text{Eta squared } (\eta^2) = \frac{\text{sum of squares between groups } (t^2)}{\text{total sum of squares } (t^2) + \text{degrees of freedom } (df)}
\]

(Pallant, 2007).

### 3.2.4 Data interpretation: Analysis of covariance

ANOVA is a selection of statistical models, which are designed to analyse the difference between the means of compared groups: in essence it tests whether the variation in the means of parameters tested are equal between groups.

ANOVAs replace performance of multiple t tests and thus reduce type 1 error.

Effect size can be determined and ANOVA can be run as one way or two way using either one or two inputs.

<table>
<thead>
<tr>
<th>Effect size (ES) when</th>
<th>Effect size (ES) when</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>there is one input (One-way ANOVA)</td>
<td>there are two inputs (Two-way ANOVA)</td>
<td></td>
</tr>
<tr>
<td>ES ( \leq 0.04 )</td>
<td>ES ( \leq 0.02 )</td>
<td>The effect is statistically significant but weak.</td>
</tr>
<tr>
<td>( 0.04 &lt; ES \leq 0.36 )</td>
<td>( 0.02 &lt; ES \leq 0.09 )</td>
<td>The effect is moderate.</td>
</tr>
<tr>
<td>ES ( &gt; 0.36 )</td>
<td>ES ( &gt; 0.09 )</td>
<td>The effect is strong.</td>
</tr>
</tbody>
</table>

Analysis of the age range of students who took part in this study (Table 3.2) enabled comparison to published data, specifically from other similar studies; i.e. those related to science-based degrees and relatively recent (carried out over the last six years (2005-2011)). To help new in-take students, they were offered an opportunity to complete a questionnaire discussing their course of
choice. They were asked about their previous educational background to inform our analysis and extend it to include previous experience.

3.3 Results

3.3.1 Comparison of effect of age with degree award mark

This current study, carried out at London Metropolitan University, has gathered data from large cohorts of students undertaking a BSc biomedical science between 2005/6-2009/10. The most typical student age range in this modern University cohort is between the ages of 20-25, which means that they are not school leavers (M = 22.5, SD ± 5.65). They total up to 39.3% of the overall student population; followed by 16-19 year olds, who account for 38.3%. Whilst, the 26-35 year olds represent to 15.3%, those students who are the 36 year of age and over account for 7.1% Table 3.2.

Table 3.2 Age range and percentage of biomedical science students across academic years 2005/06 – 2009/10

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>16-19</td>
<td>118</td>
<td>36.1</td>
<td>38.3</td>
</tr>
<tr>
<td></td>
<td>20-25</td>
<td>121</td>
<td>37.0</td>
<td>39.3</td>
</tr>
<tr>
<td></td>
<td>26-35</td>
<td>47</td>
<td>14.4</td>
<td>15.3</td>
</tr>
<tr>
<td></td>
<td>36 and over</td>
<td>22</td>
<td>6.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Total</td>
<td>308</td>
<td>94.2</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing system Total</td>
<td>19</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>327</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is evidence, illustrated in Figure 3.2 that there seems likely these age ratios will be maintained over the coming years.
Modern Universities have a different age profile to traditional Universities with the majority being in their 20s rather than school leavers. Thus it is important to determine whether this has an impact on performance. Interestingly, it is the traditional age range of the mature student that demonstrates improved results with the group in their 20s performing similarly to school leavers (Table 3.2). The means for each age range are as follows: 16-19 (M = 57.25), 20-25 (M = 58.07), 26-35 (M = 59.87) and 36 and over (M = 60.24) (see Figure 3.2). The percentage differences are +0.17 for 20-25, +0.99 for 26-35, and +3.28 for 36 and over. There is a weak, but positive correlation between age and mean degree award grade of 0.088. It is also important to note, that despite the small increase in percentage differences, the cohort of students over 36 is on average a whole grade boundary above the other cohorts. Therefore, this suggests that they are mostly like to obtain degree awards equivalent to 2.1, whilst their younger counterparts achieve 2.2 equivalent awards.
Figure 3.2 Age range to mean award mark over academic years 2005/6-2009/10

A very strong positive relationship found: after conducting both Pearson’s and Spearman’s rho correlation statistical tests, the correlation coefficients were $r = 0.88$ and 0.86 respectively, $n = 248$, $p < 0.05$ which shows a significant difference. The small number of students of 36 and over students (18) will have reduced the power of the statistical test. In addition, the general spread of grades within age ranges made it harder to note stronger trends, however it may reflect the profile of the types of students in each age group or their response to the learning environment. The students aged 20-25 years had some of the lowest grades at 42.00% but also some of the highest at 82.20%, despite their mean average being less than those aged 36 and above. This describes the cohorts with perhaps those likely to be high fliers or poor performers less lightly to be in the position of wanting to return to education in their mid to late 30s. Mature student groups lack high fliers may be as a reflection of self-selection, employment requirement for promotion or maybe reflects their ability to fully exploit their learning environment.
3.3.2 Ethnicity and degree award mark

The data showed that some ethnic groupings do consistently better or worse overall as a consistent trend. Table 3.3 provides a summary of means, minimum and maximum award degrees by ethnicity. The White Irish group has the highest mean (M = 66.11; SD ± 10.78; 95% CI 57.81–74.39) for award grades. This contrasts with the Black Caribbean group (M = 55.20; SD ± 5.85; 95% CI 50.71–59.70) and in both groups N = 9, throughout academic years 2005 to 2009. In addition, the Black African cohort were N = 95, the mean was M = 55.71; SD ± 7.65 with a 95% CI between 54.15–57.26. This group contained students with the greatest spread of marks with the lowest award grade at 42 and the highest at 82.40 Table 3.3.

Table 3.3 Mean award grades by ethnicity.

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound.</th>
<th>Upper Bound.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>White British</td>
<td>6</td>
<td>59.0</td>
<td>7.1</td>
<td>2.9</td>
<td>51.5</td>
<td>66.5</td>
<td>50/5</td>
<td>71.1</td>
</tr>
<tr>
<td>White Irish</td>
<td>9</td>
<td>66.1</td>
<td>10.7</td>
<td>3.6</td>
<td>57.8</td>
<td>74.4</td>
<td>46.67</td>
<td>80.8</td>
</tr>
<tr>
<td>Other White</td>
<td>3</td>
<td>64.2</td>
<td>10.5</td>
<td>6.0</td>
<td>38.3</td>
<td>90.2</td>
<td>56.8</td>
<td>76.2</td>
</tr>
<tr>
<td>Other Mixed</td>
<td>7</td>
<td>58.8</td>
<td>8.8</td>
<td>3.3</td>
<td>50.6</td>
<td>67.0</td>
<td>47.1</td>
<td>73.0</td>
</tr>
<tr>
<td>Asian Indian</td>
<td>21</td>
<td>56.0</td>
<td>7.5</td>
<td>1.6</td>
<td>52.6</td>
<td>59.4</td>
<td>44.3</td>
<td>73.7</td>
</tr>
<tr>
<td>Asian Pakistani</td>
<td>17</td>
<td>58.7</td>
<td>9.1</td>
<td>2.2</td>
<td>53.9</td>
<td>63.3</td>
<td>43.3</td>
<td>72.5</td>
</tr>
<tr>
<td>Asian Bangledeshi</td>
<td>9</td>
<td>56.1</td>
<td>8.4</td>
<td>2.8</td>
<td>49.6</td>
<td>62.6</td>
<td>44.7</td>
<td>72.1</td>
</tr>
<tr>
<td>Other Asian</td>
<td>24</td>
<td>61.7</td>
<td>9.1</td>
<td>1.8</td>
<td>57.9</td>
<td>65.5</td>
<td>46.6</td>
<td>79.5</td>
</tr>
<tr>
<td>Black Caribean</td>
<td>9</td>
<td>55.2</td>
<td>5.8</td>
<td>1.9</td>
<td>50.7</td>
<td>59.7</td>
<td>47.4</td>
<td>64.4</td>
</tr>
<tr>
<td>Black African</td>
<td>95</td>
<td>55.7</td>
<td>7.6</td>
<td>0.7</td>
<td>54.1</td>
<td>57.7</td>
<td>42.0</td>
<td>64.4</td>
</tr>
<tr>
<td>Chinese</td>
<td>1</td>
<td>60.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60.5</td>
<td>60.5</td>
</tr>
<tr>
<td>Other ethnic</td>
<td>43</td>
<td>60.1</td>
<td>8.0</td>
<td>1.2</td>
<td>57.6</td>
<td>62.6</td>
<td>45.1</td>
<td>81.1</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>57.9</td>
<td>8.4</td>
<td>0.5</td>
<td>56.9</td>
<td>59.0</td>
<td>42.0</td>
<td>82.4</td>
</tr>
</tbody>
</table>

In Table 3.3 the Chinese ethnic group for statistical analysis had to be collapsed
into Other Ethnic as there was only one case, and it was prohibiting further statistical analysis.

The one-way ANOVA Levene’s statistic was 0.608 which showed that homogeneity of variance was not violated, $p < 0.002$ which is less than 0.05 and showed that there was a significant difference in degree award grade and ethnicity between groups. The post hoc test using Tukey HSD multiple comparison showed that there were specific significant differences between ethnicity and degree award for three ethnic groups. A significant difference was found between the White Irish cohort and Black African $p < 0.013$ and Asian Other and Black African $p < 0.048$. Size effect using Cohen’s equation it was calculated at 0.11 (small effect).

Comparison of the percentage differences in mean award marks compared to the highest achieving ethnic group, White Irish has been carried out Table 3.3. Percentage mean differences higher than 6% are a grade boundary below those of White Irish students. There is no overall significant difference between most of the groups highlighted because of the spread in grades found amongst the groups. But the difference in means highlights that there are definite trends in those that do consistently well and those that do not. There is also no current data within this study of why the largest ethnic population is Black African, and why they have weak performances in relation to their population size and to the White Irish ethnicity.
Table 3.4 Percentage differences of mean award marks by ethnicity
(* indicates mean differences of greater than 6%)

<table>
<thead>
<tr>
<th>Ethnic coding</th>
<th>Ethnicity</th>
<th>Difference in mean average by % to White Irish</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Black Caribbean</td>
<td>10.9*</td>
</tr>
<tr>
<td>13</td>
<td>Black African</td>
<td>10.4*</td>
</tr>
<tr>
<td>8</td>
<td>Asian Indian</td>
<td>10.0*</td>
</tr>
<tr>
<td>10</td>
<td>Asian Bangladeshi</td>
<td>10.0*</td>
</tr>
<tr>
<td>9</td>
<td>Asian Pakistani</td>
<td>7.4*</td>
</tr>
<tr>
<td>7</td>
<td>Other Mixed</td>
<td>7.3*</td>
</tr>
<tr>
<td>1</td>
<td>White British</td>
<td>7.1*</td>
</tr>
<tr>
<td>16</td>
<td>Other Ethnic</td>
<td>6.0*</td>
</tr>
<tr>
<td>11</td>
<td>Other Asian</td>
<td>4.4</td>
</tr>
<tr>
<td>3</td>
<td>White Other</td>
<td>1.8</td>
</tr>
<tr>
<td>2</td>
<td>White Irish</td>
<td>0</td>
</tr>
</tbody>
</table>

Though there was only statistical significant difference between three groups, the percentage differences between White British, Asian and African ethnics appears to be large enough to pose questions for further study and analysis as seen in Figure 3.3.

![Figure 3.3](image_url)

**Figure 3.3** Mean percentage differences between ethnic group scores compared with highest achieving cohort.
3.4 Conclusions

Donaldson and Townsend (2007) found that the articles portrayed mature students in limited and often, in negative ways, but this was not borne out by our findings as we observed that the 25+ student cohort attained better degree grades, and that this was even more evident in the +35 age bracket. During the focus group interviews to analyse the research areas that follow in chapters 5 and 6, it became more apparent that these students either had a particular reason for studying biomedical science (employment related), or they had an interest in science and medicine, and their organisational skills and clear career goals. Mature students in other studies were devalued or just ‘accepted’ (in comparison to traditional age students) but they were not seen as problematic (Donaldson & Townsend, 2007); we also saw this after a period of reassurance in some cases. More research on understanding adult students’ as a heterogeneous group is required. Kim’s (2002) identified some institutional programmes designed to assist non-traditional students within her review, it also identified that programmes using too broad a definition of non-traditional students, are less likely to meet the needs of students with ‘particular personal or logistical challenges’. When designing interventions we need to meet students’ particular needs, and we need to ‘focus on the unique qualities’ of our student cohort. Efforts must be focused on ensuring that the students of all ethnicities have equal access to support and resources, which will bring up the universities success rate in terms of retention and progression.
Chapter Four Collaborative learning

4.1 Introduction

This chapter aims to evaluate the benefits and issues with using collaborative learning exercises supported within a computer-supported collaborative environment to enhance student learning, experience and develop graduant attributes for further employability. Collaboration is a process where individuals are responsible for their actions, including learning and respecting the strengths and weakness of their peers’ contributions, the philosophy of interaction and personal lifestyle (Panitz, 1996). Collaborative learning features in many organisations worldwide increasingly becoming a major success builder within modern society. Collaborative learning supports the rediscovery of the interdependence, as Kenneth Bruffee calls it, from which society has gradually emerged (Kelly, 2002; Bruffee, 1999). The advent of telecommunications and the internet, has allowed people to rediscover the power that goes with sharing one's specialised skills and talents to create a greater good, and furthering progress more than ever before. Collaboration has become the rising feature in today's globally connected world. Social networks have served as the medium through which collaboration could seamlessly channel. As a reflection of this evolving world towards collaboration, so the educational system now can be further shaped through collaborative learning.

Collaborative learning can be used as an educational tool to enhance teaching and learning, students work together to create items, solve problems, complete tasks and enhance teamwork skills for future employment (Laal & Ghodsi,
Benefits of collaborative learning, 2012). In a working environment where people come together in groups/teams, everyone needs to deal with each other, treat each other with respect and identify individual group members' abilities and contributions. Collaborative learning activities allow students to practice and develop these skills in a low stakes environment (Zhan & Mei, 2013). Laal and Ghodsi highlight the social, psychological, academic, and assessment benefits of collaborative learning (2012). During collaborative activities, through consensus building, through cooperation, there is a sharing of authority and acceptance of responsibility among group members for the groups’ actions, in contrast to competition in which individuals compete to be better than other members of the group. Johnson and Johnsons’ survey (2009), identified further achievements that may result from collaborative learning over individual learning: Enhanced interpersonal relationships (Social), Improved self-esteem, social interaction skills and psychological wellbeing (Psychological); Greater productivity with higher level of critical evaluation (Academic) and; Higher achievement (Assessment advantages) (Laal, Naseri, Laal, & Khattami-Kermanshahi, 2013).

In terms of academic achievements, collaborative learning provides the opportunity for higher level thought processes as students become actively involved in their learning process, listening to their peers, discussing the topic, receiving immediate critique of their point of view and creating a solution together (Laal et al, 2013). Students enhance their metacognition: increased clarity of ideas, improved critical thinking skills, improved discussion and debating skills and ability to formulate the ideas raised with their peers. Students
can achieve a state of metacognition by monitoring each other, identifying mistakes and learning how to correct their errors (Gokhale, 1995).

Assessment of collaborative learning can be undertaken as: observation of the group, review of the group output, and the self-and peer assessment of the group and individual members (Angelo & Cross, 1993; Panitz & Panitz, Encouraging the use of collaborative learning in higher education, 1997).

Group work is an ideal collaborative environment used in education, it features social interaction, the period during which students discuss learning topics leads to effective cognitive learning, is one of the principal activities of collaborative learning (Zhu, 2012). As identified by Garrison and Cleveland-Innes (2005), these learning strategies support and encourage a deep learning approach within students and show effective enhancement in student achievements. There is an expanding body of research focusing on computer-supported collaborative learning environments (Zhu, 2012). Student collaboration and the construction of their knowledge can be supported and enhanced with the use of interactive technologies (Comeaux & McKenna-Byington, 2003).

So why use collaborative learning exercises, when students often feel that when they undertake group work they are disadvantaged. They feel that they do not “get the grades they deserve”, there is a perceived view that not all members of the group contribute equitably to the tasks being undertaken and that as individuals they would achieve higher grades. So why would we use collaborative learning in an higher education environment:

a) It is perceived as a valuable transferable life skill
b) Quality Assurance Agency for HE expect it

c) Employers expect it

d) Accrediting bodies such as the Institute of Biomedical Science require “‘working with others’”

e) It is a useful skill for students, one that enhances their experience and improves employability skills (when lecturers are asked for references they are often asked about teamwork and communication skills in relation to the student)

f) Students can interact with other students they may not have known well before and increase their social circle, and learn from each other

4.1.1 Institutional challenges

The revenue stream of a higher education institutes depends, to a large extent, on the size of the student population. However, there are systemic constraints that limit the indefinite increase in the student population size. For instance, increasingly large classes would tax highly on the ability of the faculty to return marked assignments in the appropriate timely manner. The focus on the use of group work and peer assessment within the HE setting has also been increasing over the years (van den Berg, 2006). Such a trend exerts pressure upon higher education institutes, which are yet to adopt the strategy. One of the benefits of administering group (instead of individual) assignments is that it reduces the overall marking load on academics. However, if such a benefit is lopsided; that is only the faculty side perceives it, and not the students, then the system becomes discredited. Students’ are after all the clientele of the higher education institutes and the direct source of income stream.
The qualification bodies address personal skill development by students; the subject benchmark statement for biosciences (QAA, 2007a) acknowledges that ‘group work has a significant training benefit’, and the statement for biomedical sciences (QAA, 2007), although not explicitly referring to group work, does include the expectation that a biomedical sciences graduate will acquire adequate communication skills, and may well have been involved in poster and oral presentations.

Whatever the perceived (or actual) benefits to the students, any assessment associated with collaborative learning must be seen to be fair. Although Race, et al. comment that establishing the level of contribution of respective group members can be problematic, Rust and East both advocate a system whereby both ‘process’ and ‘product’ are assessed (Race, et al., 2005; Rust, 2001; East, 2008). Rust suggests how ‘variable contribution’ might be teased out during the process, and Cogdell, et al. have introduced group work, into a large 1st year biology class at the University of Glasgow, that uses peer assessment to address individual team member contribution (Rust, 2001; Cogdell, et al., 2004).

4.1.2 Collaborative learning

In this form of learning, learners work within groups to achieve a common goal. Each member collaborates with every other in order to accomplish the learning task (Dillenbourg, 1999). The individual learners draw on their unique strengths and skills, and their time and effort to contribute to the group output. The underlying principle of collaborative learning is that an individual gains new
knowledge by engaging and sharing experiences with another (Kelly, 2002). The activities or tasks assigned would not have otherwise been accomplishable by an individual except through collaboration. Other skills, such as critical thinking, have been shown to be enhanced through collaborative learning (Gokhale, 1995; Pitsoe & Malla, 2013; Zhan & Mei, 2013).

Collaborative learning team/group work are all derived from the concept of setting students a task for completion by a set of students that can be put into groups by the lecturer or allowed to form their own groups (Johnson & Johnson, Cooperative learning: Where we have been, where we are going., 1993). Research has shown since the 1990s that active learning and cooperative learning techniques are superior to straight lecturing (Hake, 1998; Johnson & Johnson, Cooperative learning: Where we have been, where we are going., 1993). Tasks can be set for group projects where learned principles are applied, such as in the analysis of case studies, production of scientific posters, holding ethical debates.

Educators endeavour to encourage deep learning in their students and research supports the link between ‘social interactions, critical thinking and deep learning’ (Resnick, et al., 1991; Hartford, 2005; Holley & Boyle, 2012). Collaborative learning through group work facilitates social interaction and thus develops cognitive skills, this works through both student-student interaction and lecturer-student interaction (Entwhistle & Ramsden, 1983; Comeaux & McKenna-Byington, 2003). Virtual learning environments provide a framework for a different kind of group work allowing for asynchronous discussion. Using
this web-based method it may now be possible to, more accurately, determine the contribution an individual student makes to the group assignment. Careful consideration is important since good communication and the ability to work as part of a team are two skills highly valued by employers. Collaborative learning if used effectively can develop these skills. WebLearn provides the e-framework for a different kind of group work allowing for asynchronous discussion between group members and the tutors, and moderation of the student contributions. Using this web-based method it may now be possible to, more accurately, assess the contribution an individual student makes to the group assignment.

Although collaborative learning traditionally has been carried out through face-to-face interactions, its scope can be enhanced further through the use of online tools (Reeves, et al., 2004). In other words, the collaborators do not have to be situated in the same place in order to work together. Several online platforms have been made available for collaborative learning, an example of which is Blackboard. Computer-mediated collaborative learning has been foreseen in the early days of personal computers and widespread home-based operating systems (Warschauer, 1997). Many of the virtual learning environments platforms today have been conceived with collaborative learning as an essential feature (Sheremetov & Arenas, 2002; Aspden & Helm, 2004; Su & Beaumont, 2010). The use of wiki as a platform for collaboration has been where the efforts at promoting online collaborative learning are (Boulos, Maramba, & Wheeler, 2006; Su & Beaumont, 2010; Naismith, et al., 2011). In the field of medical sciences, a recent undertaking by Westbrook (2012) urges the use of collaborative learning for health care education.
4.1.3 Motivation by assessment

The idea that assessment motivates learning (Gibbs, 1999; Gibbs, 2006; Gibbs & Simpson, 2004; Nicol & Macfarlane-Dick, 2006) is a powerful driver for the development of assessment practices that enhance that process. Assessment motivates an individual student because it provides a sense of achievement and enables them to check on their level of learning achieved. In particular it has been shown that for assignment feedback to contribute to student learning, the feedback has, among other features, to be timely; that is, it has to be returned to the student ‘while it still matters to them and in time for them to pay attention’ - and act on it’ (Brown, et al., 2003; Gibbs & Simpson, 2004; Weaver, 2006). Feedback is a necessary requisite for learners to be able to continue with any learning task.

However, in the context of collaborative learning the challenge is on how to provide an individual mark despite the fact that the individual is part of a collaborative group. One way of doing this is to engage each member of the group to evaluate themselves and their colleagues. But in order to implement this strategy in order, a rubric system must be in place. The rubric shall guide the individual learners on how they should be evaluating the performance of their colleagues (Appendix C).

The practice of peer review is actually a good learning experience. In real instances, peer review is also being used in industry and in many professions as a way to check and balance each and everyone's share of a group task. Hence, by implementing a peer-review system for the students, they derive an
additional source of motivation (Järvelä, et al., 2010). There is also the added motivation to impress their group members by doing their part of the task to the best that they can, in order to earn the highest possible evaluation score. In other words, by injecting a peer-review process not only does the tutor extract individual grades from collaborative work, but also provides more reason for the group to be motivated in excelling in producing the highest quality output against the other groups.

The use of discussion boards within Learning Management Systems or Virtual Learning Environments allow the tutors to post comments for the students during the development of the coursework enabling them to respond to the feed-forward and make changes to the work before it is presented as their final submission.

4.1.4 Participation

Group work can be hampered by some students' lack of participation, and this may be difficult to track. Brighter students can feel that they have made the best contribution and would have been better alone. In this research, the author has found, in agreement with other published work (Haynes & Haynes, 2012), that the students' group mark was higher than the score achieved for their individual report. Peer assessment is one documented way to get over some of the problems associated with marking students (in the biological sciences) who are part of a team (Falichov, 1986; Orsmond, 1996; Cogdell, et al., 2004; Davies, 2009). As mentioned in the previous section, by engaging group members in the process of evaluating each other’s performance an additional source of
motivation is derived. This motivation to excel is exactly the impetus that pushes the students to participate in collaborative tasks (Dooly, 2008; Järvelä, et al., 2010). As long as the students are guided by clear rubrics on how to evaluate their peers the system should provide a positive addition to the collaborative learning strategy (Cogdell, Brown, & Campbell, 2004).

