PRESENT and FUTURE

CHALLENGES for E-LEARNING

in DENTISTRY

by

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DEDICATION

Dedicated to my husband and

children

ABSTRACT

Aims: The aim of this study was to explore the potential and challenges for e-learning in dental education using a case-study approach.

Methodology: The University of Birmingham, School of dentistry, e-learning platform "e-course", was assessed at four stages. The attitudes of third year dental students towards an online orthodontic e-course were assessed to explore students' learning needs using a five Likert-scale questionnaire. The different tools and components on the e-course were explored to assess its technical and instructional efficiency using descriptive analysis. The Prosthetic discussion archive was analysed for its efficiency to support a higher-level of teaching and learning using content analysis. Dental students and academic teachers were interviewed using one-to-one interviews and focus groups. Their attitudes towards e-learning in dentistry were analysed for emerging themes in three main categories; technological, pedagogical, and curriculum design.

Result: E-learning has shown great potential in supporting change to dental education. There are differences between students and teachers. Students are enthusiastic in its use, whilst teachers have many concerns on its implementation related to work load and use of information.

Conclusion: E-learning has a great potential in supporting curriculum reform in dental education, but is not fully utilised. Institutional strategies and support together with strong leaderships is needed when implementing e-learning into a dental school.

DECLARATION

I hereby declare that the work presented in this thesis has not been submitted in support of an application for another degree or qualification of this or any other University or Institute of Learning.

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PREFACE

The work of this dissertation has been undertaken over the last four years (September 2006 – July 2010) in the University of Birmingham Dental School. During this period some of the materials in this paper has been published and presented to scientific meetings.

Published Papers

Students' attitudes towards an on-line orthodontic learning resource
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Published in the European Journal of Dental Education, (2009); 13; 87–92.

Online Discussion Boards in Dental Education: Potential and Challenges
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Accepted for publication in June 14th 2010 in the European Journal of Dental Education (in press).

Oral Presentations

Online Discussion Boards in Dental Education: Potential and Challenges
A. Linjawi, A.D. Walmsley, and K.B. Hill
University of Birmingham, Birmingham, United Kingdom
BSDR - British Society for Dental Research; Glasgow Caledonian University, Glasgow, UK, from 2 – 4 September, 2009 (Number 124901).

Poster Presentations

Students' Attitudes towards an On-line Orthodontic Learning Resource
A.I. Linjawi[1], A.M. Hamdan[2], D.G. Perryer[3], A.D. Walmsley[3], and K.B. Hill[3]
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PEF IADR – PEF International Association for Dental Research; Queen Elizabeth II Conference Centre, London, UK, from September 10 - 12, 2008 (Number 723).

Encouraging Reflective Learning Using Online Discussion Board in Dental Education
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University of Birmingham, Birmingham, United Kingdom
ADEE – Association for Dental Education in Europe; 35th Annual Meeting, Helsinki, Finland, from 26 - 29 August 2009.

The author of this thesis has also been awarded two certificates in Online Learning from McWeadon Education, an Education Unit of BK Global Ltd, USA;

1. ***E-learning Certificate Program***, covering the following courses;
    - E-learning Instructional Design
    - E-learning Instructional Development
    - Motivating and Retaining Online Students
    - E-learning Evaluation
2. ***Virtual World in Education and Training Certificate Program***, covering the following courses;
    - Getting a Second Life
    - Exploring Your Second Life
    - Settling into Your Second Life
    - Instructional Design for Second Life

GLOSSARY

Terms	Definitions
Asynchronous interaction	Learning in which interaction between instructors and students occurs intermittently with a time delay. Examples are self-paced courses taken via the Internet or CD-ROM, Q&A mentoring, online discussion groups, and email.
Blended Learning	Learning events that combine aspects of online and face-to-face instruction.
Blogs	The term "blog" is an abbreviation of "web log". An extension of the personal Website consisting of regular journal-like entries posted on a Webpage for public viewing. Blogs usually contain links to other Websites along with the thoughts, comments, and personality of the blog's creator.
Discussion boards	Forums on the Internet or an intranet where users can post messages for others to read. The list of posts that form the original statement and all the responses to it is called a **thread**.
E-learning 2.0	Refer to new ways of thinking about e-learning inspired by the emergence of Web 2.0.
Learning management system (LMS)	A software application (or set of applications) that manages the creation, storage, use, and reuse of learning content.
Netiquette	Online manners, short for network etiquette. The rules of conduct for online or Internet users.
Open Source Software (OSS)	1) Software for which the original programme instructions, the source code, is made available so that users can access, modify, and redistribute it. The Linux operating system is an example of open source software. 2) Software that meets each of nine requirements listed by the non-profit Open Source Initiative in its Open Source Definition.
Pedagogy	The term generally refers to strategies of instruction, or a style of instruction.
Podcast	A series of digital-media files which are distributed over the Internet using syndication feeds for playback on portable media players and computers.