The motivation to participate would be further enhanced if an individual recognition system were put in place. The affective issues are just as important as the social issues in the context of participation in a collaborative setting (Jones & Issroff, 2005; Dooly, 2008; Wang Q., 2009). Education technology has been crucial in enhancing the participation of learners in collaboration with others (Wang Q., 2009).

As a matter of fact, by facing the prospect of being graded, it does not really matter as from whom the assessment originate (Wiliam, Lee, Harrison, & Black, 2004; Davies, 2009). Hence, if now the student in a collaborative-learning scenario faces the prospect of being graded by the teacher and by other students, then all the more will the student be driven to excel. The drive to impress collaborators becomes an additional extrinsic motivation to participate in collaborative work.

4.1.5 Student self-perception of their performance within group work

Academic motivation is directly related to self-perception of performance. A study finds that academic motivation is a key element in determining the contribution of a learner to the group output. The role that the learner takes
within the group is likewise influenced by the individual academic motivation (Rienties, et al., 2009).

Self-perception of performance is however not necessarily what a student is projecting to his collaborators. The peer-review system essentially provides a feedback mechanism that the student could use in conjunction with their self-perception. In order to be fair at this, self-perception may also be integrated into the grading system. A portion of the student's individual grade for collaborative work will be taken from self-perception of performance, while the rest will be taken from the evaluation of his peers. A weighted average might seem appropriate.

In this peer-review system, the teaching team will evaluate the output of the group. But gradations for individual marks will be made by a combination of the project grade and the one emerging from the peer-review and self-perception of performance.

4.2 Assessment of Collaborative learning

4.2.1 Peer Evaluation

For collaborative learning tasks, it is common to include an element of peer evaluation. Educationalists have varying views with strong positions for and against the use of peer evaluation, when in a tutorial environment the tutor can facilitate the development of the pros and cons for either side. Some argue that for fairness in evaluation of contributions to collaborative work they should be at the individual level; hence, there is no need for peer evaluation, believing that
students should never be put in the position of evaluating other students. Arguments for this state “That is not up to them [the student]”, “It is not their [the students] role” or the academic institute may actively discourage peer evaluation as they are concerned it will develop adversarial relationships between students.

The opposing view is that a process that can include peer review such as this is a common occurrence in everyday life and offers students the opportunity to develop soft skills should evaluate collaborative work. Peer evaluation also helps the lecturer or tutor identify which members undertook which tasks and at which level of competency. To generate a feeling of fairness for the students there must be a means of reward or punishment in terms of grades achieved by group members to discourage “surfing” or “lurking” and the building of student resentment during the process.

Groups working in teams require time to form successfully, some researchers indicating this can commonly, take a third or half a semester for this to occur (Hake, 1998). So for this intervention, the groups are established in week one and the outputs for the coursework are evaluated in week eight.

### 4.2.2 Tutor grades

The products of the collaborative work are graded against the rubrics for poster, leaflet and ethical debate, which are presented to the students at the outset of the coursework. Two instructors evaluate the ethical debate section and all
tutors get together and review the posters and leaflets produced by the
students.

4.2.3 Online discussion groups

Hartford (2005) sought to determine whether online discussion groups can
facilitate group work and if online messages can be used to inform moderate and
feed-forward during assessment. The utilisation of virtual learning environments
to support collaborative learning increases elements of online learning
undertaken by students, which in turn enhances students’ academic skills as they
involve different skills from those needed for face-to-face learning (Hartford,
2005; Garrison & Cleveland-Innes, 2005; Zhu, 2012). These include motivation,
cognitive and metacognitive skills, which all play a greater role in online settings.
Researchers assert that the use of online discussion and the asynchronous
availability involves more students because it gives them time to think, digest
and reflect (Young, 2008). Schön thoughts are as relevant now, as in 1987 “The
practitioner allows himself to experience surprise, puzzlement, or confusion in a
situation which he finds uncertain or unique. He reflects on the phenomenon
before him, and on the prior understandings which have been implicit in his
behaviour.” (Schön, 1987).

4.2.4 Aims of this chapter

To examine the effectiveness of using discussion boards within WebLearn to
enhance the learning, and socialisation of students studying haematology and
transfusion science. To explore how useful WebLearn discussion tools are at
monitoring students’ contributions and allowing the tutors to facilitate and
moderate the group work activities. To explore the potential of WebLearn discussion boards to:

- Enable students to communicate asynchronously with each other and their tutors to develop their coursework.
- Enable students to develop new ways of working together which can alleviate stress and frustration of being heard in a group or being unable to attend all meetings.
- Encourage, and build students’ self-esteem and confidence in their learning abilities via feedback on postings.
- Enable peer support and promote independent learning.
- Enable students to improve their grades.
- Enable students to acquire transferable skills including research skills including ethics, literature searching, scientific communication and teamwork.
- Tracking student participation and quantifying the value of their contributions.
- Facilitate and moderate the contributions utilising feedback to feed-forward and develop higher quality outcomes.

- To conduct a pilot study utilising WebLearn to facilitate and moderate group work with a cohort of students studying haematology and transfusion science, a BSc 2nd year module.
4.3 Method

4.3.1 Research setting

The study in this chapter focuses on examining the self and peer evaluation of student: performance, satisfaction, online performance, and achievement through peer interaction of students. For this purpose, two cohort experiences were evaluated (BM2006N Haematology and Transfusion Science, and BM2005N Molecular and Cellular Pathology, BM2005N ran the semester before BM2006N). The WebLearn (Blackboard™, our institute’s virtual learning environment) for BM2006N was enhanced with discussion boards, email, and file exchange for the coursework being assessed. The process was repeated for five years altogether with modifications made each year in response to student and tutor feedback. The student groups were of similar age range and had studied the same first-year subjects, as both were second-year university students. The tutors were inducted into the process of facilitating their groups in forming a group, outlining the coursework and using the discussion board tool. For the first iteration, students were allowed to self-select into groups within their pre-set tutor groups, 6 members ideally, but not less than 4 (Haynes & Haynes, 2012). During the first tutor group session, the coursework was introduced, and the students were set a team-building activity. The students were given a brief: one member of the group is to act as an observer, the rest of the group were to build a tower with newspaper and sticky tape (Figure 4.1).

On completion, the group select their leader, and distribute the other roles for the group for the coursework, and they select their topic. Support materials for the development of the coursework were posted on WebLearn. The tutor
presented examples for the styles for each component during the first tutorial. Once groups were formed, and topic area selected group areas were established on WebLearn with a linked blog discussion area, intergroup email and file sharing facility for each group. Tutors trained students how to use the virtual learning environments to participate in, group discussions, email their group and the tutor and how to share documents and webpages.

The students were given a scenario for example haemochromatosis, sickle cell anaemia and pregnancy, bacterial enzymes converting A, B, AB, to O. The students were asked to produce a scientific poster, public information leaflet and hold a debate with an ethical aspect on the topic. Their group work was presented to their peers and tutors as a presentation eight weeks later. Students were facilitated and moderated via the WebLearn module by the tutors during the development of the coursework but were largely self-directed. Students will have used WebLearn previously, and were given a demonstration in class to show how to use the discussion board area and attach documents, links, so they can see how the system works, how the tutors and the course leader can view and comment on their postings. The students were encouraged via WebLearn to post questions to each other and provide peer support to their group members; the tutors monitor the postings and moderate postings and facilitate the development of the assignment. Familiarity with the on-line environment is “crucial” (Mason & Bacsich, 1998). Schön (1983) observed “When a practitioner makes sense of a situation he perceives to be unique, he sees it as something already present in his repertoire......The familiar situation functions as a precedent, or a metaphor, or... an exemplar for the unfamiliar one”.

112
<table>
<thead>
<tr>
<th><strong>Table 4.1 Module format for the introduction and support of collaborative learning</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction to the module theme</strong></td>
</tr>
<tr>
<td>Group work tutorial: What is group work? Evidencing group work effectively.</td>
</tr>
<tr>
<td>Face-to-face initial tutorial with designated group tutor arranged by each group.</td>
</tr>
<tr>
<td><strong>Team building activity</strong></td>
</tr>
<tr>
<td>Online critical evaluation tutorial and WebLearn demonstration.</td>
</tr>
<tr>
<td>Weekly review of Group activities, completion of tasks including posting minutes of meetings to the online discussion facility</td>
</tr>
<tr>
<td>Feedback by tutor to facilitate the coursework</td>
</tr>
<tr>
<td>Presentation of poster, leaflet and conduct debate</td>
</tr>
<tr>
<td>Complete the peer assessment form and post to the assessment area on WebLearn</td>
</tr>
</tbody>
</table>

Weekly, the tutors and the course leader visited the group discussion areas to moderate and facilitate the groups’; they post messages of encouragement, direction and guidance. In the face-to-face tutorials, the tutor will ask their groups for updates of progress. A regular reminder about the coursework and the use of the discussion boards to reduce disputes when work is graded is reinforced during lectures.
Figure 4.1 An example of a tower built by one of the groups and their tutor describing the coursework.

Analysis of the student performance and engagement was evaluated via statistical tools within WebLearn, tutor evaluation of output and also via analysis of student responses via self and peer assessment forms.

4.3.2 Participants

To investigate collaborative learning, two modules were chosen so that there were students on each that did not need to undertake the module as part of their course, this enabled us to compare cohorts that did not study this module and compare them to those who did to enable us to evaluate the effect of incorporating collaborative learning.

For this research, students undertaking group-work as part of Haematology and Transfusion Science (BM2006N) and studying Molecular and Cellular (BM2005N) over the period of 2005/6-2009/10 were included (Table 4.2). The average age of the students was 22.5 years.
Table 4.2 Student populations for the study period

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Student Numbers in Each Academic Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005/6</td>
</tr>
<tr>
<td>BM2005</td>
<td>102</td>
</tr>
<tr>
<td>BM2006</td>
<td>172</td>
</tr>
<tr>
<td>Total</td>
<td>274</td>
</tr>
</tbody>
</table>

This large cohort enables statistical evaluation to be highly powered.

It is important to note that there are students on each module that did not need to undertake the module as part of their course, so where appropriate student data was compared to evaluate the effect of incorporating collaborative learning.

4.3.3 Procedure and instruments

Except for the second iteration where students were randomly assigned to a group of six students, groups were allowed to self-select from within the pre-allocated tutor groups. After the first week where students undertook a bonding exercise and chose their topic for research, students were required to participate in the online group discussions and group work on their selected assignment. The assignment lasted eight weeks, and the students were encouraged to contribute to online discussions and the group work activity at least twice a week. An instructor was assigned to 3 or 4 groups as the supervisor for each of the student groups. After eight weeks of online work, student online contributions were assessed, using qualitative and quantitative criteria. The first step of the assessment was based on the products of the group, and each group was informed of the overall score for their components.
4.3.4 Generation of individual grade for members of each group

In the grading process for this collaborative learning exercise, students are not grading themselves and their peers for their perception of the quality of the products (poster, leaflet and debate) but they assign marks from 0 to 3 for research efforts, the quality of the work produced and for the enthusiasm in participating in the group (see Appendix C). The instructional team are the ones giving the grades for the quality of the component sections of the coursework: - scientific poster, public information leaflet and ethical debate on the individual group topic; and the peer evaluations are used to canvas the group members about their relative contributions. The module leader is then able to moderate grades allocated to each student by reviewing the contributions made by each student via the virtual learning environments discussion boards.

The formula to calculate the individual grade for each student completing the coursework, is shown in Table 4.3 this calculation was used for every iteration of the collaborative learning assessment, there was no need to alter the formulae as used by Cogdell, et al. (2004).
Table 4.3 Calculation of peer assessed marks (based on Glasgow University tested formulae) instructions given to the students in their module book (Cogdell, et al., 2004).

Two tutors assign a group given mark for the three elements \((y)\) out of 100
This is multiplied by number of students \((n)\) in group to give total group mark \((yn)\)
Members of the group give each other a mark out of 10 for the contribution they feel the others made to the assignment
These marks are averaged to give each student a peer mark \((mi)\)
From this we obtain sum of peer marks \(\sum_{i=1}^{n} mi\)
Final mark for each individual student \((i)\) = \(\sum_{i=1}^{n} mi \cdot yn / mi\)

Examples of how the students’ individual mark were created:
1) A group of 3 students are awarded a total of 60% for their poster & debate & information leaflet \(y = 60, n = 3\)
If all the students in group gave each other in the group the same mark, for example \(7 (mi)\)
Each has average peer mark of \(7 (\sum_{i=1}^{n})\)
Each gets a final mark of \(((7+7+7) \times 60 \times 3)/7 = 60\%\)

2) A group of 3 students are awarded a total of 60% for their poster & debate & information leaflet but Tim gets average peer mark of 5, Farah gets 8 and Ahmed gets 7 from the peer assessment
Final mark for:
Tim \(((5+8+7) \times 3 \times 60)/5 = 45\%\)
Farah \((8/20) \times 180 = 72\%\)
Ahmed \((7/20) \times 180 = 63\%\)

4.3.5 Questionnaire on student satisfaction/dissatisfaction with collaborative learning and online activity

After eight weeks of online collaborative learning, students were asked to complete the self and peer assessment questionnaire. The questionnaire (Appendix C) consisted of 23 questions assessing their view of their contribution and their peers, and an opportunity to feedback their view of the experience (Zhu, 2012; Angelo & Cross, 1993).
4.3.6 Content analysis

Students were asked to collaborate on an assessment task and this was monitored for the purpose of the research via a discussion board. This methodology is a tried and tested way of monitoring collaboration via virtual learning environments. There is a body of evidence that says that this kind of student-student interaction is a vital part of learning (Prawat & Floden, 1994; Scardamalia & Bereiter, 1994). Research demonstrates that student lead interactions, discussion and postulation of ideas via a VLE facilitated and enhanced learning (Hartford, 2005; JISC Infonet, 2006).

Over the period of the research, it became evident that there was a need to both monitor number of posts to a discussion board, and evaluate the quality of the posts: the number of posts per student was seen to rise, but compared with student performance was either stalling or falling. A scheme for grading the quality of the contributions was implemented during the research period 2012-13. The postings from each group of students was coded and analysed, producing a data set consisting of transcripts of all messages posted during group discussions by these groups during the period of the coursework (Veerman, et al., 2001). Two independent coders (to avoid bias from the researcher) were employed to evaluate the messages in the transcripts. Evaluative grades were allocated as follows: posts not contributing to the development of the coursework = 0, solely diary/timetable comments = 1, content discussion and/or sources/links = 2, posting draft work, or critiquing the work of others = 3. Inter-coding reliability was analysed by requiring a percentage agreement of 93% between first and second markers.
4.3.7 Statistical analysis

Student achievement within group assignments was compared and the difference in performance between pre-intervention (BM2005N) and post intervention (BM2006N) over the course of five years. Correlation analyses were performed, using SPSS, to determine trends between individual mark and group mark. It was determined that there was a gender bias when looking at peer grade versus individual marks. One-way ANOVA analysis was used to interrogate the data for potential differences between the degree pathways being studied, group versus and gender versus individual mark. Student t-tests were used to analyse the differences between the paired performance of students on pre-intervention (BM2005N) and post intervention (BM2006N) modules regarding their whole module performance.

4.4 Results

An analysis of the frequency of student postings versus quality of the work was conducted to determine whether this would correlate with the final coursework grade attained (Figure 4.2 and 4.3). It was only possible to evaluate for one year (2012) as the posts for previous years did not survive an upgrade of WebLearn to 9.1.
Figure 4.2 Relationship between the number of messages posted and the group grade. A1-4, B1-4, C1-3, D1-4, E1-4 and F1-3 are the names of the groups there were 22 groups in total (not all labelled on the x axis). Each group had between 6 and 8 members.

Figure 4.3 Correlation between number of posts made per group versus the quality of the contributions for 2012 cohort. The grades were allocated as follows: posts not contributing to the development of the coursework = 0, pure diary/timetable comments = 1, content discussion and/or sources/links = 2, posting draft work, or critiquing work of others = 3 (tutor posts were discounted). Except for one outlier (48) the trend is for the higher the quality of the posting the higher the grade for the group. Pearson’s correlation revealed $r = 0.691$ is seen as a strong positive relationship between the quality of posts and final group grade for the coursework.

When the outlier [numbered 48 above] was analysed per student, it could be seen that two of the group members provided a number of high quality posts and the other three members of the group contributed little of value. Interview
with a member of the group revealed that only two of the students did the majority of the work.

4.4.1 Self versus group rating

An interesting aspect of this research was the opportunity the analysis provided to enable evaluation of individual student results compared with the group. It allowed us to review student self-grading versus actual grade attained and enabled us to review any gender differences in the self-grading. Firstly, the formula used to generate individual grades from the collaborative learning exercise showed that the mark ranges for individuals’ has a normal distribution. Figure 4.4.

Figure 4.4 Relationship between the group mark and the variation of grade lowest to highest of group members (taken from 2008 cohort). A similar pattern was observed for each year studied. A1-4, B1-4, C1-3, D1-4, E1-4 and F1-3 are the names of the groups there were 22 groups in total (not all labelled on the x axis). Each group had between 6 and 8 members.

In Figure 4.4 it is possible to observe that when group members do not participate they may attain a fail grade, conversely if they contributed well to the work, they were more able achieve a personal grade in excess of the grade...
attained for the group output. These findings were extant for each iteration of the collaborative learning examined for this study (data not shown).

Table 4.4 Example of correlations of data obtained by comparing gender with the individual mark achieved, the score allocated to the group and the students self-score (2010 iteration).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Individual mark</th>
<th>Group score</th>
<th>Self score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Pearson Correlation</td>
<td>1</td>
<td>0.81**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>77</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Female</td>
<td>Pearson Correlation</td>
<td>0.72**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>0.39**</td>
<td>0.54**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.4 Correlation analysis of the 2010 iteration of the collaborative learning exercise, which is used as an example of the findings over the period of research. For this group Pearson’s Correlation revealed a very strong positive relationship between the group rating and individual rating for male students (p < 0.0001, r = 0.81**) and their personal expectation (p < 0.0001, r = 0.58**) although strong their belief out stripped the result. The difference between the group rating and individual rating for female students (p < 0.0001, r = 0.72**) is lower than for male students but still a very strong positive relationship. It is interesting to note that female students were more likely to predict their final grade more accurately, based on their interaction with the work.
The rating is a mark out of 10 (9 ascribed by the student and one comes from peer assessment).

Figure 4.5 shows a significant gender difference in the self-rating of the students contribution to the groupwork, the mean self-rating for whole group was 8.4, for males the mean rating was 9.0 (SD ± 7.7) and females mean rating was 7.9 (SD ± 1.6). In can be surmised, that at least in this group, the males are likely to rate their ability and contribution more highly than the final grade they attain (m = 7.5, SD +/- 0.1) whereas females are likely to rate their contribution more accurately but slightly lower than the final grade achieved (m = 7.9, SD +/- 1.1).

These results are corroborated in the literature concerning gender differences and self-image “In studies, men overestimate their abilities and performance, and women underestimate both. Their performances do not differ in quality” (Dunning, et al., 2003; Ehrlinger & Dunning, 2003; Kay & Shipman, 2014).
Figure 4.6 Performance analysis between BM2005N (pre-intervention) and BM2006N (collaborative learning)

Figure 4.6 shows little significant change in performance across modules pre and post intervention except for the 2010 cohort ($p = 0.0075$). The lack of detectable difference can be explained by a number of confounding factors; student results were not paired with each other, before 2010 intake students could begin the course in September or February so students may have taken the intervention and non-intervention modules in reverse order. Details are shown in Table 4.5 where the last column shows the significant difference between pre-intervention (BM2005N) and post-intervention (BM2006) cohorts where these students had taken the module in the same order i.e. the intervention came second.
Table 4.5 Statistical data for each iteration of pre-intervention (BM2005N) and post-intervention (BM2006N) study cohort from 2005 to 2010 cohorts.

<table>
<thead>
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<tr>
<td>Total number</td>
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<td>102</td>
<td>102</td>
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<tr>
<td>Sum of numbers</td>
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<td>3328</td>
<td>5801</td>
<td>4808</td>
<td>3069</td>
<td>3150</td>
</tr>
<tr>
<td>Mean value</td>
<td>49.8</td>
<td>48.2</td>
<td>56.8</td>
<td>47.1</td>
<td>43.8</td>
<td>45</td>
</tr>
<tr>
<td>Std deviation (±)</td>
<td>14.6</td>
<td>14.6</td>
<td>16.8</td>
<td>10.8</td>
<td>13.6</td>
<td>10.1</td>
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<tr>
<td>Std error</td>
<td>1.7</td>
<td>1.7</td>
<td>1.6</td>
<td>1.0</td>
<td>1.2</td>
<td>1.2</td>
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<tr>
<td>2-tailed t-test</td>
<td>p = 0.16</td>
<td>p = 1.46</td>
<td>p = 0.42</td>
<td>p = 0.52</td>
<td>p = 0.53</td>
<td><strong>p = 0.007</strong></td>
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4.5 Discussion

Student evaluation through a standard module monitoring report and student feedback from the online assignment showed that > 80% of students enjoyed the coursework, also that WebLearn facilitated the group work and allowed student contributions to be evidenced. Students stated that the discussion boards on WebLearn were particularly important when it came to receiving frequent feedback, which was more easily achieved online: this is very desirable for the students’ learning (Race, 2001). The findings in this study are supported by the work of Olsen and MacDonald (2004), who observed an increase in outcome in a comparable study where students were offered opportunities to undertake formative assessment. Their intervention achieved an improvement in mean percentage of 8.8%, almost a grade increase in performance. Experience from our study indicates that the online discussion assessment strategy must be ‘crystal clear’, by this is meant that the instructions are simple, clear and accurate. In our post-intervention cohort, evidence of reflection, co-operation
and collaboration was found (evaluated via the posts), in addition to knowledge gain (evaluated by mean mark). The intervention showed peer-to-peer help including sharing of material and, interestingly, supportive online feedback from the tutor (evaluated through the student questionnaires). There was evidence that students changed their opinion of group work during the exercise (evaluated through the student questionnaires). This study revealed the biggest benefit was the ability to give more and more timely feedback. In addition, questionnaire evidence revealed that students found the group work/collaborative learning in an online environment was less stressful than previous conventional experiences.

While it is difficult to assess the quality of the discussion board content, there is a body of evidence that says that this kind of student-student interaction provides a unique and vital part of learning; Prawat and Floden state that, “to implement constructivism in a lesson, one must shift one's focus away from the traditional transmission model to one which is much more complex, interactive, and evolving” furthermore Scardamalia and Bereiter assert “Knowledge-building is accomplished through student-initiated interactions and reflections, in real-time in class, and in delayed-time using an electronic bulletin board system (BBS)” (Prawat & Floden, 1994; Scardamalia & Bereiter, 1994). As well as facilitating student interaction on the discussion boards, it is essential that tutors fully engage with the process or the facilitation and make use of the opportunity to provide timely feedback and to feed-forward. These practices influence the outcome of the coursework and can be missed if tutors use the tools poorly. In this study, students did not take up the opportunity to grade the quality of other
group member’s posts. This can be useful because it is instructive to the grader and helps them and informs them for their own work.

When analysing the whole group self and peer assessment over the research period, there is a no significant correlation between the individual mark and the group mark ($r = 0.5$). There is a stronger correlation between group mark and individual mark for males ($r = 0.8$) than females ($r = 0.3$) although both are significant at $p \leq 0.0001$ similar to findings by other researchers (Dunning, et al., 2003; Ehrlinger & Dunning, 2003). A one-way ANOVA comparing gender with individual grade revealed no significant difference between males and females, although the there was greater standard deviation in the for male group Table 4.4. The correlation of the group grade versus individual grade and degree pathway was $r = 0.4$, $p<0.0001$ for biomedical science students. An ANOVA analysis of the relationship degree pathways of the student showed a significant difference between groups: BSc biomedical science leading to medical doctor higher than BSc biomedical science, which is higher than BSc biochemistry. Looking at the means, and standard deviations there are differences, but this is likely to reflect the difference in entry qualifications for each course.

When looking at group rating of an individual versus final degree grade that individual achieves, a significant effect was observed, this potentially could be used as a predictor for final degree grade – this phenomenon could provide an interesting area of research for educational psychologists to determine if peer observation of individuals in a collaborative learning context links to social awareness of the ability of others.
4.5.1 Pros and cons of collaborative learning

Collaborative learning has advantages and disadvantages in terms of effectiveness in achieving both the narrow and the wider learning goals in a module or a degree as a whole. The main benefit derived from collaborative learning is the enhancement of critical thinking skills (Gokhale, 1995; Pitsoe & Malla, 2013). Indeed, when one works with a group of individuals, the problem-solving task becomes easier but also attains a complexity through division of labour. Perhaps the most important advantage of collaborative learning is the possibility of instilling in students the reality of interdependence (Kelly, 2002). We are now living in an intricately connected global economy. Interdependence is an essential element of progress. In order for someone to specialise in a particular profession or skill, they will rely on others who specialise in providing those skills that support the person’s other needs. By engaging in collaborative learning, students would be able to integrate the dynamics of interdependence in today’s society. The student would emerge as an individual who is ready to accept help from other people, and is ready to help out other people in need.

Academics are asked to comment on students’ teamwork and other attributes by potential employers in references and this activity enables comments on observed activities.

The process of organising the group and assigning sub-tasks to every member is a different problem layer on top of the task at hand. The perceived disadvantage of collaborative learning is the risk of freeloading, regarded as a “socially self-retarding behaviour” (Rogers & Lea, 2011). There is a natural tendency in some individuals to dependence rather than interdependence. The interdependent
student relies on other people for some of his/her needs, but in return is also providing for those needs that others could not provide for themselves. The dependent, on the contrary, is a person who just receives and never gives anything in return. The dependant ‘freeloaders’ could take advantage of the work done by more diligent members in the group. That is the reason that an individualised marking and peer-review system must be in place when using a collaborative-learning approach. The individualised marking system would tend to deter freeloading behaviour because of the prospect of getting a low mark due to peer evaluation.

It is often reported as a weakness collaborative learning activities that some individuals were benefitting whilst contributing little or nothing, to the group. Traditional group journals or diaries cannot reveal inadequate participation, until completion of group work. Often a student, who is academically brighter than the rest of the group, feels they could gain higher grades without the rest of the group. As stated by Hartford (2005) "Giving the same mark is inequitable; one way to overcome problems is to involve students in the assessment. Peer assessment can be used to enhance the fairness of assessment and encourage students to both participate in and reflect on the group work process". The inclusion of peer assessment encourages personal responsibility (Goldfinch & Raeside, 1990) and as highlighted by Earl, this increases maturity and confidence, enhances social relationships and relevant future employment skills (Earl, 1986). For the process to be a success the students need a complete understanding of the assessment criteria: see, feel, be comfortable about assessing and also confident that peers are assessing fairly (Orsmond, 1996). Peer assessment has
been documented for a variety of assignments in biological sciences (Cogdell, et al., 2004; Orsmond, 1996) and a range of grading and weighting rubrics reported in the literature (Cheng & Warren, 2000; Cogdell, et al., 2004; Li, 2001).

This study was implemented utilising the Glasgow University Peer Assessment Formula (Cogdell, et al., 2004), the system allows for the production of individual grades. Interestingly, these were generally higher than a non-intervention piece of coursework, produced as a solo effort. These findings are in agreement with Haynes and Haynes (2012), who found students produce higher quality work when working in groups Figure 4.5.

In the exercise reported in figure 4.3 where an online continually assessed discussion board was used, there was a high rate of satisfaction recorded for this exercise by students. Quotes from the students’ feedback forms are given below:

Student A: “The group have done excellent work, we done (did) our best to produce the poster, leaflet and the debate, everyone contributed in the group, we had meetings to comply [sic] the quality. We chosen [sic] ... ... to be the group leader, almost two days a week we had meetings”

Student B: “Group work can be good, if you can find the right people to work with. Thankfully we only had one loose cannon.”

Student C: “Everyone in my group put a very good effort towards the work. I got a lot of information regarding the topic we researched. There were so many things I had no idea about so now with the increase in knowledge about the topic, ...”
Student D: “I believe it’s a good experience, allowing the members to communicate and learn how a team work should be done.”

4.5.2 Adaptations to the assessment

After the first year the intervention was put in place, there were a few changes made to the way it was applied in year two:

1) The peer assessment form was expanded to include evaluation of the student experience and identify areas of student engagement/development.

2) Initially, a second iteration (with a different topics) was conducted where students were put into groups by the tutors. This arrangement was changed back to self-selection of groups, within pre-assigned tutor groups, after one iteration due to increase student dissatisfaction.

3) Group formation instructions expanded to include a team charter, allocation of roles, instructions as to how to conduct all meetings and a recommendation that activities be conducted in English to enhance inclusiveness.

4) Provision of clear instructions pertaining to putting meeting minutes online and posting of draft versions of work by group members, on the virtual learning environment’s discussion board. This allowed extended tutor support in developing coursework. In addition to the validation of individual grades where a student disputes their grade or if there is more than ± 10% variation from group grade compared to grade achieved by the individual.
4.6 Conclusions

The use of virtual learning environments’ discussion boards means that the process for developing coursework can be assessed more effectively, by tutors. Instructors can guide the groups and assist the development of pieces of work. By monitoring of postings, some traditional group issues can be abated. The group assignment model works well for tutors and the students were ‘won round’ when they were able to see that they were rewarded for their efforts.

Investigating and evaluation processes of introducing collaborative learning, where all students in a group are allocated the group mark, brings issues, as with other research. Initially, before the process is described whereby we derive an individual score for each group member, students are against the idea. Negative reactions are often founded on prior unfavourable experiences. The intervention, implemented in this study, is one of a range of practical alternative mechanisms that have been piloted, reviewed, and reported, for allocating marks to individuals within working groups. The findings reported here reflect perennial issues, highlighted by other researchers. These concern the initial establishment of the task and then the important variables such as the: allocation of student grades, grade distributions, student behaviour and student attitudes towards the acceptability and equity of collaborative learning as a form of assessment. Similar issues relating to the impact of group size and formation of the group student performance and on perceived fairness have also been reported by other researchers. This study showed that there are more negative issues with groups when they exceed seven. Each of the five iterations revealed at least one group who were dysfunctional to the point it affected their grades,
but the majority of groups managed to work through initial difficulties and produce good quality work. Changes, such as the introduction of group charters and the instruction to assign tasks and post those responsibilities onto a public space i.e. the virtual learning environment, improved group interaction (section 4.3.2). Students were reassured that they were likely to obtain a grade representative of their efforts, in their collaborative learning experience, when the grading process was carefully explained and sample data from previous group results was provided in week one.

This research has attempted to highlight the strengths and weaknesses identified in relation to collaborative learning, it is important students understand:

a) why collaborative learning is being used beyond the generation of coursework marks,

b) understand how the assessment system works to generate their final mark,

c) soft skills that collaborative learning enhances, acting in an ethical manner with others and team work skills.

The use of web-based collaboration is explored in Chapter six with a view to enhancing tutor support and providing a virtual meeting space for students to perform collaborative learning tasks in the future.
Chapter Five: Effectiveness of formative learning on student performance

“A primary focus of formative assessment is to identify areas that may need improvement .... It is good practice to incorporate this type of assessment to “test” students’ knowledge before expecting all of them to do well on an examination” (Northern Illinois University, n.d, p. 2).


5.1 Introduction

Formative learning is centred on the qualitative improvement that a learner obtains from engaging in the learning experience. The corresponding types of assessment for developmental learning are referred to as formative assessment and are ‘low stakes’ for the student. This type of assessment is in contrast to summative assessment, which is typically undertaken through ‘high stakes’ tests (Smith & Gorard, 2005; Bell & Cowie, 2001). Low stakes tests have either no grades or very low portions of grades attached to their final marks, whereas high stakes tests have a large impact on the final marks for the learning event. The effective use of formative learning techniques is known to have an impact, either negative or positive, on student performance in higher education (Yorke, 2003; Trimble, et al., 2005; Nicol & Macfarlane-Dick, 2006).

The drive toward alternative strategies for administering the learning process has been and remains an active field of education research. The use of formative learning addresses the rather unfeeling nature of traditional education (Yorke & Thomas, 2003). In learning the process of formation adds a reflective element to the students learning identifying what elements they know and which topics
need further work or attention, in addition to just being a cognitive process. In this context, formative learning presupposes that humans learn most effectively when they can honestly assess their feelings while undergoing the learning process. Retention of information is the domain that formative learning purports to address (Yorke, 2003). Learned knowledge, according to pedagogic researchers who support the concept, is information kept in the memory for a longer time if the learning process and experience are reflected upon and reinforced. There are many techniques by which positive reinforcement of acquisition of knowledge can be brought out in the context of a learning engagement, including ‘low stakes’ formative learning (Smith & Gorard, 2005). Tutors can assess the assimilation of materials by the learner and can enhance future work through feedback prompted by the answers provided by the students in response to the questions asked.

Part of the reason that formative assessment has not been popular previously in traditional HE teaching is twofold:

1) the extra effort that must be put on top of achieving content mastery by the students,

2) the extra work burden on lecturers/tutors to develop and grade the ‘low stakes’ material. The teacher/facilitator must be highly skilled at gauging how the students are reacting to the concept transferred. Evoking and reinforcing student engagement during the learning process should provide context clues that enhance retention, and retrieval of the learned knowledge later on (Shute, 2008). The availability of Web-based and online learning tools could help in facilitating the method of
administering this type of learning (Gikandi, et al., 2011; Wang, et al., 2006). Nicol and Macfarlane-Dick (2006) have actually laid down several principles on how to conduct formative assessment in conjunction with self-regulated learning.

There are many areas in which formative learning have been proposed as a solution to an impending problem, are students prepared for their ‘formal’ summative assessment? and, do students understand the concepts being taught? (Brown, et al., 2003; Burr, 2009; Smith & Gorard, 2005). Educational researchers have noticed how different learning styles pose a problem with the didactic and regurgitative form of teaching commonly employed in traditional educational settings (Gibbs, 2006; Kaftan, et al., 2006; Wang, et al., 2006). In other words, by forcing the transfer of knowledge for its own sake would miss the entire point of enabling others to acquire such knowledge (Hattie, 1999; Wang, et al., 2006). As people receive knowledge in different ways, then the educational researchers who support formative learning have hypothesised, that the learning experience must be made variable enough or complete to meet the individuals’ needs (Brown, et al., 2003). Positive memorable experiences are associated with enhanced learning engagement and knowledge. Employing this strategy should encompass the diversity of learning styles. Even though people learn in different ways, the elicitation of positive emotions is one aspect that binds all learning styles. Hence, formative learning strikes deeper than the individuals learning phenotypes. Being able to stimulate the feelings in connection with the learning experience enhances the power of retention (Yorke & Thomas, 2003).
5.1.1 Assessment as a developmental tool

The word assessment or examination evokes a gamut of emotions for students and mixed ideas about what assignments are designed to achieve. As stated above they can be utilised in many ways to manage the assessment process in either in a summative or formative way. To date these have both been used with various degrees of imagination and success (Gült, 2008; Maley, et al., 2008; Ecclestone, 2007). The primary criteria for the use of either formative or summative assessment form are that they must be: used within a framework, continually monitored by the educator, with a steady feedback loop from the student to the educator (Bransford, et al., 2000). Since the arrival of the technological age, teaching methods have been adapted to suit an ever-growing computer literate student population (Gült, 2008). As with the other research in this thesis an intranet based system supporting the virtual learning environment – WebLearn was used. This space has an ‘infinite’ amount of exploitable options, and it becomes the lecturers’ responsibility to seek out and take advantage of these potential opportunities. There is limited research published regarding e-learning although this is a rapidly changing environment and is a growing area of interest (Walker, et al., 2008). A number of authors have shown that student learning achievement is increased with the use of formative assessment (Wang, et al., 2006). Educationalists today tend toward the use of summative testing for determining student learning, confusing this with knowledge, and the purpose of education (Kaftan, et al., 2006).

Assessment is an educational tool used to: gather, interpret, record and analyse information about students interpretation and engagement with an educational
task, mainly to differentiate between teaching and learning (Harlen, et al., 1994). Not only do lecturers value assessment as a tool of estimating learning, students see it as a motivator to learn. Students associate learning with passing examinations, although educationalists require students to demonstrate the knowledge they have gained from teaching materials (Kaftan, et al., 2006). "Assessment drives learning", "Students respect what is inspected" are typical quotes found in educational literature supporting the role assessment can play in driving learning and motivating students to engage with their learning process (Pead, 2008). Assessment can be utilised to shape and drive the student-learning environment to enhance their engagement (Tomlin, et al., 2008).

Mendenhall states it is important to “recognise the profound influence assessment has on the motivation and self-esteem of the students, both of which are crucial influences in learning” (2003). Although the National Science Education Standards (1996) prescribed assessments to probe students understanding, this has not been shown to be the norm. In practice, the assessment processes may be overlooked by lecturers, becoming their last priority in their busy schedules when developing teaching materials (Duschl & Gitomer, 1997).

“To bring the focus back to learning for understanding, formative and informal assessments need to be part of the instructional process” (Kaftan, et al., 2006, p. 44).

In 1996 the National Research Council produced National Science Education Standards, to promote the practice of gathering information relating to student understanding, analysing the results, then adapting future instruction as a result of ‘best practice’ (Trimble, et al., 2005). Within the interactions between
students, tutors, and learning materials, a place for deeper learning can be generated; a place where teaching, learning, and assessment intermingle (Kaftan, et al., 2006).

5.1.2 Pedagogy

Pedagogy refers to the research and creative thinking that is applied to educational techniques and approaches. Formative learning is commonly regarded to employ more progressive pedagogy than summative learning (Bransford, et al., 2000; Bell & Cowie, 2001; Gibbs, 2006). The theories surrounding the concept of formative learning heavily focus on how the effective aspect can be utilised as a feedback tool (Harlen & James, 1997; Nicol & Macfarlane-Dick, 2006). Formative feedback is atypical of traditional scholastic education (Shute, 2008). Instead of being asked what they know from the learning engagement, they are asked how they feel about the process. The presumption here is that learning is more in-depth if the learner can feel and reflect upon the process (Rushton, 2005). The challenge with formative learning is on how to motivate students by gauging their performance based on qualitative rather than quantitative measures (Smith & Gorard, 2005; Shute, 2008). Teaching guided by formative assessment focuses on the student and the associated principles of learning. A student-centred approach enables the student to focus on factors that are under their control. The educational theories involved in implementing formative assessment is meant to motivate students, by: interesting them in learning content, noting areas for improvement indicated by the feedback provided, and acting on that information to enhance learning (Yorke & Thomas, 2003; Tomlin, et al., 2008). Retention of the learned
knowledge is more long lasting if the learning experience is integrated with emotions rather than just through memory.

The design of instructional systems based on formative learning remains the subject of intense research ever since the late 1980s (Sadler, 1989; Taras, 2005). However, the convenient technology that would make it possible did not become available until software had been developed with the functionalities that they have today (Gikandi, et al., 2011). Indeed, evidence has shown the effectiveness of computer-based tools in enabling the implementation of formative learning strategies (Wang, et al., 2006). The enhancement of the pedagogic practice in higher education has also been the subject of intense discourse (Yorke, 2003). Theories have been put forward in regard to how formative learning can be implemented in the HE setting practically. Efforts toward implementation have more or less remained in small research niches, but the time has come to mobilise such theories to be practiced more widely (Wormald, et al., 2011; Bennett, 2010), for example, McNiesh, et al. (2011) attempted to apply the principles of formative learning and assessment for accelerating the learning process in nursing education. The creation of various learning designs must be encouraged to further the search for the best tools or strategies (Boettcher, 2007).

Much of the related literature on formative learning focuses predominantly on formative assessment and feedback. The assessment and feedback serve as an interface between a teacher's expertise and the student. Without feedback and assessment the learning experience could not be complete because the learner
would not be able to gauge whether they had acquired the knowledge or not (Smith & Gorard, 2005; Bennett, 2010).

Pedagogy has been creative within the context of formative learning indeed, by having different views and perspectives on how to stimulate the feeling aspect of the learning experience, the notion of formative learning now takes on more explicit shape (Wang, et al., 2006). There is also a strong link between formative learning and the diversity in learning styles (Wang et al. 2006). "A complexus of related characteristics in which the whole is greater than its parts. Learning style is a gestalt combining internal and external operations derived from the individual's neurobiology, personality and development, and reflected in learner behaviour" (Keefe & Ferrell, 1990). It is always a good idea to adapt the learning process according to the style of the learner (Kolb, 1984; Robotham, 1999).

5.1.3 Formative assessment

Bell and Cowie (2001) defined formative assessment as "the process used by teachers and students to recognise and respond to student learning in order to enhance that learning, during the learning." A study by Yorke (2003) on the use of formative learning techniques highlights the double-edged sword effect of formative assessment towards learning. A study on the impact of formative assessment on learning was conducted by Wiliam et al. (2004) on secondary school students. The study showed positive results toward learning if formative assessment is utilised. This implies that student performance might be positively reinforced when formative learning techniques are employed. In the case of medical education (Rushton, 2005), learning is said to occur with more depth if
formative assessment tools are used as feedback on student performance. Healthcare education, as with many other disciplines, is administered with feedback in the form of summative assessments. The deeper learning that might originate from formative assessment is crucial in the medical and healthcare professions that rely heavily on intuition, and critical comprehension. Developing the appreciation toward formative assessment, the healthcare professional may obtain a more suitable mind-set when dealing with medical cases that the professional has not yet encountered.

For assessment to be successful all members (tutors, examiners and students) must understand the process. Not all assessments need to contribute to the final grade but can be used for “formative” self-assessment, for the student to gage their own progression (Burr, 2009). Formative assessment helps students to: keep up with reading around the topic, identifying gaps in their knowledge, and promote their understanding of the educational content. Student time spent on the task is increased, but only as small part of the total time involved on a topic, and this more than offsets the added value and relevance of that time in the actual learning process (Mendenhall, 2003). Students taking formative assessments before summative assessments have been shown to exhibit reduced anxiety levels (Zakrzewski & Bull, 1999). Having established the value of formative assessments the development of the quality of the assessment is crucial.

The use of formative assessment as a feedback tool must be appropriate if formative learning is implemented. There have been several attempts of
designing instructional systems based on the precept that learning becomes a better experience if feelings are explicitly engaged (Sadler, 1989; Rushton, 2005). What this means is that the assessment must gear more toward identifying how the learner feels about the experience rather than solely what new knowledge has (or has not) been gained. Making the learner understand that somebody cares to know whether they are really acquiring the knowledge expected of them is the kind of feedback that formative assessment represents. Yet this is also the kind of feedback they are not usually getting from traditional face-to-face strategies. By being able to assess students in a more personalised manner, the message of caring is transferred across the social/professional barrier between the teacher and the student.

5.1.4 Purpose of feedback

“The simplest prescription for improving education must be dollops of feedback.... providing information about what a student does and does not understand, and what direction the student must take to improve” (Hattie, 1999, p. 11).

Formative feedback brings out qualitative aspects of the learning process. As formative assessment produces an increase in student study time, increases familiarity with learning materials, exposure to the style of summative examination material they will meet and develop familiarity with the testing process (Bell & Cowie, 2001; Jacoby, et al., 2013). Feedback from online formative work allows the learner to gauge their performance immediately after the assessment is completed (Cassady & Gridley, 2005). From this feedback, the student can make adjustments to improve future performance a process often termed ‘feedback to feed forward’ (Cherem, 2011). Students are more engaged
in their learning process when feedback is presented in a timely manner. Student performance is enhanced with the immediate feedback provided by virtual learning environments, and the ability for students to see the result of their efforts in their achievement. The impact of formative feedback is strongly associated with retention of information (Yorke, 2003; Cherem, 2011). The concept of built-in electronic, continuous assessment enables lecturers to provide instantaneous feedback; this idea is supported by Bojanić et al. (2009), where, they identified the advantages of continuous assessment to student performance. The feedback must focus on quality and provide positive feedback rather than a mass of information gathered by lecturers, with no student benefit (Cherem, 2011).

Additionally, formative assessments allow tutors to review and revise individual student performances and identify larger scale problems concerning student learning. All feedback needs to always be timely, whether the assessment is formative or summative. Ideally, the learner will be able to gauge their performance immediately after the assessment was taken. The adjustments that the learner must make to improve performance are more engaging when feedbacks are presented in a timely manner (Juwah, Macfarlane-Dick, Matthew, Nicol, Ross, & Smith, 2004). Hounsell (2007) has described formative feedback as a more effective method than summative feedback methods for improving student performance. It is in the learning outcome that the formative feedback is distinct from summative feedback (Smith & Gorard, 2005): the latter is more concerned with transfer of knowledge, whereas the former is also concerned with retention. Formative feedback adds more to the teaching process than just
knowledge transferred to the learner. For example, a mnemonic when learnt becomes engraved deep into the learner's memory to make later access and retrieval from memory of the material easier. Emotion-related retrieval cues have been shown to be more efficacious due to a more immediate way by which formative feedback is provided (Cassady & Gridley, 2005; Ehrlinger & Dunning, 2003).

Feedback has been linked with self-regulated learning by way of formative assessment (Nicol & Macfarlane-Dick, 2006). Self-regulation implies that the student/learner adjust accordingly based on the corrections received through feedback. The essence of formative assessment is that not only does it engage the student in the learning process, but also provide immediate corrective feedback (Gikandi, 2011). Hence, formative assessment is deemed fit as better suited for distance or online learning wherein student motivation can be difficult to follow. Formative feedback compensates for the lack of grades (Smith & Gorard, 2005) with the timely evaluation of performance. The students are much better able to cope with the learning process with direct comments as to how they could improve or do better, self-regulation (Gikandi, 2011). Numerical scores, on the other hand, must first be interpreted with respect to a grade scale in order to make sense to the student. Moreover, numerical marks can be misleading especially that some teachers expect higher standards than others (Cassady & Gridley, 2005; Gikandi, 2011).

The use of formative feedback has seen growing support in recent years owing to the mounting evidence for its effectiveness (Shute, 2008; Gikandi, et al., 2011).
However, despite the increasing body of literature many HE institutions maintain summative assessments as the only form of feedback used. The reason is that formative feedback are more challenging to design because of the effectiveness element that must be considered in addition to the knowledge transfer (Cherem, 2011). On the other hand, summative feedback has been made standard in the form of written test types. An extra amount of added value is also seen in formative feedback, enhancing the student’s feelings to a point where they are in a more prepared position to engage with their learning experience (Cherem, 2011).

5.1.4.1 University policy on feedback

LondonMet policy states students should receive feedback on their coursework submitted within three weeks of submission. This process has inherent issues; the work may take a week to be released from the assessment unit (personally experienced worst case was five weeks after submission), the work needs to be first and second marked by tutors (rotating 150+ scripts can be time consuming and logistically difficult to process). Work is taken to tutorials for redistribution, when not collected it is then taken to the school office for retrieval (approximately 90% is never retrieved based on 8 years personal experience). An ‘in-class’ review of coursework feeds back the main positives and weaknesses of the whole cohorts’ work are delivered to the entire class. Furthermore, the National Student Survey reveals that students do not appreciate that they have received feedback (http://www.hefce.ac.uk/whatwedo/lt/publicinfo/nss/)

Figure 5.1. The School of Human Sciences has recognised this lack of understanding as a weakness and therefore has introduced a series of points
where feedback processes and forms are explained to students regularly. Therefore, the utilisation of an electronic feedback system will deliver the material to the student directly and will allow tutors the opportunity to determine who has not accessed the material, enabling them to engage with the feedback process. The form use in this action research study involves immediate feedback on completion of each question answered by the student.

![Figure 5.1 Satisfaction scores for each National Student Survey question scale over the last nine years of the use of survey tool (HEFCE, 2014). The graph shows that even though there is a year-on-year improvement of student responses to satisfaction with the assessment and feedback questions in the national student survey it is out and out the weakest area for degree cohorts.](image)

**5.1.5 Designing assessments**

Formative assessment provides an opportunity for practicing alternative assessment techniques, allowing both the student and the tutor to assess the learners' progress, practice assessment techniques in a 'low stakes'
environment. There is also an opportunity for tutors and students to explore their learning experience. Although summative assessment has been proven to be efficient for many years, it delimits the kind of learners who would gain from it. A more encompassing assessment is one from which the largest number of learner types benefit. Retention of knowledge is the best manifestation of learning. Yorke (2003) conducted a study in the context of HE indicating that formative assessment promotes knowledge retention. Gibbs and Simpson (2004) further support this hypothesis by laying down conditions under which assessment fosters learning. They assume that an assessment is a primary motivator of learning in terms of how, and how much they want to study (Gibbs & Simpson, 2004). By making the feedback personalized, just as in formative assessment, student diversity is addressed. The goal of making as many learners gain maximally from the task is almost achieved compared to traditional face-to-face strategies employing summative assessment alone.

Wingate (2007) describes formative assessment as a method of “learning to learn” as a transition beyond the learning methods implemented for a long time in many educational settings. Without such framework, sustainable feedback to students would most likely not be delivered (Hounsell, 2007). Sustainable feedback has truly been considered as a solution to the problem of motivating students (Haggis & Pouget, 2002).

The design of assessments today has been supplemented with technology. Hence, educational technology is seen as a major player in influencing the type of assessment models that could emerge in the future. As a guiding principle, formative assessment should work best with today’s generation of learners.
Since the advent of the internet and social media, people have become more connected with almost everyone else in this vast matrix of information. The assessment designs should now assimilate the kind of processes that are associated with web-based technologies. For instance, blogging has become an important educational tool through which outspoken and communicative experts can broadcast valuable knowledge to other people. Connectivity through social media has also encouraged collaborative work, such as through Google Docs (Chu & Kennedy, 2011). The eventual interplay of common educational methods with computer-based technologies is anticipated to go through progressive refinements over the next five or ten years. Formative assessment as a scaffolding for the design of modern assessment tools is not farfetched. The compatibility of personalised feedback afforded by formative assessment with the one-on-one capability of modern electronic communication tools should serve as a real advantage.
Table 5.1 Assessment Conditions (taken from Brown, et al., 2003).

<table>
<thead>
<tr>
<th>Student learning is best supported when the following conditions are met:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessed tasks capture sufficient student time and effort</td>
</tr>
<tr>
<td>These tasks distribute student effort evenly across topics and weeks</td>
</tr>
<tr>
<td>These tasks engage students in productive learning activity</td>
</tr>
<tr>
<td>Assessment communicates clear and high expectations to students</td>
</tr>
<tr>
<td>Sufficient feedback is provided, often enough and in enough detail</td>
</tr>
<tr>
<td>The feedback is provided quickly enough to be useful to students</td>
</tr>
<tr>
<td>Feedback focuses on learning rather than on marks or students</td>
</tr>
<tr>
<td>Feedback is linked to the purpose of the assignment and to criteria</td>
</tr>
<tr>
<td>Feedback is understandable to students, given their sophistication</td>
</tr>
<tr>
<td>Feedback is received by students and attended to</td>
</tr>
<tr>
<td>Feedback is acted upon by students to improve their work or their learning</td>
</tr>
</tbody>
</table>

Table 5.1 can be utilised as a tool to focus the development of successful formative assessments as it links the principles of assessment engaging learning, and provides timely, quality feedback to inform, develop and complete the loop in student learning.

5.1.6 Electronic assessment

The rise in the utilisation of online learning tools has given impetus toward electronic assessment. Virtual learning environments and other intranet environs are now capable of administering assessments online. A review by Gikandi et al. (2011) discussed the use of online formative assessment for HE students. The review study finds that when electronic assessment tools are used effectively, learners are bestowed valuable learning experiences. However, the issue with electronic assessment is validity and reliability. However, research has been active toward establishing these aspects for online formative assessments in higher education. The main advantage with electronic assessment is the ease by which data can be gathered, and the convenience by which formative feedback can be relayed to the learners. The minimal face-to-face interactions...
also imply that learners more readily respond to formative feedbacks because of lessened emotional apprehension.

There has been a study in regard to the relatively higher degree of responsiveness of learners in online platforms than in face-to-face settings. The reason is that an online interaction at a distance affords relative anonymity (Freeman & Bamford, 2004; Chester, et al., 2011), such as in terms of non-visible facial expressions unlike in face-to-face interactions. Even in nursing education, the perceived higher anonymity with online learning makes it a more efficient channel for openness in the learner (Ali, et al., 2004). Due to this higher degree of openness, then the use of electronic or online assessment should be appropriate for formative learning. Since formative assessment operates on the assumption that personalised feedback requires honest reflection from the learners themselves, it is hoped that electronic formative assessment should be more efficient than traditional face-to-face methods. Moreover, the formative electronic-assessment technology could be applied as well in many other subject areas.

Formative assessments delivered electronically long term can reduce human effort by automating problem presentation and marking, and provides consistency reducing inter-marker variation. Online assessment tools, have developed beyond “multiple choice” into more sophisticated question styles, make formative assessment representative of summative examinations, are easier for tutors to manage and enable immediate feedback. e-Assessment also allows students to engage with the material at a time convenient to them, and
also enables new forms of testing to be introduced. Significantly, students can also receive instant feedback and allow them to be directed to further resources to improve their learning. Initially designing reliable, high-quality assessment content is time-consuming, and can prove difficult but once loaded onto a virtual learning system they can form a bank of questions that can be built on step by step. This repository can allow lecturers to set up an assessment by selection and ordering pre-formulated questions, with little additional effort after the initial hard work creating the materials (JISC, 2007).

5.1.7 Delivery system

For this action research study the virtual learning environment “WebLearn” is utilised, building in quizzes, mini tests and progress tests as an assessment of current knowledge to release ‘learning modules’. Learning modules are a grouping of related educational materials on the relevant topic as determined by the lecturer. These assessments can be used as the linking tools, along with date gates and other criterion, to moderate the release the following learning modules to the student, allowing the student to access further material, as they are ready to progress. The assessments enable a level of self-paced learning. The stages gating materials can also be set up in a way that students personalise their learning route through the module, opening materials suited to their learning needs.

5.1.8 Aim

To build a continuous formative “self-assessment” loop adapted to the individual students’ need in order to facilitate engagement in learning. The design of the
feedback loop will be informed by collecting and analysing data collected in this study during the intervention study.

5.2 Methodology

For this study, the module BM1006N was evaluated over a five-year period using the year 2005 as the control group. The module iterations that ran in autumn and spring of each academic year from 2006-2010 were included. Each week a formative assessment was based on the same theme as the lecture was open for students to assess their understanding of the topic. From the second iteration the student was required to pass a formative assessment with a minimum pass mark (40%), with a maximum of three attempts before the following week’s material was made available, to enhance uptake. Students who failed three times were referred to a tutor for support in clarifying their issues with the topic. The process acts like a ‘domino effect’ as the student completes an online formative assessment the next set of material is revealed and onwards until all of the material available to them. This process is termed continuous and comprehensive evaluation.

The formative assessments were created in WebLearn focusing on the assessment criterion described by Brown et al. (2003) (Table 5.1), as a focus the process was designed as follows:

- Each quiz was designed to take a maximum of 30 minutes to complete
- A quiz was made for the end of the learning module containing topics relating to each week’s teaching
- Feedback was included in relation to each question set, highlighting where they went wrong or supporting why they were correct after each question.
- The feedback was linked to the topics learning goals and to summative assessment criteria.
- Allowing multiple attempts (three) so the student can act upon the feedback to enhance their learning\(^1\).
- A pass criterion of 40% or greater was set to allow the next learning module to be opened, the tasks engage students in productive learning (this was introduced after the autumn pilot)\(^2\).

Online formative assessment was chosen to improve access, and as a way to improve the quality of educational support materials that could be delivered in response to the individual’s feedback. The WebLearn system allows each student’s progress to be tracked individually, and the e-assessments present on WebLearn provided immediate feedback to students on completion of the assessment or after each question attempted.

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\(^1\)At this point the student contacts the module convener or their tutor, their area of weakness is identified, the student is advised to engage with the appropriate extra learning materials then their previous attempts are deleted allowing another three attempts.

\(^2\)Learning modules can be used to batch a collection of materials related to a topic together, these modules can then be “hidden” from students until criterion are attained. These selective release criterion can be one, or a combination of all or any of the following; Date Criteria, Member Criteria, Group Criteria, and Grade Book Criteria. For this study only the grade book criterion was utilised.
For this module, the summative assessment was arranged as follows:

Coursework – Practical assessments (online quizzes) 50%; 2. Unseen Online Exam 50% weighting. Students taking formative assessments before summative assessments have reduced anxiety levels (Zakrzewski & Bull, 1999; Smith & Gorard, 2005; Cassady & Gridley, 2005).

To investigate the reasons for none compliance, a focus group was used. Morgan’s focus group framework (1997) suggests the following: 1) use homogeneous strangers as participants - this was not possible in this research framework as the participates are members of the same class, 2) rely on a relatively structured interview with high moderator involvement - this is the format used, 3) have 6 to 10 participants per group, this was the target figure but for this group only four students attended), and 4) have a total of three to five groups per project this was not undertaken.

5.2.1 Student feedback, end of module 2006-2010 (autumn and spring)

Over the period of the study, there were 1,087 students registered. After completing the module before, the exam results were released the students were asked to complete the following questionnaire in parallel with the school module satisfaction form.

For this additional form, the students were provided with the following information at the top of the feedback form:
“This feedback is to let us know how you are finding the course and what your university learning experience has been so far. Space has been provided for you to write comments should you feel it appropriate”.

Five simple and similar statements then followed regarding the following: lectures; tutorials; formative assessment on WebLearn; coursework; unseen exam. The statements are reproduced here:

On a scale of 1-5 (with 5 being the best) how helpful have you found the lectures?
On a scale of 1-5 (with 5 being the best) how helpful have you found the tutorials?
On a scale of 1-5 (with 5 being the best) how helpful have you found the formative assessments?
On a scale of 1-5 (with 5 being the best) how much support do you feel you have had for the coursework?
On a scale of 1-5 (with 5 being the best) how much support do you feel you have had for the end of module exam?

A 30-minute focus group was help where 6 students chose to attend. Interview question themes included:

If you did not complete more than 3 formative assessment tasks please explain why?
Did the formative assessments help you identify areas of weakness you sought further help with?

5.2.2 Data Analysis
The student performance data from EVISION were analysed for sample
characteristics using the statistics package SPSS. These data were interrogated by descriptive statistics, calculation of frequencies and drawing of graphs, before proceeding to more in depth analysis. Explore was used to assess normality, which was set at ‘exclude case pairwise’ not only to exclude missing data, but to allow all available data to be used. T-tests were used to compare students undertaking ‘no quizzes’ and those taking ‘quizzes’ for their mean module grades. One-way ANOVA was used to compare the pre-intervention mean module grades against all following year groups. The operations from semester to semester are broadly consistent – student enrolment; tutor interactions with students; student access to learning materials, and taking final exams, this enables continuous monitoring the effect of the intervention.

5.3 Results
Student engagement informative assessments increased between the autumn and spring semesters, from 52% to 61% respectively. This is likely as a consequence of a new parameter applied through the VLE where by taking the assessment released the next set of learning materials.
The student cohort taking the module in the autumn semester, had formative assessment without “reward”, spring semester formative assessment linked to release of further learning modules. These results are first sit grades (re-sit grades excluded because the examinations are capped at 40% and would distort the results). The bimodal peak observed is closely associated with the activity of students completing or not completing the assessments (passes and failures respectively). R1 (25-39%) and R2 (0-24%) are fail grades, DF indicates there was some form of academic irregularity. D and E are combined as they cover 41-49% (E is 40-42%). Spring mean = 51.5 ± 2.3, n = 117, autumn mean = 44.3 ± 2.3, n = 70, Unpaired t test with Welch’s correction, p = 0.02, if significantly different at p < 0.05.

Key: A = 70-100, B = 60-69, C = 50-59, D/E = 40-49, R1 = 25-39, R2 = 0-24, df = 0 for academic misconduct.

For the post intervention iteration of this study it was observed a number of students did not complete assessments to gain access to the next learning module, a focus group was used to explore this phenomenon.

The student interviews revealed some comments for none completion of 3 or more quizzes such as: “My friend just printed off a copy for me too”, “Could not be bothered”, “Made notes in class then read a book”. These responses reveal a further area for future study with regards to student attitudes to self-directed learning.
Figure 5.3 Engagement in formative assessment via quizzes, for 2006-7 cohort (Jacoby, et al., 2013). This figure shows the number of students plotted against number that attempted the quizzes. All but the last (urinary system) was associated with a reward, i.e. the lecture notes.

The number of students accessing the assessments varies as the module continues and it is interesting to note the last quiz (urinary system) was not attempted by any students, the completion of this quiz did not result in the opening of a further learning module. A review of the exam paper sat by this cohort revealed the urinary system questions were not answered well. Further work may shed light on the relationship between non-completion of the quizzes (meaning students were not experienced with answering questions and receiving feedback on this topic) and exam performance (Jacoby, et al., 2013).
Assessment of the effectiveness of formative learning on final module grade. The pre-intervention cohort (2005: students had no option for formative assessments) is plotted alongside student groups who self-selected for doing the quiz, or not. a) control versus each combined year group is significantly different in the p < 0.001-0.0001. The parameter, against which they are measured, on the y-axis, is the final module mark. b) The data are highly significantly different, in all year groups, when looking at quiz takers and quiz avoiders, p<0.00001. (*** p = 0.001, **** p = 0.0001, ***** p = 0.00001).

Assessment of the effectiveness of formative learning on final module grade was performed using one way ANOVA, there is a significant difference between each following cohort and the control group (a). Using the 2005 pre-intervention cohort as a control group, student results were compared to each individual intervention group, p < 0.001 to p < 0.0001. Inter year group analysis where quiz takers were compared with quiz avoiders, the avoiders achieved significantly lower grades p < 0.00001 (Control group N = 190, mean mark 55.2% ± 1.2, for students not taking quizzes the mean marks were all lower ranging from 34.4% ± 1.7 to 42.6% ± 0.9 over the five-year study period). Quiz takers performed
better than the control group with the mean marks ranging from 59.2% ± 0.9 to 61.1% ± 1.0. For each year the variation between quiz takers and quiz avoiders produced a difference between the mark means ranging between 18.5% ± 1.2% to 24.7% ± 1.5. These analyses indicate that those who took advantage of the support provided in the intervention cohorts significantly improved their achievement (p < 0.0001) over those pre-intervention and those quiz avoiders who were not engaging.

5.3.1 Student feedback

Feedback forms are collected routinely for each module. These were collated over the study period and analysed revealing that 55.5% of students responded to the question “How helpful have you found the formative assessments?” Responses to this question were tabulated Table 5.2. Of the respondents half of the students rated the formative assessments as being helpful (4-5).

<table>
<thead>
<tr>
<th>Responses to:</th>
<th>How helpful have you found the formative assessments?</th>
</tr>
</thead>
<tbody>
<tr>
<td>scale 1 to 5 (with 5 being the best)</td>
<td>None given</td>
</tr>
<tr>
<td>Number of students</td>
<td>45</td>
</tr>
<tr>
<td>Percentage of students</td>
<td>7%</td>
</tr>
</tbody>
</table>

The results of the feedback question compared to the improvement in grades are a surprise. Written comments are more in line with the grade outcomes. Students were allowed to write five lines of text along with their rating. A sample of student comments included:
• “It is very helpful.”
• “Helped my revision.”
• “Useful because I can get the lesson.”
• “Training more and more because my English is not too good, I can understand better the lesson when done the assessment.”
• “Didn’t bother with em [sic] got the lectures from my mate.”
• “The formative assessment have been so great, felt good for exam.”
• “Good but sometimes the question they ask is not on what I have learnt in the lecture.”
• “It improvements me [sic]”
• “Had to read more to do the quiz.”
• “Looked forward to them to no I’d learned.”
• “Formative assessment, it corrects me on the mistakes.”
• “I find them too difficult jut [sic] give lectures.”
• “Also helps me to understand the subject more thought the exam would be harder.”
• “Waste of time I am too good already.”

The responses show a mixture of positive and negative feelings about their experiences; it is not possible to link comments to student grades as all questionnaires are anonymous. As first years, some students are beginning to realise that they must read more widely for the subject to be successful. After all, the objective for formative assessment is to engage the interest of the students while motivating them to study independently (Taras, 2002).

5.4 Discussion

Specifically designed learning modules (learning packages that contain objectives, activities and provision for assessment (Robinson & Crittenden, 1972)) that respond to individual student needs, empower students to focus on the material where knowledge is needed. Teaching materials can be tailored to meet the learning needs of the individual student (Mendenhall, 2003; Tavangarian, et al., 2004; Rae & Samuels, 2011). Interactive assessments actively involve the student as learner and enable students to interpret their individual feedback as a tool for learning rather than a negative critique, punishment or
reward system (Tunstall, 1996; Chu & Kennedy, 2011). Although students’ focus on performance related to summative assessments (performing to get a grade), the fact that student motivation for learning is linked to formative assessment (learning to understand) needs to be a focal point for educationalists (Brown, et al., 2003; Gibbs & Simpson, 2004; Smith & Gorard, 2005). For this study, students were required to attempt formative assessment on the VLE (WebLearn) as an independent learning activity. After the first iteration formative assessment, the issue of student uptake was observed. What has been strikingly evident from this study is that for formative assessment to have any impact the student must engage and this can best be achieved by application of some kind of reward system. Student engagement with any formative assessment, without reward, was limited.

In this study, after the first iteration of the intervention study, where only 52% of students engaged with the formative assessment, an incentive was introduced – successful completion of the assessment opens up the next learning module subject (Gibbs, 2006; Ecclestone, 2007). By setting a pass criterion of 40% or greater to allow the next learning module to be opened, the tasks engage students in productive learning activity (they can repeat the assessment three times before they needed to contact the module convenor to allow them to be reset) (Haggis & Pouget, 2002; Walker, et al., 2008). Three attempts were selected as the point where tutors would need to intervene with the students to help clarify their learning. It also gave the teaching team the opportunity to spot general areas of confusion and alter the face-to-face tutorials to fit the more general areas of weakness identified. VLE (e.g. WebLearn) tracking tools can be
used to observe student activity and highlight common problems. Virtual tracking allows tutors to intervene and encourage students who are not engaging. Weeks 11-13 (pre-exam) revealed a flurry of requests for extra access to the assessments from students starting their revision process. Utilising the data from the quiz returns, revision was targeted to the cohort, instead of going back over the entire topic, specific questions could be visited, and specific concepts were re-taught where the majority of the students did not understand.

5.4.1 Responses to feedback
London Metropolitan University, School of Human Sciences staff provide students a considerable amount of prompt and useful feedback both orally, and in written form in a variety of contexts, but as reflected by the National Student Survey 2008, students did not necessarily recognise or value this feedback. These results have been highlighted as a problem in other institutes too by Gibbs et al. (2003). Written feedback for items can take up to three weeks from when the work was submitted (the university deadline) and by the end of this time period, the students often no longer feel they need to engage with the topic or even collect their work to read their feedback, if they can receive their grades by another source. Instant electronic response to the student input allows the student to respond instantly to the feedback and this supports their successes and directs them to improve their weak areas.

The advantages of utilising learning opportunities, independent of time and place, need to be highlighted to the students. It also allows students to practise their comprehension of both course material and the scientific language style in
which it is written. Experience shows that the formative assessments need to be paced to support and encourage student progress and completion. Table 5.2 shows 60% of respondents expressed a positive response to the formative assessments.

### 5.5 Conclusion

This study revealed the high positive impact of formative assessment delivered via a VLE. It acts as a driver in promoting student engagement and enhancing student performance and provides continuous and comprehensive evaluation. Student motivation through feedback is truly an essential aspect that ought to be given serious consideration in designing assessments. Although formative assessment produces an increase in student study time, as with all active learning, it benefits students by increasing familiarity with learning materials, exposure to the style of upcoming summative examination material and familiarity with the testing process (Bojanić, et al., 2009).

- Students and tutors can collaborate in an active learning process.
- Assessment and evaluation systems can promote quality learning.
- Students have higher expectations of undergraduate study support.
- Student background is very diverse learning need to be delivered with a variety of learning and teaching styles that respond and adapt to their diversity.

Learning is improved when students spend more time on the task and are engaged as active learners, for example: no one learnt to talk in full sentences immediately, they learn words, practiced them then expanded them into
sentences. Learners should see assessment as part of their learning experience, not as a one-off “snapshot” tool to measure performance.

This longitudinal study enabled the development of “student-centred” personalised learning route through the outcomes of student assessments in for piloting in another module – (see Section 7.5.1).
Chapter Six - Use of web-based collaborative tools to support teaching

“Technology is changing the way people communicate and will revolutionize education and training in the 21st century”. (Gold, 2001, p. 76)

6.1 Introduction

This chapter reports on a pilot investigation into web-conferencing for tutorials in distance-learning modules and for revision sessions on taught modules. The more extensive connectivity to the World Wide Web today means that most households are linked to the internet or have mobile devices (in the first quarter of 2014 – 61% of UK adults own a smartphone, 44% own tablets, 63% of homes have laptops) (Holmes & Gardner, 2006; Ofcom, 2014). This has led to the explosion of social media (Facebook, twitter, Instagram, snap chat) in the last five years (Butler, 2014). The implication of this wider connectivity is that Web-based learning tools can be deployed more extensively including in medical education (Cheston, Flickinger, & Chisolm, 2013; Cartlegde, Miller, & Phillips, 2013). Collaborative learning between people from opposite sides of the world is now an actuality. Knowledge transfer from one place on the globe to another has accelerated dramatically. By utilisation of computer networks for learning, the way by which education is delivered has changed forever. With internet-based technology now part of everyday life in the UK, online communication software has become commonplace, these ‘social’ communication tools are embedding into work and leisure activities (Joinson, et al., 2007; Kear, et al., 2012; Butler, 2014). More innovative advances in the use of online communications are seen in the educational arena. There are various ways of implementing collaborative learning
and enhancing the feeling of community in face-to-face and distance learners. The question of ‘how’ social communication tools can be utilised to bridge the physical and psychological space between teacher and learner in distance education becomes necessary. Universities are now experimenting with social software tools to help students and to build virtual communities (Kear, 2011). Incorporating web-based distance learning tools for collaboration has never been as seamless as before through the use of tools such as Google Hang Out, WebLearn Collaborate, Skype. Previously online communication for learning has used asynchronous technologies such as discussion forums, blogs and wikis (Boulos, Maramba, & Wheeler, 2006; Kear, 2011; Su & Beaumont, 2010). Students can interact easily with each other and tutors through a discussion forum on specific topics. Through the forum, students can find solutions to their subject-related problems, either by peer learning or tutor intervention. Some web-based forums allow the sessions to be recorded and made available to students for review to refresh their knowledge or revision. This tool also gives students who were unable to attend the conference a chance to see what was covered at a more convenient time. Meaning they do not miss out so do not feel alienated. Availability of the session promotes the sense of community. The problem associated with seeking Web-based tools, like Blackboard virtual learning environments, is in how to cater to diverse learning styles, create a safe environment and to develop a learning community (Smyth, 2011; Cornelius, 2013). Until recently this educational challenge has been unaddressed.
6.1.1 Forming an online learning community

Adults learn from social relationships through others, knowledge can be constructed through collaboration, where individuals act upon the knowledge brought to the collaboration by others. Their relevant knowledge is then contextualising in relation to the knowledge produced by the others. The social construction of knowledge is the fundamental principle behind collaborative learning at university especially at postgraduate level where each student can bring a great deal of experiential or theoretical knowledge to topics being studied (McGregor, 1992; Cornelius, 2013). Also, it has been recognised that alienation and a weak sense of community is a major cause of attrition in distance learning students (Rovai & Wrighting, 2005; Rovai & Downey, 2010).

In relation to the student experience the literature surrounding online distance learning highlights the need for social interactions between learners, whether the course features collaborative learning or not. Effective online learning occurs in an environment that develops a sense of community and socialisation parallel to a traditional classroom (Willis, 1993). Socialisation can be achieved by combining both self-directed learning activities with synchronous online interaction with peers and tutors (Cornelius, 2013). Socialisation was identified as a key to successful distance learning in the 1990s for example; Dede (1996) stated “to succeed, distributed learning must balance virtual and direct interaction in sustaining communion among people”. Palloff and Pratt (1999) also found that building a learning community produced a successful virtual environment for students.
Renzi and Klobas (2002) observed that even those students who meet for face-to-face teaching benefit from online collaborative work, benefitting from socialisation while they develop the skills required using the technology for computer-supported collaborative learning. It is important to recognise that students many not have the necessary technical skills or be able to be quickly independently able to engage with online learning or collaboration. Online educators also acknowledge technical issues such as accessing the technology (hardware, software, network), navigation of the user interface, and efficient online communication affect the student experience. If distance-learning instruction includes collaborative learning, group members need to interact effectively to solve any problems with the use of the technology, and developing their social community, respect for each other relationships and trust (Renzi & Klobas, 2002; Croft, et al., 2010). Tutors need to moderate and encourage a sufficiently high level of student participation to ensure successful output from the group collaboration (Renzi & Klobas, 2002; Zawacki-Richter, 2004).

Active education research reveals the contribution of online community to effective online learning has become evident (Kear, et al., 2012; Cornelius, et al., 2011). A thriving online community encompasses the shared purposes of learners; mutual encouragement, support, information/knowledge sharing, exploration of ideas and social, informal interaction (Kear, et al., 2012; Cornelius, 2013).

6.1.2 Collaborative learning via the web

The potential of web-based collaborative learning has been researched over the last few years and the findings have now been widely integrated into textbooks
such as by Simpson (2013), and by O’Neil and Perez (2013). The dates of publication of appropriate journal articles relating to the use of web-based collaboration related to education imply that the strategy has appeared over approximately twenty years.

The collaborative approaches proposed by forward-looking thinkers, such as Warschauer (1997), two decades ago are now being gradually realised through mobile and computer technology. The use of web-based collaborative learning tools has boomed in recent years because of its proven effectiveness. The key to the effectiveness of online collaboration technology is their ability to stimulate affective and social issues among learners (Jones & Issroff, 2005). Reeves et al. (2004) have studied the fundamental implications of online collaborative learning in the context of a developmental agenda. Pedagogical research has thus geared towards finding the compatibility and synergy between educational technologies to serve as a platform for collaborative learning.

Sheremetov and Arenas (2002) have, for instance, developed ‘EVA’ which is an interactive environment for having collaborative learning to which the current generation of students respond positively. Indeed, the socio-cultural milieu of the times serves to support the use of online technologies for collaborative learning. Today’s generation of students is more than ready to take on the shift in the way education is administered. As a response to the observation of collaborations in the workplace, the act of implementing collaborative learning approaches is a value-adding policy. The students/learners not only learn the content distributed to them by the teacher. They also gain friendships and social connections, which
allow them to get help from when help is needed. The networks of peers established through the seminar talk also make opportunities for collaborative research available.

The evidence that collaborative learning accelerates the development of critical thinking skills has been shown by Gokhale (1995). Critical thinking is one of those highly relevant workplace skills, which employers expect to find in graduate employees. This acceleration is a result of the autocatalytic feedback obtained when different minds work together for a piece of a large problem. By allowing people to be a conduit for the free flow of ideas, and then it should be possible makes students learn not only from their facilitator but also from other learners. Students' understanding of a particular module of the course might serve as an input to be combined with those from other learners.

6.1.3 Pedagogy in relation to the use of web-based collaborative tools and distance learning students

The complexity of online collaborative environments requires careful pedagogical design. For students, the module setup is essential to their retention, ability to progress and final achievement. Problems at the initial stages of a module can demotivate and disengage students and compromise the success of the module or the whole course. Students need to be inducted effectively into what for many is a novel learning environment, so they need to develop the necessary skills to collaborate effectively on content-related tasks. After initially establishing the learning environment to help students develop their online skills, tutors need to monitor primary activities, and provide rapid intervention if problems arise, for
example, when the technology fails or if inappropriate interactions occur between students (Kear, et al., 2012; Bower, et al., 2012).

The use of web-based tools is itself already an art and science. Online tools are commonplace today. The pedagogy here is in the combining of collaborative learning and distance learning into one platform. By addressing the visual dimension through images and other rich visual content, Web-based tools enhance the learning of abstract and difficult concepts. Teaching difficult concepts, usually, best taught face-to-face is among the examples. The pedagogy of administering online collaboration capitalises on the multiplier effect of social processes embedded in collaboration.

The educational research in the area of collaborative learning has focused on the impacts that collaboration has on the way individuals learn and in their attainment. For example, Järvelä, et al. (2010) point out that the combination of individual and social learning processes is essential to the effectiveness of the collaborative approach. Learners participating in collaboration are shown to enhance critical thinking (Gokhale, 1995; Ghodrati & Gruba, 2011).

Academic motivation has always been a pedagogic aspect, which is actively studied by educational researchers. Rienties et al. (2009) have demonstrated the role of motivation in computer-based methods of implementing collaborative learning. Collaborative work is not a trivial engagement to assign to learners. The work must be designed carefully like a puzzle the pieces of which are challenging enough for an individual to do. Collaboration involves the completion by each
member his/her piece of the puzzle. After completion, the facilitator or a leading member of the team would consolidate the output as the group solution to the problem. While collaborative learning is not explicitly lectures during the formation of the activity, the design of the task itself implicitly invites students to learn collaboratively. The challenge in designing such collaborative tasks is precisely the reason that most HE institutions until today employ the traditional methods.

6.1.4 Improving student retention, progression and achievement especially with distance learning student using web-based collaborative tools.

Student performance is of the utmost importance, and improving or enhancing it is certainly important. Collaborative learning in higher education has already been established as an enhancer of critical-thinking faculties (Gokhale, 1995). Distance learning, on the other hand, tends to focus the learners' time on the learning process while they are in the comfort of their home or office. Improvement of retention, progression and achievement could serve as a reflection of the benefits that collaborative and distance-learning offer to HE students. The use of web-based tools enhances the learning even further. By visualising rather abstract concepts to imagine (which is a difficult task for many students), the comprehension of complex subjects becomes easier.

In addition to the enhancement of critical-thinking skills, Westbrook (2012) has also demonstrated that collaborative learning increases the level of achievement among medical students. Hron and Friedrich (2003) have emphasised how the benefits of collaborative learning extend beyond those offered by the technology.
As a matter of fact, the increase in the capacity of individuals to solve complex problems together is notable (Uribe, et al., 2003). Real biomedical practice, also involves an inevitable amount of problem solving. Even in the nursing profession the prospect of encountering a complex problem cannot be sidestepped. Collaborative learning offers the readiness for biomedical students to engage in working with a team toward solving a complex problem. By breaking down a problem into workable sections, the complexity is resolved by scaling it down for each member in a collaborative team. The team then comes up with a solution to a complex problem by consolidating the solutions to the individual pieces of the problem.

It should, therefore, follow that collaborative learning improves the retention, progression and achievement among those engaged in collaborative learning endeavours, by reducing isolation, enhancing community and developing effective materials to refer to. Web-based technologies used to build the platform, allow distance-learning students to capitalise on this opportunity. Collaborative learning has truly democratised the way education is administered. It has enhanced capabilities of students/learners whenever and wherever they may be.

6.1.5 Designing tutorial activities - web-based collaborative tools

Web-based collaborative platforms make the design of collaborative tasks easier than before they had existed. We are now in a fortunate period wherein the web infrastructure has been laid down already. The infrastructure now calls upon the development and design of actual tools that are going to be deployed through the platform (Hron & Freidrich, 2003).
The design of tutorial activities using Web-based tools has been made easier today with the availability of web content management platforms, for example, Moodle, BlackBoard. Social networking sites also offer an exciting platform for knowledge sharing. An important aspect in the design of Web-based collaborative tools is on how knowledge is shared not only by the facilitator to learners, but also among learners. Collaborative-learning design concepts are valuable in providing a framework for design of tutorial activities that involve students helping other students in a collaborative mind-set.

Complex problems have been shown as the appropriate basis for developing collaborative learning activities (Uribe, et al., 2003). The complexity of the problem is, usually, burdensome for an individual student/learner to complete. However, the complexity is scaled down dramatically for an individual if the complex problem is pieced up into more workable sub-problems. This design of online collaborative exercises should be similar to the collaborative editing of the document that is currently available using Google docs (Rimor, et al., 2010). The online platform is a primary example of how collaboration by piecing a complex problem into workable sub-problems can work (Rosen & Rimor, 2009). Such type of collaborative tasks could serve as the most suitable template for designing online collaborative tasks and tutorial activities.

6.1.6 Blackboard Collaborate™ - web-based collaborative tool

There are several web-based collaborative tools available, and many are regularly used in business, but not many have been designed for educational use (Pitcairn, 2011; Pappas, 2013). The collaboration tools within Blackboard have been
designed with educators in mind being developed from forerunners Wimba and Elluminate. This tool allows students to participate in real-time lessons and discussions with their lecturers synchronously via web-conferencing. The sessions can be run in real-time, as online classroom discussions. Using guest speakers where they can lead sessions from another location (saving travel and time costs) is a great advantage. Instant messaging, tutorial sessions, virtual group areas for students to work in and then present back to the main session and live question-and-answer sessions can all be done synchronously on this conferencing software. Students and instructors can communicate via the microphone tool or by typing their questions within the chat tool (this can be private to the tutor or public to the whole class). There is a planning system (Plan) allowing preparation of materials in advance. Materials can be “pushed” to students during the synchronous session but also is available for asynchronous viewers to pick it up later. Students and tutors can use Whiteboards so a tutor can virtually “send” students into groups to undertake collaborative exercises together. All types of sessions can be recorded then made available for review, or to be watched by others who could not join the synchronous event. The tool can be accessed from computers, laptops, tablets and smartphones via the tool within BlackBoard or via an app. This piece of action research utilises many of these features and explores the student experience via a survey.

6.1.7 Student demographics

Ten MSc students undertaking the newly launched MSc Blood Science by distance learning took part in Collaborate™ sessions. Of these students, only two live in London and would have had the potential to attend any face-to-face
events/tutorials. Students studying on this route live in Canada, Saint Maarten, Ireland, London, Surrey, and Manchester. BSc students on modules: BS5001 (148) level 5 and BS6002 (150) level 6 are cohorts who usually attend face-to-face taught sessions and are predominantly studying biomedical science (descriptions of the demographics were explored in Chapter Three).

6.1.8 Aims

This chapter aims to address the following questions in relation to using a commercially available educational version of web-conferencing.

1. How did students find teaching and learning via web conferencing compared with face-to-face teaching?
2. How did the students experience accessing and using Collaborate?
3. What are the benefits and issues for tutors of using web conferencing to support learning?

6.2 Method

The pilot for this tool was used for three student groups, MSc blood science (Distance Learning), BSc biomedical science students on modules BS5001 (level 5) and BS6002 (level 6). The Blackboard Collaborate™ tool was deployed with WebLearn and then various sessions were developed and implemented for students to engage with. Before using Collaborate, thorough training sessions were provided for instructors. Pilot user group meetings to discuss experiences continued through the research period. This provided the impetus for employment of best practice with collaborate and familiarisation with the functions and protocol for conducting various activities. A set of instructions for
how to check Collaborate will operate on the participants’ computer, laptop, tablet, or mobile and how to participate in the sessions was designed for the students. Tutorial events were developed using the Plan™ tool in Collaborate™. Documents were uploaded for distribution to the students via the Push tool and online etiquette (netiquette) rules incorporated.

For the MSc distance learning students, each time session was mutually agreed by previously setting up a Doodle calendar for students to select the time slot they could join from a series of different days and times (including weekends and evenings). The sessional time selected was the decided from the most popular student availability. Then details and the meeting link were emailed to the students deployed for students to engage.

For MSc Student - Interactive tutorials on haematological morphology and interpreting antibody screening profiles both of which are typically best taught face to face were delivered. The Collaborate tool Plan™ was used to develop the teaching event. The instructor led the subject introduction then the students in groups were ‘sent’ to virtual classrooms to discuss the process of interpretation with each other and solve the problems set. The instructor then brought them into the central area and invited the groups to present back to the whole class. The sessions were recorded and then made available via WebLearn for the students to revisit if they participated or watch if they were unable to join the tutorial.

After successful trial with distance MSc students, collaborate staff discussed with the face-to-face undergrads on BS5001 and BS6002 about participating on an
online revision tutorial for each module. The students that felt the ability to record sessions would be beneficial.

For the BS5001 and BS6002 tutorials the students were invited to either attend the scheduled class based revision or join the lecturers online for this session.

After completion of the pilot period, students were sent a survey using the ‘SurveyMonkey’ tool the questions (Likert scale and free text) can be found in Appendix D. In accordance with many Likert scale models respondents were offered a choice of seven or pre-coded responses with the neutral point being neither agree nor disagree (Likert, 1932). When analysing Likert scale data two problems commonly arise when trying to analyse answers: (a) some responders prefer to "sit the fence" by always marking the most neutral possible answer, and (b) it may be difficult to decide what kind of scale the data coming from such an item represents (how different is a response of 1 or 2, or 6 to 7) (Brown J. D., 2000). Brown (2000) also notes that there can be a lack of concordance between a Likert response and free text answers, so further analysis may be required using a focus group to clarify themes.

Number of students targeted for the collaborate sessions/attended - examples A: BS6002-150/80, B: BS5001-148/34, C: MSc students 10/3-7, the various sessions were facilitated by eight members of staff in total.

Two 30 minute focus groups 1) with students and 2) with tutors were carried out to gather general feedback about the Collaborate tool.
6.3 Results for Collaborate pilot

Full engagement with all distance-learning students was achieved by them either joining the live online sessions or accessing the recordings. Two students who were lagging behind the other students and not effectively engaging with the online materials before Collaborate sessions were introduced, improved their access and went on to successful complete their two modules for the semester. For BS6002 revision tutorial 84 out of 150 students joined the live online collaborative tutorial (notably more that, the less than 1/3rd (46) turned out for the mid-year revision session) and there were 197 hits for the recording.

There were some promising indicators for the effectiveness of the pilot, Table 6.1 compares the grades for the final exam for 2012-13 (no Collaborate) and 2013-14 (Collaborate) where there was a significant differences between % first passes (p = 0.04) and the SD between average pass marks = 7.9196 with 2013-14 cohort showing the improvement.

Table 6.1 Differences between end of year exam for BS6002 2012-13 verses 2013-14

<table>
<thead>
<tr>
<th>Assessment component</th>
<th>Final exam 2012-13</th>
<th>Final exam 2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average mark (pass %)</td>
<td>43.6 (SD = 39)</td>
<td>54.8 (SD = 33)</td>
</tr>
<tr>
<td>No. Students passed first time (%)</td>
<td>54 (47%)</td>
<td>82 (54.6%)</td>
</tr>
<tr>
<td>Total number of students</td>
<td>87</td>
<td>150</td>
</tr>
</tbody>
</table>

It is interesting to note that students who passed the final year exam performed better in the 2013-14 iteration and that a larger number of them passed the exam first time. There were 84 students who joined the live Collaborate revision session. 76 students stated they felt more prepared for the exam at the end of the revision
session and planned to review the recording on a poll conducted at the end of the session (the others at left the session or did not respond).

Table 6.2 The differences for BS5001 for 2013-14 iteration.

<table>
<thead>
<tr>
<th>Assessment component - Exam</th>
<th>Mid-year 2013-14</th>
<th>Final 2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average mark (%)</td>
<td>29</td>
<td>49</td>
</tr>
<tr>
<td>No. Students passed first time (%)</td>
<td>54 (36.9%) 82 (56.5%)</td>
<td></td>
</tr>
<tr>
<td>Total number of students</td>
<td>146</td>
<td>145</td>
</tr>
</tbody>
</table>

As shown in Table 6.2 the effect on exam performance were more profound with a significant improvement $p < 0.0001$ between the mid-year exam (face-to-face revision) and the final exam (revision sessions via Collaborate).

6.3.1 Student experience self-report survey

There were 32 respondents (excluding 1 who accessed and declined to complete the survey), using a scale from 1 (uncomfortable) to 7 (extremely comfortable), when asked about their comfort in WebLearn 28 (90%) rated themselves at least 5/7, and 31 (100%) at least 5/7 in comfort in using WebLearn. Indicating that the students were not ill at ease using the virtual learning environment. When asked about awareness of the online tutorials 86.3% of 22 respondents agreed that they definitely knew the Collaborate session was going to happen before it happened.

When asked how they accessed Collaborate sessions 22 of the students answered the question indicating that: 12.9% had accessed the Live session only, 22.5% accessed the Recording only and 41.9% had accessed both (22.7% of students did not indicate their access pattern.
On a scale of 1 (extremely unclear) to 7 (extremely clear), the opinion on the clarity of the instructions given was divided: median = 5, range 3-7 and one student commented, “perhaps have the students pre-practice this form of workshop so that they gain more confidence in answering the questions”. Another stated “The instructions that were given on the lecture before the online tutorial were very clear and informative”.

6.3.2 Student preparedness
When asked did they feel prepared to engage? (with the tutorial) most of the students responded positively mean = 5.13, n = 23. Students’ comments included: “I knew it would be a very important tutorial, and wanted to make the most of it, so I prepared myself in advance”.

“It was a revision tutorial that meant we had to have covered some of the revision already to be able to benefit completely. For some of us who were in the midst of revising, parts of the session were not helpful, e.g., parts which we hadn’t covered in our own revision yet”, “it was made available on short notice”.

6.3.3 Ease of use
The participants found access to the Collaborate sessions and ability to participate easy (4.95 and 5.2 mean respectively) for those students who accessed the live sessions (Figure 6.1).
The majority of students found the tool easy to access and easy to participate in the sessions. The first revision session for BS6002 resulted in the students requesting the same style online tutorial for another level six revision session planned for later the same week.

6.3.4 Feedback from students relating to experience

Students liked the online students compared to face-to-face tutorial = 4.3 (SD ± 2.0), they expressed they experienced increased engagement = 4.8 (SD ± 1.85) and they contributed more than a traditional face-to-face tutorial = 4.4 (SD ± 1.81). 80% of students indicated the sessions met or exceeded expectations (1 below, 1 n/a), that it improved understanding of module topics (4.8), and that the tutorial increased academic their self-efficacy (5.3).

Students were asked about the tools available in Collaborate, (see Table 6.3) and they showed a preference for tutor presence on video rather than a still picture and being anonymous themselves if they ask a question.

Table 6.3 Percentage of student responses to “What did you like about BlackBoard Collaborate?” and the component tools utilised.
<table>
<thead>
<tr>
<th>Item</th>
<th>Liked</th>
<th>Didn’t like</th>
<th>Didn’t try</th>
<th>Don’t remember</th>
<th>Wasn’t there</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push Doc</td>
<td>20</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Whiteboard</td>
<td>50</td>
<td>5</td>
<td>20</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Quiz</td>
<td>45</td>
<td>5</td>
<td>20</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Polling</td>
<td>35</td>
<td>10</td>
<td>10</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Images</td>
<td>80</td>
<td></td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Tutor Pic</td>
<td>40</td>
<td>15</td>
<td>15</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Tutor Vid</td>
<td>70</td>
<td></td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Anon. Qus</td>
<td>60</td>
<td>20</td>
<td>15</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Ans. Qus</td>
<td>50</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

70% of students found it valuable to be able to scroll up and down the conversation in the chat box (grading at least 5/7, 40% at 7) during the session.

Overall student evaluation Students (n=19) agreed at least 5/7 that:

- BB Collaborate would make them more likely to attend (50%);
- They’d like BB Collaborate in more of their modules (70%);
- They’d like to use BB Collaborate to work with other students on group projects (60%);
- They would like to use BB Collaborate to have supervision and other meetings with staff (70%)

In response to the question: What would you suggest to improve them [online tutorials] for students in the future? Students commented “the microphones for the Lectures were playing up a bit at the begining [sic] which made take too long to set up before we started. so better sound and visual effects pls”. “I would suggest to set a precise time to finish the tutorial. The first tutorial was very interesting indeed but students did not know what time the tutorial would be finishing”. “perhaps have the students pre-practice this form of workshop so that they gain more confidence in answering the questions”. “it would be great, if it was
made available every end of the month and for all the taught module. for revision etc”. Generally positive feedback with issues being easy to resolve.

In response to: What caused you to feel this way [were you sufficiently prepared for the session]? “I had all my notes prepared and had written down questions”, “I had started revising and had a lot of areas I need clarification on”, “I knew it would be a very important tutorial, and wanted to make the most of it so I prepared myself in advance”.

“It was a revision tutorial that meant we had to have covered some of the revision already to be able to benefit completely. For some of us who were in the midst of revising, parts of the session were not helpful, e.g. parts which we hadn't covered in our own revision yet.”, “We had a week to study for the module on our own before the session [sic] online, giving us a chance to come up with questions [sic]”, “it was made available on short notice.”, and “The instructions that were given on the lecture before the online tutorial were very clear and informative”.

The sessions encouraged students to have undertaken revision beforehand so they could improve.

In response to: If you didn't try to access the live session, can you please tell us why you didn't? “i wasn't prepared.”, “I wan [sic] not available at the time of the session”. Students who did not prepare before the session were reluctant to join in the live broadcast but did access the recording.

In response to: If you didn't try to access the recording, can you please tell us why you didn't? “I benefited a lot from the online and wrote notes”.
In response to: What did you like best about your Blackboard Collaborate experience?

“Having all the tutors accessible at once”, “Easy to use”, “the fact that many Lecturers were involved and the best Lecturer to answer a certain question did whilst some added extra useful info which rily [sic] help with exam prep”, “The fact that I could come back to it as many time as I needed to, I wish I had this facility from my first year.”, “That the individual tutors mind-mapped the important parts of their lectures. That the main tutors were all available to talk via comms or messaging.”, “the fact that you could reveiw [sic] the diagrams and the explanations about them. It really helped as I am a visual learner”. “The lecturers went through all the revision information in details and answered all the questions in good details [sic]”.

The response from students showed the students liked being able to interact with more than one tutor at a time and the richness of the way material could be presented to them.

In response to: What did you like least about your Blackboard Collaborate experience?

“Hard to login. Downloading software”, My tutorial it was a bit long, but I enjoyed anyhow!”, “the chat box was small and could not be enlarged to see live questions and answers as an option during or after the setion [sic]”.

There were a few issues with students accessing the sessions but this was minimal and the instructions for navigation the session could be more explicit (chat box can be enlarged by the student on their screen).
In response to: What did you like most about your Blackboard Collaborate experience? “I can be home in my blankets in winter and be getting my education :) love it”, “

In response to: Did you find that you had to make any changes or updates to your computer in order to access the Blackboard Collaborate room? “Download java”, “I downloaded the latest Avira system in my PC”, “i think i had to download a software and make collaborate compatible. It TOOK AGES but got there in the end”, “Java & jnlp files update”.

In response to: Did you need to buy or borrow any additional hardware (e.g., webcam, microphone, headphones) in order to engage with this tutorial fully? “I had to call a freind to navigate my way to the setion [sic]”. “Microphone”.

In response to: Are there any other comments that you would like to make about your Blackboard Collaborate experience? “Don’t rely too much on blackboard collaborate”, “Have it available in tutorial so that during revision we can access it. Hearing and seeing is better than just reading”, “The overall experience was very interesting, and being able to access it at any time creates a huge advantage for the student.”, “if only it had been there sooner.....most of my friends [sic] found it easier to ask, questions in the setion thta [sic] were vital for the exam”

6.3.5 Feedback from tutors relating to experience

Feedback from tutors in the focus group was positive and included comments such as “Training sessions for academics were useful but Plan [I think] is a bit pants”, “Dedicated training environment with multiple students may be useful”, “it is
easier to use than I thought it might be”, “Would have liked more time to learn the tools more proficiently”, “Enjoyed the large tutorial where we interacted, asking each other questions as well as the students”. “I felt the sessions were very useful for the students. It was good to have all the tutors online so they could answer questions on their specific topics. They could also add to the answers of other tutors to give a more comprehensive coverage to the students. The chat tool allowed those who may not want to speak online to ask their questions. Tutors could prepare the answer to the chat questions while another tutor was speaking. This meant questions arising from the session could be quickly answered or directed to the appropriate tutor. The synergy between tutors made for a comprehensive coverage of the material”.

6.4 Conclusions

Learning needs assessment (incorporating gap analysis) for our online cohort showed a definite need for a tool that provides all the functionality of a modern lecture theatre, but allows two-way engagement at a time and place to suit the learner. Moreover, use of web-based collaboration tools brings distance learning in higher education out of the dark ages of ‘loneliness of the long distance learner’ and into the digital age of online social interaction. A review of the marketplace products available revealed BlackBoard Collaborate™ was a potential candidate for meeting our needs (seamless integration, interactive whiteboard, video conferencing, embedding materials, recording). Coincidentally BlackBoard were looking for UK academic institutions to take part in a pilot for the use of the Collaborate tool.
The annual SWOT analysis indicated an operational need to become leaner in our approach, and recycle useful materials, such as the ‘how to read a paper’ tutorial was recorded then inserted into several other modules where it was adding value to the student resources.

1. How did students find teaching via web conferencing compare with face-to-face teaching?

The pilot on the whole provided substantial evidence of student satisfaction, and especially at MSc level it enabled us to retain 50% of the students as they were expressing issues with ‘isolation’, ‘confusion’, ‘lack of motivation’ and felt studying on their own in a different country online too complicated. The students all felt the online tutorial system allowed them to feel part of a learning community and was better than the Skype system for communicating with the tutors. For BSc students the BS6002 students interacted with the online revision session well and had such a positive experience they wanted to use Collaborate for a revision session on another module later in the same week.

2. How did the student find their online experience?

There were very few problems with accessing the sessions, and 80% liked the forum. The majority of students provided positive responses to all areas relating to their online experience.

3. What are the benefits and issues of using web conferencing to support learning for tutors?

Feedback from tutors included comments such as “Training sessions for academics were useful but Plan [I think] is a bit pants 😊”. “Dedicated training environment with multiple students may be useful”.

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Collaborate proved popular with our younger learners who were less wary of using the technology. They are more familiar with a mobile tablet than a lectern and regularly use online social networking tools. The challenges encountered were:

1) rendering the recording. This took longer than expected but was an issue with the pilot setup, where the rendering took place on a remote server.

2) Transcript for a deaf student, this was overcome by the note taker creating notes from the recording.

However, the student who was originally nervous about the web-conferencing found: as long as the tutor appeared on the screen they could follow the themes. The text chat box allowed monitoring of questions and answers from other students, and the whiteboard area helped, so this experience was no more problematic than the face-to-face sessions. No other problems were encountered during the pilot with Disabilities and Dyslexia Service identified students, but the team is mindful that issues may occur in the future with other students and materials may have to be available in an alternative format. Web-conferencing also benefited students who could not otherwise attend the revision tutorial for the face-to-face students and also enhanced the learning experience for those distance learners.

When reviewing the exam performance for 2013-14 the mid-year pre-intervention had a lower pass mark and fewer students passing first sit than the end of year exam (Table 6.2) where Collaborate was used for the revision session. A confounding factor is this is not a direct like for like comparison as there is a difference in topics (Clinical Biochemistry for Mid-year, Haematology and Transfusion Science for End of year). Although the comparison for end of year
exam performance between 2012-13 and 2013-14 cohorts (Table 6.1) does reveal a significant improvement in performance.

### 6.4.1 Lessons learnt:

When setting up sessions it was found to work better if instructors were in separate locations to avoid feedback across the microphones. Clearly publish the finish time and clarify the period of time open before the session starts is to enable students to sign in and ensure their setup is working, and the tutor is online at this point to deal with set up issues only. The protocol for online ‘netiquette’ needs to be published in advance and reiterated at the start of the session.
Chapter Seven Conclusions, Impact, and Reflection

“Imagine how transformative it would be if we could combine self-paced, self-directed postsecondary learning (which has been around in one form or another for millennia) with online delivery of content that has embedded in it both the sophisticated assessment of learning and the ability to diagnose learning problems, sometimes even before the learner is aware of them, and provide just-in-time interventions that keep the learner on track” (Cavanaugh, 2013, para. 6).

7.1 Introduction

The studies described by this thesis investigate student learning experience and satisfaction, performance, and knowledge construction through blended learning interventions. The subjects were a series of student cohorts studying biomedical science at London Metropolitan University. Previously, investigations of education development has been purely been based around the translation of qualifications into outcomes and competencies. Prosser and Trigwell (1999) stated that student learning experience, context, and outcomes should not to be seen as separate variables and processes but they are interrelated. Many previous studies focused on comparing student performance online versus traditional learning for example, Stansfield, et al. (2004). When a blended learning instrument is applied, in the process of evaluating the effectiveness of e-learning student satisfaction should be considered (Hron & Freidrich, 2003; Klett & Pharow, 2006; Chu & Kennedy, 2011). Students will engage more with e-learning or blended learning if they are comfortable with an e-learning environment the level of student learning satisfaction plays a fundamental role in participation.

In Figure 7.1 the traditional teaching delivery in higher education to the right requires massive investment in building space and lecture theatres, but does offer
the human interaction between lecturer/tutor and student to provide support (Cavanaugh, 2013). On the other hand to the left diagram in Figure 7.1 educational material is provided to the student solely online, which can be delivered “anytime, anyplace, anywhere” (asynchronously). Asynchronous delivery allows the student to access their learning programme from home, their workplace, or when travelling at a time convenient to them (Gült, 2008; Cavanaugh, 2013).

**Figure. 7.1 Sliding scale of higher educational uptake of blended learning**

The myth associated with online/distance provision is that it is less expensive for the university to deliver the same programme, in an online format. This is not the case, as learners may feel isolated, become easily demotivated and increasingly likely to either, disengage and fail a unit or abandon their studies all together (Vogel & Klassen, 2001; Simpson, 2013; Westbrook, 2012). To engage these effects as much as possible the material presented has to be more than just a repository for the lecture material provided for face-to-face students. It must be expanded to capture their interest and engage them in the learning experience. They also require regular access to tutors, both in terms of schedules events and a system allowing access to tutors at other times (Kear, 2011). Blended learning can often be the stop gap providing the best of both worlds: collegiate environment with peers and face-to-face tutor support supplemented by the students’ ability to work remotely, for example be sent and submit work electronically (Jones & Issroff, 2005; Cavanaugh, 2013; Simpson, 2013).
Wang et al. (2006) demonstrated the effectiveness of web-based learning tools in catering for diversity in learning styles. By being able to address learning-style diversity, web-based modules enabled us to learn the mode through which formative assessment could best be implemented. Self-regulated learning through formative feedback will truly be a future reality (Nicol & Macfarlane-Dick, 2006).

7.2 Conclusions

Educational research indicates that active learning takes place if students are interactively engaged, rather than passive listeners.

In Chapter one a series of research questions were proposed and will now be reflected upon. There were:

1) What major factors predispose a student to using technology to supplement their face-to-face teaching? How will we respond to this answer?

In general students had no issues with using technology regardless of their age but not all students wished to engage with technology for example the formative assessments. The usage of tools such as Blackboard Collaborate were engaged with much more effectively and students found it much more useful in supporting their learning. We need to emphasise the added value to their individual learning to encourage students to engage with the technologies.

2) Is there a case for extending the use of blended strategies in higher education in general and in our institute in particular?

There are many advantages see in terms of either improved performance or enhanced student satisfaction with the implementation of the various
technologies. Many modules in the School of Human Sciences now include formative assessment and this work has been published for wide dissemination. "Enhancing learning through formative assessment" in *Innovations in Education and Teaching International*, and was the journal's Most Read article throughout 2014. There are papers in development relating to groupwork, online collaboration and abstract entitled: ‘Virtual Collaboration for Engaging the 21st Century Learner’ has been selected for submission as a PhD paper to the PhD Colloquium at the 14th European Conference on e-Learning ECEL-2015.

3) To which of the implemented blended teaching strategies do students respond most positively?

Students responded most positively to the online support system for groupwork, the improved standards in output were related directly to the quality of the posts and interaction with the tutor. The interaction between peers is greatly enhanced when they have received feedback from tutors to feedforward for their groupwork topics.

7.2.1 Student satisfaction with online collaborative learning

Student satisfaction in e-learning environments provides an area is a fertile area for explanation. (Wu, *et al.*, 2010; Zhu, 2012). Our findings match other studies that found students who undertook online collaborative tasks reported higher satisfaction levels with their learning process, compared to students who did not participate (Zhu, 2014). Studies by other researchers indicate that students from one cultural background may respond differently towards educational interventions than those from other backgrounds. This area was not fully explored
in this study (Dewiyanti, et al., 2007; Zhu, 2012). Moreover, comparative research into learners’ online interactions and the impacts of ethnic differences on student online collaboration has indicated that this is a complex area which needs exploring further (Zhu, 2012), especially in terms of how timely academic intervention can help poorer performing groups improve their performance.

7.2.2 Collaborative learning and shared knowledge construction

Formed from social constructivism, groups working together to accomplish a task provide a characteristically powerful learning environment, which facilitates dynamic development of knowledge. Research identified that students in collaborative learning conditions had undertaken a constructive learning processes (Zhu, 2012). Social interaction between student groups and the tutors enabled some participants to acquire and share learning experiences or knowledge and this process is termed Collaborative Learning. The positive effects of collaborative learning observed within this research are supports findings in the literature. Moving these social interactions onto web-based platform, with supported communications, can enable student meta-cognitive processes, reflective communication, problem solving, knowledge development and learning via group interactions. Through the online environment, students can create and share information, critically appraise their work and that of others and come to a group consensus by negotiation, in order to produce collaborative pieces of work.

7.2.3 Collaborative learning and quality of online contribution

Previous studies have revealed a positive correlation between students’ observable learning behaviours, such as participating in online activities, and their
achievement of learning outcomes (Wang, 2004). The findings in this study agreed and enhanced previous research that suggested there were two main forms of discussion behaviours; 1) task-oriented and 2) non-task-oriented communications.

The development of student group collaboration using an online platform involves five phases:

1) sharing and comparing information,
2) exploring conflict or incongruity,
3) negotiating meaning,
4) developing, synthesising, and reaching agreement, and
5) applying the co-constructed knowledge to the end product.

7.2.4 Student performance in online discussions and group work

Measurements of student performance in online learning modules are emerging as a crucial ingredient in their evaluation. Empirical studies reveal a positive correlation between students’ visible learning behaviours, such as participating in online activities, and their learning outcomes (Wang & Hsu, 2008). Collaborative learning has been known to provide additional motivation among learners, keeping them engaged and achieving highly in learning tasks (Bruffee, 1999). Being able to foster additional learning motivation amongst students would allow the teacher to focus more on providing a rich content. The use of WebLearn has allowed many teachers to switch their roles from content distributors into facilitators with the help of collaborative learning. Interdependence is an essential transferable skill that is learned through collaborative approaches, desirable in many professions including medicine. Thus, assisted by e to the preponderance of
computer technology and networks, computer-based collaborative learning has been seriously examined (Jones & Issroff, 2005).

7.2.5 Student performance in module formative assessments

Wang et al. (2006) demonstrated the effectiveness Web-based learning tools in accounting for learning-style diversity through implementing a formative assessment strategy. Without Web-based tools, formative feedback, which is required in the self-regulated progress of the student through a learning pathway, would not have been possible.

7.2.6 Summary

Students, who most frequently accessed the VLE, WebLearn, to complete assessment tasks or participate in discussion boards or collaborative sessions were also the ones with the highest final grades in these courses. It appears that the online interaction, collaboration and assessment were contributing factors to student achievement – better grades, increased retention – completed the module, and progression – accessed further modules (Vaughan, et al., 2011). Results are consistent with other research findings in UK and other countries (Vaughan, 2007; So & Brush, 2008; Arbaugh, et al., 2009; Siew-Eng, et al., 2010; Hartman, 2010).

7.3 Reflection

As a biomedical scientist and educator it has always been important to review, assess, and respond to actions and changes. The issues around blended learning need careful consideration before further time and money are ploughed into
building complex virtual learning environments, installing infrastructure and training staff. Blended learning is changing and evolving all the time but can best be described as a combination of face-to-face ‘traditional’ teaching and web-based support and has been defined as: “Blended learning is the enrichment to learning experiences supported by various strategies combining face-to-face student-centred interaction with web-based technology”, in this thesis. Over time, this support has become increasingly extensive so that rather than just saving on printing, it has become interactive both remotely through tools such as quizzes and as a way to access live tutor support 24/7 (Figure 7.2). These studies investigated several blended learning interventions and assessed each as to whether they enable a student to actually improve learning outcomes and whether all students respond in the same way. Where are the gaps we can plug, or web strategies best avoided? Holmes and Gardener (2006) illustrate the processes required to investigate and reflect upon the utilisation of blended or e-learning activities see Figure 7.3.

Chapter Two reviewed blended learning in higher education. The historical background traced the development of blended learning from the early days of PLATO up to the virtual learning environments of the present. The history of blended learning co-evolved with the emergence of computing technology as the leading information and communication technology at the present time. The sophistication of educational technology has progressed along with the improvement of computing and information technology.
The aim of Chapter Two was to review the definitions (reported within or deduced from the literature) relating to blended learning technologies and development. Those definitions were vast and varied; the characteristic feature that emerged from the research is that ‘blended learning’ is commonly acknowledged as the combination of education on the one hand and technology on the other. The combination can be defined more precisely to be an integration of face-to-face with online instruction, through deliberate planning, based on pedagogical considerations. The most distinguishing feature of ‘blended learning’ is the presence of a trade-off in face-to-face with online time.

**Figure 7.2 Mixing map for learning.** This Venn diagram examines the standard features of delivering learning, highlights common areas and then shows entirely independent learning mechanisms.
A review of the demographics of students on biomedical science over the period of study revealed a varied mix of ethnic groups and a wide range of age groups. Novelly, in our study performance of students showed greater achievement by students aged 25+ than was previously reported in the literature (Donaldson & Townsend, 2007). Investigation of various ethnic groups produced interesting findings. However, there were no indications that these students responded differently to others when after analysis the effects of the type intervention with respect to different types of interventions? Not all activities brought about an increase in performance, but students often expressed they felt their student experience was enhanced, in addition to development of transferable skills, for example with collaborative learning. It was important to engage and inform the students with respect to the added value of the activities. It was explained to them:
a) how formative assessment contributed to enhancement of learning and self-evaluation of their progress;

b) why collaborative learning was being used beyond the generation of coursework marks;

c) how the assessment system worked to generate their final mark,

d) that they were acquiring and enhancing soft skills through collaborative learning, such as appropriate ethical behaviour and teamwork skills.

The use of web-based collaboration was explored in chapter six with a view to enhancing tutor support and providing a virtual meeting space for students to perform collaborative learning tasks in the future. Our pilot results indicated that tutors experienced some challenges when they were managing various online tasks whilst at the same time being careful to maintain and develop a social presence. The pilot study also involved overcoming specific technical obstacles to enable tutors to respond to students’ requests. The results of our pilot informed the provision of training and support for when the project was expanded and the web tutorials offered to all tutorial groups in the intervention module. Overall, experiences from the web tutorials in our study indicate that tutors and students reacted positively to the opportunities web conferencing provided for interactive learning and teaching.

7.4 Impact on practice

Student satisfaction with the learning and the level of knowledge construction in the e-learning environment are also important variables that influence student learning, especially in a student-centred e-learning environment. Understanding
these variables is helpful for instructors in designing meaningful educational activities to enhance student satisfaction and performance and to promote student knowledge construction through social and peer interaction. Many areas of the research undertaken in this thesis have evolved into extensions of the interventions to other areas within the school and across the faculty. To date, the use of online communication for learning had focused on asynchronous technologies such as discussion forums like those utilised in Chapter Four (Kear, et al., 2012).

It was observed that in the collaborative learning exercises, student satisfaction is high for those who engaged fully together with improvement in performance and increase in personal confidence. Students’ gained skills such as teamwork and communication skills that could be transferred to future employment. For communication, the discussion boards have been shown to provide benefits such as the convenience and flexibility associated with asynchronous communication for students. Disadvantages have been reported as in the impersonal nature of the forum and lack of feeling of real (face to face) communication with other students and tutors (Kear, et al., 2012; Vonderwell, 2003). Because there are no formal times for engagement with the discussion areas students could disengage with learning and fall behind with their studies because they did not schedule the necessary time slots for learning activities, and in turn this lead to low levels of participation in some published reports (Kear, et al., 2012; Skinner, 2009). These weaknesses led to the investigation of web-based synchronous collaborative tools that were piloted in Chapter Six and so were largely avoided in our study. The formative online assessments investigated in Chapter Five, have been used
for students on several modules at level 3, 4 and 5. After positive feedback from students, online exams were developed for level 4 modules. Creating problem sets and allowing students to undertake individually generated exams can improve the richness of the exams. There was a stringent review of questions included in the question sets to determine the equity of the quality of the exam compared to traditional exams. Formative assessments can also be used to develop individualised learning pathways within the virtual learning environments. These have been implemented in many of the School of Human Sciences (London Metropolitan University) distance based learning modules whereby access to the next set of learning material in the series depends on the student attaining more than the ‘gating’ grade on a prerequisite quiz. If a student attains lower than the ‘gating’ grade, the student is directed to alternative learning materials designed to fill the learning gap identified by the assessment. For the blended learning face-to-face students, it has allowed the identification of topic areas in need of reinforcement during tutorial sessions.

The research in Chapter Six revealed that careful planning and design are needed for successful synchronous collaborative events, but an element of flexibility is required to cope with the unpredictable nature of supporting learning in real-time (Kear, et al., 2012). Synchronous online delivery requires lecturers to adapt to the student questions, their responses and needs minute-by-minute – Sawyer (2004) described this as ‘disciplined improvisation’. The effect of synchronised web-based conferencing has enhanced student retention in the newly launched distance learning MSc called haemoglobinopathies. The software package Collaborate™ (http://www.blackboard.com/platforms/collaborate/overview.aspx) was deployed as
part of a wider teaching strategy, which sought to offer context to learning materials, beyond mere reading and recall. Web-based collaboration allowed us to provide context to established texts and traditional learning materials. A gap analysis showed a need to employ novel teaching tools in order to deliver the best value to our students. Especially in science education, there is a need to regularly evaluate our students’ comprehension in order to tailor our delivery to student’s needs. The gap was significantly narrowed by the inclusion of Collaborate within the virtual learning environments, providing a two-way communication stream allowing an evolving microanalysis of students’ comprehension. Much of the work undertaken has been disseminated to other areas of the university and publication of more of the work is underway: “Bridging the gap – bring students together in the virtual classroom”, Heugh, Frost and Lochun.

“An Investigation into the Effectiveness of Discussion Boards within a Virtual Learning Environment to Support and Enhance Collaborative Learning” Heugh and Hudson.

7.5 Future

Currently completing a paper entitled: Virtual Collaboration for Engaging the 21st Century Learner if it is accepted it will be presented it at the 14th European Conference on e-Learning ECEL-29-30th October Hatfield, UK.

Submitted an application for the University Teaching Fellowship award at London Metropolitan University indicating my role in disseminating the educational research I am undertaking, and encourage others to try some of the methodologies I have implemented. If awarded there is a small amount of money available for educational research and dissemination.
Enhance the distance learning provision by the biomedical science cluster using blended learning technology. In a world where student expectations of their educational experience are increasing, many traditional methods are seen as out-dated and not in keeping with these expectations. So, rather than distance learning merely replacing the postman with email it needs to be much more. Material posted on virtual learning environments and discussion board type tools are seen as out-dated, old-fashioned and not fit for purpose. The new enhancements of interest to students include: Camtasia, MP4, MP3 recordings, instant messaging, and web-based collaboration that are fully integrated with WebLearn.

London Metropolitan University has attracted students from around the world to its distance learning provision. Web-based collaboration has allowed it to engage students that do not have access to masters’ level qualifications in biomedical science in their country of origin. Student engagement showed a marked improvement for both undergraduates and postgraduates with previous years revision sessions. Further research assessing students who did not attend or access first sit revision tutorials (pre-intervention) compared to those who attended the re-sit revision tutorial (post intervention using Collaborate) may reveal whether the improvement in performance trend is still apparent. A successful bid was put in to the university to fund an extended pilot for deeper evaluation of the tool entitled “Bridging the gap, bring students to the virtual classroom”.
By enhancing our biomedical science provision, we can continue to attract students from around the world and deliver excellent quality accredited learning to students with whom we could not have engaged with previously.

### 7.5.1 Developing individualised learning pathways from current work

Personalised learning through electronic methods has been developed by the implementation of formative learning (Hummel, et al., 2004). Individualized learning pathways are the outcome of the planning and design of personalised learning to address diversity of learning styles and fill knowledge gaps. Recently they have been considered for use beyond the educational setting, as a career intervention strategy and for continual professional development (CPD) (Solberg, et al., 2012). That the ability to develop individual learning pathways to meet a person’s needs can be utilised in the context of supplying enhanced and directed learning materials both within the course and through to career development, is testament to the universality of application of blended learning. Solberg et al’s hypothesis puts forward is that the diversity of learning types is linked to the statistical variations inherent to the demographics (2012). Individuals have distinct predispositions for learning that result from the combination of genetic and environmental factors. This fact has been recognised for a long time in the educational literature. However, the seemingly common factor despite the diversity of the student base is learners globally “prefer to learn in an unstructured, experiential manner” (Attwell, 2007; Ross & Gage, 2006). An individual learning pathway addresses the preference for more experience-based learning. Setting learning outside the classroom and with less use of face-to-face interactions addresses the preference for less structure. Based on these
characterisations, individual learning pathways can be taken as a student-centred learning approach. Student-centred learning is diametrically opposite to the traditional teacher-centred approaches, which are still common in the educational system. The fact that today's classes are mostly conducted in face-to-face settings and the widespread use of the lecture type format show that learning is still predominantly teacher-focused.

The prevalence and efficiency of computer networks today have paved the way for the realisation of individualised learning pathways (Nicholson, 2007). The reason for this phenomenon is that individualised learning pathways are best administered remotely. The interaction between teacher and student is primarily virtual, but collaboration with co-students is possible through social media tools. Collaboration is now much easier to implement today than, say, eight years ago. With the anticipation of further improvements to this technology, the design of individualised learning pathways is expected to become only better. The popularity of computer-based educational methods is now trending upwards (Vogel & Klassen, 2001), as more schools and HE institutions take up virtual learning environment tools such as Blackboard and WebLearn. This increasing popularity allows online tools to serve as a channel for individualised learning pathways. Our study has contributed to the fact that students now have the potential to identify their preference to learn in an unstructured and experiential way (Ross & Gage, 2006; Wang, et al., 2006; Attwell, 2007). I plan to use this approach to enhancing our distance learning modules and evaluate their impact. If successful results will be publish and findings disseminate to Heads of
Universities Centre for Biomedical Sciences conference to encourage others in this disciplinary area to use them.
References


Duffy, T. M., & Kirkley, J. R. (2004). *Learner-centered Theory and Practice in Distance Education: Cases from Higher Education* (1st ed.).


http://www.hefce.ac.uk/pubs/year/2012/cl112012/#d.en.72527

HEFCE. (2010). *What Next for Online Learning: The Australian Experience*. From www.hefce.ac.uk:
http://www.hefce.ac.uk/media/hefce/content/whatwedo/learningandteaching/enhancingltonlinelearningtaskforce/StuartHamilton.ppt

http://www.hefce.ac.uk/pubs/year/2014/201413/#d.en.87641


http://www.edpsycinteractive.org/materials/tchlrnmd.html


IBMS. (2010). *Criteria and Requirements for the Accreditation and Re-accreditation of BSc (Hons) degrees*. London: Institute of Biomedical Science.


JISC. (2007). *Effective Practice with e-Assessment*. JISC.


QAA. (2007a). *Subject benchmark statements*.


Renzi, S., & Klobas, J. E. (2002). Developing Community in Online Distance Learning. *ECIS, 1384-1393*.


Zawacki-Richter, O. (2004). The Growing Importance of Support for Learners and Faculty in Online Distance Education. In J. E. Brindley, C. Walti, & O. Zawacki-Richter (Eds.), *Learner Support in Open, Distance and Online Learning Environments*. BIS-Verlag der Carl von Ossietzky Universität Oldenburg.


Abstract

Using e-learning to engage with diversity in Health & Human Sciences

This presentation will explore how a variety of approaches to the integration of technology into course delivery have enhanced and extended the experience of learners. It will illustrate the application of content delivery, interactivity, communication, collaboration and assessment within the life sciences and highlight how these methods have promoted engagement, motivation and achievement. We seek to demonstrate how the lessons learned from these experiences may be transferred and applied within a variety of curriculum contexts. The key message from our studies is that e-learning will be most effective when it adds value to tutor-student interactions and creates new models for knowledge and skill development rather than merely imitating conventional modes of information exchange. Examples of work with students include use of an electronic portfolio in HEO modules, and using discussion forum to support group work (integrating self-assessment/peer assessment and formal assessment) to provide individual grades in an I level module.
What is e-learning?
Using electronic devices, data networks and internet services to do what we have always done!

What can e-learning offer?
- Exchange: e-learning is used primarily to transmit information
- Enrich: e-learning is used to bring a subject to life
- Enhance: technology enables learning to take place in new ways
- Extend: learning takes place in new environments in ways controlled by learners
- Empower: learners are empowered to transform their own world of learning

LONDON METROPOLITAN UNIVERSITY
LEARNING & TEACHING CONFERENCE 8TH JULY 2008

University Learning and Teaching Strategy Framework
- Core themes include:
  - Providing a range of learning opportunities and support that meets the different needs of our socio-culturally diverse students

University Learning and Teaching Strategy Framework

Transformation
Transmission
Comprehension
Application
Analysis
Synthesis and Evaluation
Transaction

Level of learning
Passive
Mode of learning
Active

265
LondonMet Learning & Teaching Conference (10 July 2012)

STAFF PANEL DISCUSSION

chaired by the Deputy Vice-Chancellor, Professor Peter McCaffery

Topic: Transforming learning through connecting research and teaching

Panel members

Dr Maddy Coy is the Deputy Director of CWASU (Child and Woman Abuse Studies Unit) within the Faculty of Social Sciences & Humanities, and Course Leader for the MA in Woman & Child Abuse. CWASU’s research approach is to create ‘useful knowledge’, in combining the voices of research participants with ‘middle range theorising’: concepts that are rooted in lived experience whilst illuminating the wider contexts in which they are located. Prior to becoming an academic, Maddy worked in a range of support services for women and girls experiencing violence. While at CWASU, she has led on projects that include: evaluations of specialised services for victim-survivors of violence; the UK’s largest survey of men who pay for sex; mapping specialised violence against women services; and a template for developing an integrated strategy on violence against women and girls. She has published numerous book chapters and journal articles about young women and sexual exploitation, women’s experiences of prostitution and the sex industry, and more recently on the sexualisation of popular culture. Maddy is also a member of the End Violence Against Women and Girls Expert Prevention Network, the Canadian Observatory on Violence Against Women, and is a volunteer on the national Rape Crisis helpline. She draws on both her practice experience and academic skills in CWASU’s work and consultancy with policymakers and practitioners and throughout teaching on the MA in Woman and Child Abuse.

Steven Curtis is a Senior Lecturer in International Relations, in the Faculty of Law, Governance & International Relations, and Course Leader for the BA in Peace and Conflict Studies and the new BA in Diplomacy. He has been awarded a number of prizes and titles in recognition of his innovation and research in teaching, including a LondonMet University Teaching Fellowship (2010) and the prestigious award, in July 2011, of a National Teaching Fellowship by the Higher Education Academy (HEA). Steven is currently the national Discipline Lead for Politics at the HEA, building on his previous work with the former Subject Network. He has been co-opted onto the Executive Committee of the British International Studies
Association (BISA) as an expert on learning and teaching in the discipline. Although he has recently begun writing for publication on the subject of diplomacy, over the past seven years Steven’s main research activity has been in the area of innovations in the learning and teaching of Politics and International Relations. He has been centrally involved in two major government-funded research projects, one focused on developing more effective modes of giving constructive feedback to students, and the other on new models of placement learning.

**Dr William Dixon** is a Senior Lecturer in Economics, in the *London Metropolitan Business School*, and a researcher in the Centre for Socio-Economic Research (CSER), which promotes economic research that considers the ethical, psychological and sociological dimensions of individual economic behaviour and how these may influence markets or organisations. William’s particular research interests concern economics and morality, political economy and the independent labourer, and the self, economics and other disciplines. He has published a number of articles on these topics and is co-author, with David Wilson, of *A History of Homo Economicus: The Nature of the Moral in Economic Theory* (Routledge 2012). In their article on ‘Performing Economics: A Critique of “Teaching & Learning’*, *International Review of Economics Education*, 8 (2), 2009, these authors challenge approaches that tend to treat the teaching process as a ‘purely presentational issue’ and to abstract ‘teaching’ from ‘content’ and its underpinning connection with research.

**Sheelagh Heugh** is a Principal Lecturer in Biomedical Sciences in the *Faculty of Life Sciences* (FLS), and Course Leader for the BSc in Biomedical Science and MSc in Blood Science. A Fellow of the Institute of Biomedical Science, Sheelagh is also a member of the FLS *Cellular and Molecular Immunology Research Centre*, which aims to help further our understanding of the immunology of infection and cancer progression and to apply this knowledge for possible future therapies. As well as writing articles and chapters related to her subject specialisms, Sheelagh is pursuing a Professional Doctorate in Biomedical Sciences, investigating the impact of blended learning techniques on student performance and satisfaction. This builds on the pedagogical action research that she has conducted towards her award of the Postgraduate Diploma in Learning & Teaching in HE. As an educational practitioner and Blended Learning champion, Sheelagh is particularly interested in developing novel e-learning teaching tools for biomedical science.
Professor Mikis Stasinopoulos, Professor in Statistics in the Faculty of Computing, has worked for the last 22 years at London Metropolitan University having previously worked for the Wellcome Foundation and Lancaster University. He is a member of STORM, the Statistics, Operational Research and Mathematics research centre, and a Fellow of the Royal Statistical Society. Mikis is an expert on statistical modelling and one of the founding members of the statistical modelling society. He has published extensively in the area of statistical modelling and contributed to the creation of the GAMLSS model and statistical software used worldwide. As a supervisor of doctoral students and lecturer on mathematics courses and modules, he is also very active in teaching.
Enhancing learning through formative assessment

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The student cohort on the University Science Extended Degree (SED) course is diverse in terms of educational experience. One of the key facets of teaching at this level is to engage and prepare students for higher levels of education in the sciences. The purpose of this evaluation is to relate a specific virtual framework, designed for students participating in biology modules contained in the SED course, with levels of student engagement. Central to this is the use of weekly on-line formative tests that students are expected to complete in their own time. Whilst over-all module pass rates remain stable, results indicate that a substantial proportion of students completed all of these assessments, and this appears to be directly linked to attainment of higher grades. Student feedback indicated that over 80% of responding students found the tests helpful. This model relating to learning and teaching encourages students to take responsibility for their own learning experience.

Keywords: formative assessment; virtual framework; student engagement; learning and teaching

Introduction

‘The simplest prescription for improving education must be dollops of feedback ... providing information about what a student does and does not understand, and what direction the student must take to improve’ (Hattie, 1999, p. 11). Formative assessment produces an increase in student study time, increases familiarity with learning materials and can introduce the student to the style of summative examination material they will meet in the future. This has the purpose of increasing confidence and familiarity with the testing process. Built-in electronic, continuous assessment enables teachers to provide instantaneous feedback, which has the potential to enhance student learning, as they are able to see the impact that their efforts relate to achievement and reflect upon the outcome (Sadler, 1989).

Academic teaching staff value assessment as a tool for estimating learning, while students can see it as a motivator to learn. The main criterion for the use of formative or summative assessment is that it must be used within a framework that is continually monitored by the educator with a viable and steady feedback loop from the student (Bransford, Brown, & Cocking, 2000). For assessments to be effective, the student and teacher must both actively participate in the process. Formative assessments can be designed for use as teaching aids and disclose feedback

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to both the student and the teacher. This is useful to both as outcome can identify and
differentiate strength of knowledge within a subject area (Kwan, 2011).

Since the birth and application of virtual age environments, methods have been tailored to
suit an ever-growing computer-literate student population (Gütl, 2008). Research published
regarding e-learning is increasing as this is a rapidly changing aspect of higher education
and continues to be a growing area of interest (Walker, Topping, & Rodrigues, 2008). A
number of authors have shown that student’s learning achievement can be increased with
the use of appropriate and timely formative assessments (Wang, Wang, Wang, & Huang,
2006). Although students may associate learning with examination success, educationalists
often require them to demonstrate the knowledge they have gained from teaching materials
(Kaftan, Buck, & Haack, 2006). ‘Assessment drives learning’, and, ‘students respect what
is inspected’, are typical statements found in the literature supporting the role assessments
can play in increasing learning by motivating students to engage with their learning process
(Pead, 2008).

Teaching guided by formative assessment allows the student to focus on the learning they
need to derive from their particular subject area. This approach enables students to focus
on factors that are under their control. Bell and Cowie (2001) defined formative assessment
as ‘the process used by teachers and students to recognise and respond to student learning
in order to enhance that learning, during the learning’. For assessment to be successful, all
parties (e.g. tutors, examiners and students) must understand and follow a similar process.
Not all assessment needs to contribute to the final summative grade but they can be used
for self-assessment formatively whereby students can determine their own progress
(Britton, 2011). Formative assessment used in this way helps students to remain motivated
by encouraging them to read around the topic and therefore identify gaps in their knowledge
which may promote understanding of the educational content. Having established the value
of formative assessments, the assessment task should ideally be designed to meet the
intended learning outcome (Burr, 2009). This forms the basis for the study conducted here.
The pedagogy involved for implementing self-assessment is intended to motivate students
by facilitating the delivery of the curriculum and the learning process. This identifies areas
that can be improved through feedback and active learning so allowing academic staff to
intervene in a positive manner while increasing student engagement (Mostafa, 2011).

Academic staff often overlook the process of formative assessment, as it increasingly
becomes the last priority in busy schedules, larger classes and especially when it involves
developing a series of teaching materials (Duschl & Gitomer, 1997). Formative
assessments delivered electronically require a substantial investment in terms of time,
energy and other resources to develop initially. This investment of time can be offset
against:
• Modest time for delivery (self-access and computerised results);
• Reduction in human effort in the long run by automating question presenta tion;
• Marking;
• Consistency by removing inter marker variation – student numbers are ever increasing
  with approximately 90% increase over the last two cohorts (see Figure 1);
• Providing instant feedback to students;
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Successful formative assessments can be used as a tool to focus the development of support for student learning by linking the principles of assessment, engagement in learning, and provision of timely, informative feedback. This can be achieved if various assessment conditions are taken into account as a process of dynamic practice (see Table 1).

**Rationale**

The present structure, or framework, employed in this institution provides the students with definite structure to their studies and so providing a window of opportunity for candidates to achieve their educational goals. The rationale for this study originates from the institution’s engagement in developing the STEM (Science Technology, Engineering and Mathematics) agenda that is in-line with UK government policy for further and higher education. The main mission statement of this university is to widen participation by including a broad range of students from all backgrounds and thereby increasing the accessibility of science in higher education. This course Science Extended Degree (SED) has a wide and diverse intake, comprising of roughly 50% traditional entry qualifications (AS/A level) with the remaining students having a range of vocational qualifications. Over two-thirds of

<table>
<thead>
<tr>
<th>Table 1. Assessment conditions (Brown, Gibbs, &amp; Glover, 2003).</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Student learning is best supported when the following conditions are met:</em></td>
</tr>
<tr>
<td>Assessed tasks capture sufficient student time and effort</td>
</tr>
<tr>
<td>These tasks distribute student effort evenly across topics &amp; weeks</td>
</tr>
<tr>
<td>These tasks engage students in productive learning activity</td>
</tr>
<tr>
<td>Assessment communicates clear and high expectations to students</td>
</tr>
<tr>
<td>Sufficient feedback is provided, often enough &amp; in enough detail</td>
</tr>
<tr>
<td>The feedback is provided quickly enough to be useful to students</td>
</tr>
<tr>
<td>Feedback focuses on learning rather than on marks or students</td>
</tr>
<tr>
<td>Feedback is linked to the purpose of the assignment and to criteria</td>
</tr>
<tr>
<td>Feedback is understandable to students, given their sophistication</td>
</tr>
<tr>
<td>Feedback is received by students and attended to</td>
</tr>
<tr>
<td>Feedback is acted upon by students to improve their work or their learning</td>
</tr>
</tbody>
</table>

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the year group are female. In respect to age profile over 25 and 55% of the students are 21–24 and under 20 respectively. There is wide ethnic diversity (see Figure 2). This is typical of students recruited from this geographic location.

Over the past decades, there has been consistent growth in terms of student numbers, and currently, the course attracts over 350 students and about 14% join the year group in the February entry programme (see Figure 1).

The university incorporates an intranet system available for teaching and learning to both staff and students and with an integrated virtual learning environment (VLE) – WebLearn. This flexible VLE allows educators to import learning materials for students in many forms; PowerPoint presentations, text documents, animations, videos, audio tracks, weblinks, etc. In this study, one of the main features used on WebLearn is the process of building learning modules that are linked to related areas of the curriculum. This approach enables assessments to be used as linking tools. The process adopted enables a level of self-paced learning and may also be tailored on an individual basis allowing, for example, students with severe disability to bypass some criteria to enable them to access materials that would otherwise be restricted. The institution employs similar systems of a VLE on biology modules for the first year of the SED. The SED offered at the university is one of the major feeder routes into science degrees at the institution and is also one of the largest courses of its type offered nationally. In this study we will evaluate the engagement of students with the VLE enhancements.

**Utilisation of the VLE**

The SED programme consists of eight modules, two of which are biology. The biology modules run sequentially and employ teaching methods that are supported heavily by the VLE. A book compiled in-house, by two of the authors, specifically designed for these modules was adopted as the core text for the biology course and each week one chapter is covered in the lecture slot (Bax, Botey Salo, & Jacoby,

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Material supplied with the book (e.g. lecture slides, formative assessments, learning objectives, notes, and images) is transferred manually onto the VLE. Each module on the VLE contains a series of learning modules that include all the material relevant to each chapter/lecture.

Formative assessments contained within each learning module consist of 10 multiple-choice questions for which the students must achieve a minimum pass mark of 40% in order to open the next learning module in the series. Only the first learning module in the series is open for all students to access unless recognised disabilities requires otherwise. Each formative assessment contains a bank of 40–60 multiple-choice questions that have been graded as easy, with some medium included. These formative assessments are complimented by the core text and therefore give the students an appropriate and reliable resource. The formative assessments were structured so that the students are able to have unlimited attempts and an unlimited amount of time to complete each assessment. Each time the candidate begins a new formative assessment 10 questions are taken from the question bank that has been further subdivided into chapter categories to maintain topic equality in the questions selected. If the students continue to use this assessment tool then the bank of questions will be exhausted. This normally amounts to about 20 attempts on average; so there should be ample opportunity for the students to successfully complete the exercise.

As there is no time limit it is also possible for the students to leave an assessment without completing it and return at a later time (unlimited) to pick up where they have originally left off. This aspect of flexibility is important with the cohorts of students that have become the mainstay at the institution (- 45% are classed as mature students) as they often have other commitments and this enables them to fit short bursts of activity or interruptions into their lifestyles. The unlimited time allowance also encourages students to use resources available on hand, primarily the core text, to select an answer and hence minimising the stress of a limited time-frame. Staff on the programme strongly encourage the use of both the VLE material and the core text in order to complete formative assessments as this aspect is regarded as an invaluable comprehension and study skills exercise (Bax et al., 2010).

The majority of materials used on the VLE from the core text provide the students with consistency within the developmental framework of acquiring and/or enhancing study skills. Each time the students submit a completed formative assessment and they are rewarded with instant feedback, as the work is instantaneously marked and available containing any appropriate corrections.

The present delivery of electronic assessments and feedback, with parameters as indicated in Table 2, enables tutors the opportunity to identify who has or has not accessed the material. When further feedback is required emails are sent to students on the basis of how many formative assessments have been completed and passed. Those students who are up-to-date receive an email of congratulations and encouragement for progress attained. Alternatively, candidates who have fallen behind are given a gentle reminder and offered assistance should this be required.

Unlike formative self-assessments that include weekly quizzes, summative assessments in these two biology modules occur as progress tests twice for each module. Summative assessment is presented randomly from the formative assessment questionnaires as 20 multiple-choice questions for which the students receive a time limit of 30min. The system is set in such a way that each student will receive a unique set of 20 questions (although the same number of questions from

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each topic). This has the effect of reducing opportunity for academic misconduct during the assessment.

**Evaluation of VLE material**

**Questionnaire**

A questionnaire was given anonymously through WebLearn to students at the end of each module to assess engagement and student satisfaction feedback. The questionnaire consisted of three simple and similar statements regarding the following: lectures, tutorials, and formative assessment on WebLearn. Firstly the students were asked to ‘score’ each of the statements. The statements are reproduced here:

- On a scale of 1–5 (with 5 being the best) how helpful have you found the lectures?
- On a scale of 1–5 (with 5 being the best) how helpful have you found the tutorials?
- On a scale of 1–5 (with 5 being the best) how helpful have you found the formative assessments?

Extra space was provided after the statements for the students to note any further comments.

The comments made by students were read and evaluated in relation to responses being positive, negative or neutral towards the formative assessment. It was assumed that the students who made no comment were not dissatisfied by the assessment task or did not engage with the VLE. Tabulated responses for the formative assessments statement appear in Figure 3.

The results (responses from about 280 students) show that the students were positive towards formative assessment. Feedback for Biology 2 was, however, slightly more positive than for Biology 1 but this could be attributed to the students becoming acquainted with this style of assessment. It is apparent that students in Biology 1 require more time to realise the value of the assessment and the response in Biology 2 (a score of five) was increased by approximately 15%.

Participation from the wide and academically diverse nature of these students needs to be considered when designing assessment profiles. A significant proportion of the student group has often been alienated by formal education due to process and this has invariably impaired their learning process (Case, 2008). It is viewed from the overall response received from the student feedback questionnaire that the development of a framework encourages student engagement and promotes an active learning environment. With the development of the VLE in the institution, its

---

![Table 2. Parameters on the SED effective learning model.](image-url)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time restraint</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Feedback</td>
<td>Formative assessment result on completion/submission accompanied by the correct response where appropriate</td>
</tr>
<tr>
<td>Attempts</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Date gate</td>
<td>None</td>
</tr>
<tr>
<td>Incentive</td>
<td>The next weeks’ material was made available on a ‘pass’</td>
</tr>
<tr>
<td>Pass mark</td>
<td>40%</td>
</tr>
</tbody>
</table>

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use has become more important to effectively broaden the students exposure to learning materials by adopting a blended learning approach and this is consistent with the views of others (Bax et al., 2006).

**Distribution of marks**

As can be seen in Figure 4, with the introduction of the weekly electronic formative assessments the pass mark remained largely unchanged but the number of students receiving a higher mark increased by approximately 20%; especially migration into grade A of achievement.

**Formative assessment**

The data (see Figure 4) show an increase in the uptake of the formative assessments during the year and a slight increase in the marks achieved for the formative assessments. This could be attributed to the students realising the reward of having the opportunity of seeing all of the questions in the question bank if enough time and effort is put into the weekly formative assessments. The results also demonstrate similar levels of student engagement for both biology modules (about 70%) with pass rates in the 66–72% range. The combination of increased higher grades (see Figure 5) and a high uptake of formative assessment (see Figure 4) can be linked directly to an increase in student engagement.

**Discussion**

Claus Brabrand states, ‘How can we make sure our students learn what we want them to?’ (Brabrand, 2007, p. 1). In answering this question the theory of constructive alignment as proposed by John Biggs was considered. He states, ‘the learner constructs his or her own learning through relevant learning activities’ (Biggs, 1996). Biggs describes teaching as a dynamic process in which the teacher must
Figure 4. Percentage of students attempting all formative assessments compared with those who also subsequently passed the module.

Figure 5. Distribution of FA Marks for the SED (comparison between 2008/9 & 2009/10).

continually evolve to address or incorporate the changing learning styles of the students and hence make the teaching style not only engaging but also effective. Thus the constructive alignment model relates to what the student learns whereas

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constructive in this context relates to what the student constructs from the material learnt and the knowledge the teacher imparts onto the student. How effectively this is achieved is referred to as alignment. The effective learning model presented here could be regarded as an example of the alignment model previously given (Biggs, 2003; Biggs & Tang, 2007). Significantly in this study, students received instant feedback and further direction to improve their learning. Initially setting up reliable, high-quality assessment content is time consuming, and can prove difficult but once loaded onto a virtual learning system they can form a bank of questions and other material of which the content can be continually monitored, adjusted and expanded should this be required. This repository can allow lecturers to set up an assessment by selection and ordering pre-formulated questions. The VLE model described here seems to be of major benefit to students as a learning tool. The response to the questionnaires submitted by students provides a useful indicator to the validity of the VLE that they and the staff use. The overriding student attitude towards the VLE indicates that they increasing engage with their subject as they progress through the academic year. This is corroborated by the system of formative assessments that show an overall upward increase in marks, especially at the higher end (see Figure 5). As the pass rates remained relatively unaltered it could be viewed that the VLE has a low impact directly on the teaching process but enhances the learning process and student engagement. Similarly, a high school study was conducted whereby the students were tested regularly and required to pass with a minimum of 90% to proceed to the next topic (Whiting, Van Burgh, & Render, 1995). The findings were positive showing that time spent on the test was decreased as the course progressed and there was a positive attitude swing towards learning shown by the students. For our cohort we have been using a pass mark of 40% in order to encourage them to progress onto the next learning module. If this pass mark were to be increased from 40%, students may disengage from the assessment process. Raising the pass mark during the semester by increments (i.e. 5% fortnightly) and observing the outcomes may prove a useful trial for a future investigation. Formative assessment was also found to have the added benefit of allowing the students to practise their comprehension of the course material and to gain familiarity with the language in which it is written. This is of paramount importance as once the students reach degree level the skill of reading appropriate text is an assumed one. Due to the anonymity of the measuring in the assessment profile carried out with respect to this evaluation, it is not possible at this time to determine factors including gender and ethnicity that influence assessment profiles and performance. As noted in Figure 5 (cohort total over 350), students are engaged in the process and the outcome clearly demonstrates that the formative assessment is currently having a positive impact on students in terms of participation and the learning strategies that we have successfully developed. From our experience based on student academic background and diversity student limitation in Biology is often lacking. Hence, the provisions of a given text book linked to information and communications technology (ICT) formative and summative assessments provides an accessible platform for students to respond to the many challenges they have in achieving success at an ever increasing financial cost.

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Conclusion

The actual achievement that students get from study will be determined by their own
engagement with the material. A determined student will make an effort to engage regardless of the material provided but the effort can be more directed with a VLE approach. We have demonstrated that this process of blended learning has both engaged and enhanced the student learning experience which has resulted in a trend towards higher grades overall. Here, we have provided an environment whereby student data can be gathered and analysed to identify student engagement. The process described enables academic staff to blend both formative self-assessments together with summative outcomes.

Finally we believe that this ICT approach builds upon a previous study that evaluated student learning based on an assessment (Bax et al., 2006). The framework, as outlined, increases engagement and confidence by giving the responsibility for learning to the student. We have developed a new model that engages alignment with assessment and relates to a modern learning environment so meeting students’ needs. This formula could be used in the future as the basis for creating distance-learning modules for the sector as a whole to share.

Notes on contributors

Jennifer C. Jacoby is a senior lecturer at London Metropolitan University where her primary responsibility is for teaching on the sciences extended degree programme. She has an interest in widening participation of a broad range of students from all backgrounds and increasing the accessibility of science in higher education by the development of a framework to encourage engagement of the extended degree students. She actively promotes these practices to ensure all students have the best possible chance of succeeding in their studies. Her science research interest is nucleotide signalling in renal transplant recipients.

Sheelagh Heugh is a principal lecturer at London Metropolitan University in Biomedical Sciences. Her research interest is in erythrocyte stability and activity at 0°C, erythrocyte microparticle evaluation and investigation of potential physiological role. She is currently completing a professional doctorate in L&T and her interest lies in e-learning and blended learning tools for the enhancement of student experience and outcomes.

Christopher Bax is a principal lecturer at London Metropolitan University and is the course leader for the SED. His other interests include transport studies in trophoblast cells, osteoblast cell signalling and sickle cell disease.

Christopher Branford-White is an emeritus Professor at London Metropolitan University and former director for the Health Institute at London Metropolitan University. His research interests are wide and include the following:

1) Influence of diet on children infected with HIV/AIDS.
2) Isolation and characterisation of natural products from plants for pharmaceutical purposes (with CENSA, Cuba and Shanghai University of Traditional Chinese Medicine).
3) Health inequalities and the delivery of health delivery strategies (with Constanza University, Romania, Cujae, Cuba).
4) Widening participation and access into science through health (with University of Plymouth).
References


Individualised learning pathways in BlackBoard 9.1

Sheelagh Hough & Juli Le Page-Pezet
9th July 2013

What are ‘Individualized learning pathways’?
• Self selected route through module
• Developed from quizzes that assess prior understanding
• Leads to:
  – More basic material – if poor understanding (<50%)
  – Releases the next module areas (~>50%)
  – Additional enhancement material (~>80%)

Folders
• In order to accommodate individualized learning pathways the folder system within the VLE has to be utilized in a specific way
• Learning modules do not support the functionality
• Personalized learning pathways have been set up for demonstration in "Test Folder"

Contents of Test Folder
Logged on as an instructor user the contents of Test Folder include:
• An initial content item describing proteins
• A compulsory formative assessment MCQ on the basics of proteins
• Two lectures with advanced materials on proteins with Haemoglobin specific info
• A ‘What are proteins’ internet link
Bridging the gap: bringing virtual students into the physical class

"Bridging the gap: bringing virtual students into the physical class"
Sheelagh Heugh, Sean Frost and Shara Lochan
8th July 2014 L&T conference

Student tutorials – enhancing engagement

Objectives
- Provide support tutorials and re-engage students on disapproved blended learning courses
- Provide staff support and training

Key metrics
- Number of student target group attended examples A-150, B-140, C-150
- C/S 4: Staff: eight
- Number of sessions Group A – 1, Group B – 1 and Group C - 1
- What tools did you use? Webinar, Online, Pan, Whiteboard, Breakout rooms and conventional style

SURPRISING
- Enthusiastic uptake

CHALLENGING
- Recording rendering. Transcript for Deaf Student.
- Technical problems for participants

WHAT WOULD EXPAND
- Utilise the plan tool. More (isa) and whiteboards (students)

OUTCOMES
- Student performance improved on BS6002 final exam.
- Full engagement for all DL students
- Student feedback
  - Positive comments and wanted further sessions
  - Teachers feedback
  - Positive feedback. Very simple to use. Would have liked more tables to learn the book more profitably. Enjoyed the large tutorial where we interacted, as well as the students.

BS6002 Final Exam

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. students</td>
<td>153</td>
<td>149</td>
</tr>
<tr>
<td>Success rate (%)</td>
<td>88.56%</td>
<td>87.58%</td>
</tr>
<tr>
<td>Total numbers</td>
<td>17</td>
<td>156</td>
</tr>
</tbody>
</table>

- Student engagement – e.g. 6/4/156 students joined live version B06002
- Student retention – esp. for DL students

Examples of collaborate activities

- Teaching morphology
- Interactive tutorial (Ab 4) allowing students to work in breakout rooms
- The recorded tutorial delivered by two tutors for students to review in their own time
- Revision tutorial for level 6 students

16/11/2014
Appendix B

VLE background information

Table B.1 Common VLE (HE and School) provision in the UK in 2014

<table>
<thead>
<tr>
<th>VLE</th>
<th>Official Website</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackboard</td>
<td><a href="http://uki.blackboard.com/sites/international/globalmaster/">http://uki.blackboard.com/sites/international/globalmaster/</a></td>
<td>Licence and hosting costs</td>
</tr>
<tr>
<td>Moodle</td>
<td>moodle.org</td>
<td>Open source. A hosting charge if required</td>
</tr>
<tr>
<td>Frog</td>
<td>frogtrade.com/</td>
<td>Licence and hosting costs</td>
</tr>
<tr>
<td>OLAT</td>
<td><a href="http://www.olat.org">www.olat.org</a></td>
<td>Open source. Commercial support/external hosting available</td>
</tr>
<tr>
<td>RM Unify</td>
<td><a href="http://www.rm.com/home">http://www.rm.com/home</a></td>
<td>Licence and hosting costs (Cloud based)</td>
</tr>
<tr>
<td>LP +</td>
<td><a href="http://www.learningpossibilities.net/">http://www.learningpossibilities.net/</a></td>
<td>Licence and hosting costs (Cloud based)(Schools focus)</td>
</tr>
<tr>
<td>Fronter</td>
<td><a href="http://www.fronter.co.uk/">http://www.fronter.co.uk/</a></td>
<td>Licence and hosting costs (Schools focus)</td>
</tr>
<tr>
<td>Study Wiz</td>
<td><a href="http://www.apac.studywiz.com/">http://www.apac.studywiz.com/</a></td>
<td>Licence + Server</td>
</tr>
<tr>
<td>Canvas Instructure</td>
<td><a href="http://www.canvaslms.com/higher-education/">http://www.canvaslms.com/higher-education/</a></td>
<td>Open Source, Commercial/AGPL</td>
</tr>
<tr>
<td>Pearson eCollege</td>
<td><a href="https://onlinelearning.rutgers.edu/ecollege">https://onlinelearning.rutgers.edu/ecollege</a></td>
<td>Licence and hosting costs</td>
</tr>
</tbody>
</table>

Adapted and enhanced from the survey at edugeek.net forums and UCISA 2014 survey (Walker, et al., 2014). As cited in UCISA survey 2014 Blackboard Learn is still the most used virtual learning environment (VLE) in HE or enterprise, followed by Moodle, usage for both has increased since the 2012 Survey as enterprise solutions. The prevalence of Blackboard was enhanced due to the migration of former WebCT clients to this platform. Moodle remains the most commonly used VLE platform, when departmental/ school implementations are also considered. There is a lower level of Adoption of other commercial and open source platforms, although Canvas Instructure and Pearson eCollege (Learning Studio) appeared for the first time in the 2014 survey. MOOC platforms such as the FutureLearn platform may become more popular in future (Walker, et al., 2014).
Appendix C

Self and peer assessment form

Please enter your assessment of the group work assignment for **yourself** and your group

<table>
<thead>
<tr>
<th>Your Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your Group No:</td>
</tr>
<tr>
<td>Title:</td>
</tr>
</tbody>
</table>

**Section A: Group member performance and contribution**

**Scale:**

- 3 = Excellent/Outstanding
- 2 = More than Satisfactory
- 1 = Satisfactory
- 0 = Less than satisfactory

In the following table insert one number between 0 and 3 in relation to each person's efforts

<table>
<thead>
<tr>
<th>Question</th>
<th>Group Members (insert names of your group starting with yourself) below</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of contribution</td>
<td></td>
</tr>
<tr>
<td>Quality of research</td>
<td></td>
</tr>
<tr>
<td>Enthusiasm as group member</td>
<td></td>
</tr>
<tr>
<td>Communicate ideas</td>
<td></td>
</tr>
<tr>
<td>Regularly attends meetings</td>
<td></td>
</tr>
<tr>
<td>Participates actively and does their share of the work</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>Uses creative problem solving techniques</td>
<td></td>
</tr>
<tr>
<td>Actively listens to other members</td>
<td></td>
</tr>
<tr>
<td>Uses appropriate time and task management</td>
<td></td>
</tr>
<tr>
<td>Help set goals and keep timetables</td>
<td></td>
</tr>
<tr>
<td>Gives constructive feedback</td>
<td></td>
</tr>
<tr>
<td>Responds well to feedback and criticism</td>
<td></td>
</tr>
<tr>
<td>Good at helping quiet team members participate fully</td>
<td></td>
</tr>
<tr>
<td>Does not dominate meetings</td>
<td></td>
</tr>
<tr>
<td>Good at not letting anyone else dominate meetings</td>
<td></td>
</tr>
<tr>
<td>Good at summarising the progress the group has made</td>
<td></td>
</tr>
<tr>
<td>Comfortable with constructive disagreements</td>
<td></td>
</tr>
<tr>
<td>Helps minimize group conflict</td>
<td></td>
</tr>
</tbody>
</table>

**Section B: Personal reflection**
Delete alternatives to leave response you require

1. Overall, how effectively did your group work together on this project/task/assignment?

<table>
<thead>
<tr>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Extremely Well</th>
</tr>
</thead>
</table>

2. How many members were allocated to your group

<table>
<thead>
<tr>
<th>Number</th>
</tr>
</thead>
</table>

285
3. Out of the group members, how many participated actively most of the time?
   Number

4. Out of the group members, how many were fully prepared for the activity?
   Number

5. Give one specific example of something you learned from the group that you probably wouldn’t have learned working alone.

6. Give one specific example of something the other group members learned from you that they probably wouldn’t have learned otherwise.
7. Suggest one change the group could make to improve its performance.

8. Suggest any changes to the coursework that would improve this for future groups.

Section B - Reproduced and adapted from Angelo & Cross (1993), p350.
Appendix D

Blackboard Collaborate: A survey of the student experience

Recently you had the opportunity to take part in a virtual (online) tutorial or workshop using Blackboard Collaborate. We are very interested to find out what your experience of Blackboard Collaborate was like, or, if you didn't use it, to understand why this might have been the case.

We would very much appreciate it if you would spend a little time completing this short survey about your experiences. This will help us to determine whether we should try to use this technology more widely in the future, and, if so, how we should use it and what we need to do to make it the best possible experience for our students.

Most of the questions require you to choose one or more answers from a suggested list. A couple of questions invite you to tell us things in your own words. The survey should take you no more than 10 minutes to complete.

Your responses will be combined with the responses of other students. These combined data will be analysed and summarised in ways which help us to understand how the group of students to which you belong felt about the use of the Blackboard Collaborate tool. We would also like your permission to use any written comments that you make, as your own words are the best way for us to share with and explain to others how you as a group felt. If we used your words, they would not be linked to anything that could be used to identify you as an individual. No one will be able to tell what your individual responses were: all of your answers are anonymous and will be kept confidential.

If you would like to ask any questions about this survey before completing it, please email Shara Lochun (s.lochun@londonmet.ac.uk) or Sheelagh Heugh (s.heugh@londonmet.ac.uk) before taking part.

If you are happy that you have understood what we have told you above, and you would like to take part in this survey, please click the "I am happy to take part" button below.

If you do not wish to take part, please click the 'I do not wish to take part’ button below.

* I am happy to take part
* I do not wish to take part.

This survey will close at midnight on Sunday 6th July 2014.
To help us to understand the responses that you give, we would like to know a little bit about you.

Please tell us which course or module you are in (tick one):
* MSc students
* BS6002
* BS5001

How comfortable do you feel with engaging in online environments (for example, online shopping, social media)?
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Comfortable and Extremely Uncomfortable

How comfortable do you feel using WebLearn as a tool for accessing and interacting with your learning materials?
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Comfortable and Extremely Uncomfortable

Were you aware that the online tutorial / workshop was happening before it happened? (pick one answer)
* Definitely Yes, I knew it was going to happen before it happened
* Definitely No, I missed this information entirely
* No, but I found out right at the last minute (for example, just before or after it started)
* I was aware of the tutorial / workshop, but not that it was online
* I was aware of something happening online, but I wasn't sure what it was
* None of the above

What did you think of the instructions that you were given about how you could join in with your online tutorial / workshop? (tick one answer for each scale below)
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Clear and Extremely Unclear
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Helpful and Extremely Unhelpful
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Detailed and Extremely Vague

What would you suggest to improve them for students in the future?
* Couple of lines for free response

Did you feel prepared for engaging with the tutorial / workshop before it started?
* 7-point scale (seven 'click in' circles?) with ends labelled as I Felt Very Prepared and I Felt Very Unprepared

What caused you to feel this way?
* Couple of lines for free response

Have you tried to access ...? (tick all that apply)
* the live session only
* the recording of the session only
* both the live session and the recording
* neither the live session nor the recording

How many times did you engage with these tutorials / workshops? (You should count both accessing the live class, and each time that you accessed the recording)
* never
* 1 time
* 2 - 3 times
* 4 - 5 times
* 6 or more times

How easy did you find it to access the Blackboard Collaborate room?
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Easy and Extremely Difficult
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either pick one choice from the scale or to click the not applicable answer, but not both.

How easy did you find the tutorial was to interact with once it started? (live attendees only)
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Easy and Extremely Difficult
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either pick one choice from the scale or to click the not applicable answer, but not both.

If you didn't try to access the live session, can you please tell us why you didn't?
* (free response - a couple of lines to type on?)

If you didn't try to access the recording, can you please tell us why you didn't?
* (free response - a couple of lines to type on?)

What did you like best about your Blackboard Collaborate experience?
* (free response - a couple of lines to type on?)
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either write free text or to click the not applicable answer, but not both.

What did you like least about your Blackboard Collaborate experience?
* (free response - a couple of lines to type on?)
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either write free text or to click the not applicable answer, but not both.

Did you find that you had to make any changes or updates to your computer in order to access the Blackboard Collaborate room?

* Yes (please detail what you remember below)
* No, I didn't need to make any changes or updates
* I don't remember
* Not applicable: I didn't access the Blackboard Collaborate room

If yes, what?
* Couple of lines for free response

Did you need help setting up the system?
* Yes
* No

If Yes what did you need help with? (please tick all that apply)
* Setting my connection speed
* Installing or updating the Java software
* Setting up or using hardware – for example, microphone, webcam
* Other

Did you need to buy or borrow any additional hardware (for example, webcam, microphone, headphones) in order to engage with this tutorial fully?

* Yes (please detail what you remember below)
* No, I didn't need to make any changes or updates
* I don't remember
* Not applicable: I didn't access the Blackboard Collaborate room

If yes, what?
* Couple of lines for free response
If you purchased hardware, was this something that you are likely to have bought within the next 6 months anyway?

* Yes, I would have been likely to buy this within the next 6 months anyway
* No, I would not have bought this hardware for any other reason
* Not applicable: I didn't buy any hardware

If you borrowed hardware, is this something that you are likely to be able to borrow regularly in the future?

* Yes, I would probably be able to borrow this hardware whenever I needed it
* No, I don't think that I would be able to keep on borrowing this hardware in the future
* Not applicable: I didn't borrow any hardware

How engaged did you feel in this online tutorial / workshop compared with your experience of a face-to-face tutorial (Campus-based students) or a non-Collaborate online tutorial (distance-learning students)?

* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Engaged and Extremely Disengaged
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either pick one choice from the scale or to click the not applicable answer, but not both.

Did you feel that you got the information from the tutorial that you wanted?

* Yes, it exceeded my expectations
* Yes, it met my expectations
* No, it was below my expectations
* Not applicable: I have not accessed the Blackboard Collaborate room

Did you like your online tutorial more or less than a traditional face-to-face one?

* 7-point scale (seven 'click in' circles?) with ends labelled as Significantly More and Significantly Less

Do you think that you contributed more, less or about the same as you would in a traditional face-to-face session?

* 7-point scale (seven 'click in' circles?) with ends labelled as Significantly More and Significantly Less

Do you think that this Blackboard Collaborate session helped to improve your understanding of the topics included in your module or course?

* 7-point scale (seven 'click in' circles?) with ends labelled as Definitely Yes and Definitely No
At the end of the tutorial, did you feel that you could do better in your exam or coursework compared to how you felt before the tutorial?
* 7-point scale (seven 'click in' circles?) with ends labelled as Definitely Yes and Definitely No

What did you think of the following specific parts of the tutorial? (please choose one answer for each tutorial element)

<table>
<thead>
<tr>
<th>*</th>
<th>liked it</th>
<th>didn’t like it</th>
<th>didn’t try it</th>
<th>don’t remember it</th>
<th>it wasn’t there</th>
</tr>
</thead>
<tbody>
<tr>
<td>push document</td>
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<td>whiteboard</td>
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<td>quiz</td>
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<td>polling</td>
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<tr>
<td>being able to see images related to what the tutor was talking about (e.g., PowerPoint slides, mind maps)</td>
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<td>being able to see the tutors as static pictures?</td>
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<td>Being able to see the tutors as video clips?</td>
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<td>Being able to ask questions without everyone knowing who you were?</td>
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<td>Being able to respond to the questions asked by your classmates?</td>
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</tbody>
</table>

How valuable did you find the opportunity to be able to view the whole event again after the live event had finished? (live attendees only)
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Valuable and Not at all Valuable
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either pick one choice from the scale or to click the not applicable answer, but not both.

How valuable did you find the opportunity to be able to scroll up and down the conversation (either during the live tutorial or during a replay)?
* 7-point scale (seven 'click in' circles?) with ends labelled as Extremely Valuable and Not at all Valuable
* an additional click box option labelled 'Not applicable: I have not accessed the Blackboard Collaborate room'. Ideally respondents should be able to either pick one choice from the scale or to click the not applicable answer, but not both.
If your had more Blackboard Collaborate sessions in your course, do you think it would make you more likely to attend (online) than having the equivalent face-to-face classes?
* 7-point scale (seven 'click in' circles?) with ends labelled as Yes and No

Would you like Blackboard Collaborate to be incorporated into your other modules?
* 7-point scale (seven 'click in' circles?) with ends labelled as Yes and No

Would you like to use Blackboard Collaborate to work with other students on group projects?
* 7-point scale (seven 'click in' circles?) with ends labelled as Yes and No

Would you like to use Blackboard Collaborate to have supervision and other meetings with staff?
* 7-point scale (seven 'click in' circles?) with ends labelled as Yes and No

Are there any other comments that you would like to make about your Blackboard Collaborate experience?
* Couple of lines for free response

**Blackboard Collaborate: A Survey of the Student Experience**

Thank you for taking part or considering taking part in our survey about Blackboard Collaborate.

*Please print and keep a copy of this page for your records.*

We will be using the results of this study to understand how our students felt about the use of the Blackboard Collaborate tool in their modules, and to consider whether we should introduce Blackboard Collaborate more widely.

We will be sharing the findings of this survey with other staff at LondonMet, as well as will staff at other Universities and at Blackboard who are interested in what you thought of Collaborate. No one will be able to tell what your individual responses were: all of your answers are anonymous and will be kept confidential.

If you would like to know the results from this survey once the data are analysed, please contact either Shara Lochun (s.lochun@londonmet.ac.uk) or Sheelagh Heugh (s.heugh@londonmet.ac.uk) by July 15th 2014.

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