Term	Definition
Sharable Content Object Reference Model (SCROM)	A set of specifications that, when applied to course content, produces small, reusable learning objects. A result of the Department of Defence's Advance Distributed Learning (ADL) initiative, SCORM-compliant courseware elements can be easily merged with other compliant elements to produce a highly modular repository of training materials.
Social networking	Uses software to build online communities of people who share interests and activities or who are interested in exploring the interests and activities of others. Most services are primarily web-based and provide a collection of various ways for users to interact, such as chat, messaging, email, video, chat, file sharing, blogging, and discussion groups.
Standard	An e-learning specification established as a model by a governing authority such as IEEE or ISO to ensure quality, consistency, and interoperability.
Synchronous interaction	A real-time, instructor-led online learning event in which all participants are logged on at the same time and communicate directly with each other. In this virtual classroom setting, the instructor maintains control of the class, with the ability to "call on" participants. In most platforms, students and teachers can use a whiteboard to see work in progress and share knowledge. Interaction may also occur via audio- or videoconferencing, Internet telephony, or two-way live broadcasts.
Web 2.0	The use of Internet technology and web design to enhance information sharing and, most notably, collaboration among users. These concepts have led to the development and evolution of web-based communities and hosted services, such as social-networking sites, wikis, and blogs.
Wikis	A collection of web pages designed to enable anyone who accesses it to contribute or modify content, using a simplified mark-up language. Wikis are often used to create collaborative websites and to power community websites.

Note: All definitions are taken from The American Society for Training and Development, E-learning Glossary http://www.astd.org/LC/glossary.htm (ASTD, 2009).

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SECTION ONE

INTRODUCTION

Chapter 1

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 Introduction

Dental education is undergoing changes to help it face a competitive future (Haden *et al.*, 2006; Swift, 2008). There is also evidence of constant innovation and changing approaches to electronic teaching and learning in dental education. A major part of that change has been brought by the widespread introduction and use of 'virtual learning environments – VLEs' (Shah and Cunningham, 2009).

Much of the dental literature on VLEs has concentrated on students' experience towards such innovations (Mattheos *et al.*, 2001; Gupta *et al.*, 2004; Welk *et al.*, 2006; Engilman *et al.*, 2007; Zary *et al.*, 2009). However, there is still a lack of good evidence to support e-learning in the development of a dental curriculum with many reported challenges and concerns from teachers, students, administrators and e-learning developers (Chambers, 2009; Haden *et al.*, 2009; Shah and Cunningham, 2009; Ward *et al.*, 2009; Zary *et al.*, 2009; Handal *et al.*, 2010). Very little is also known about how dental teachers experience curricular change or innovations, such as e-learning approaches, that may contest their established pedagogical views. A closer attention to issues of functionality and contextual factors that may impact sustainability of these systems is also lacking.

Standard frameworks for developing e-learning environments have been proposed in the literature ((Piccoli *et al.*, 2001; Conole *et al.*, 2004; Alonso *et al.*, 2005; Wixom and Todd, 2005; Holsapple and Lee-Post, 2006; Mishra and Koehler, 2006). However, a fully fledged

guide combining the educational features of dentistry, dental teachers and students, and the e-learning technology-supported management of the learning processes is under researched.

The current research will investigate the provision of e-learning in dentistry to determine what factors influence a successful e-learning implementation in dental education.

1.2 Aims

The aim of this study was to explore the potential and challenges for e-learning in dental education using a case-study approach. The case study was based on an "e-course" developed at the University of Birmingham, School of Dentistry, www.dentistry.bham.ac.uk/ecourse (password is available on request).

The current study is designed to inform e-learning developers and stakeholders who want to gain a greater understanding about implementing e-learning strategies into their institutions. It also aims to contribute to the debates around the future of e-learning in dental education.

1.3 Objectives

1. Assess the usability and current level of e-learning integration within the dental curriculum.

2. Identify the potential and challenges facing dental students and teachers in using such innovations.

3. Explore the relationships and potential pitfalls between dental students, teachers and the curriculum in implementing e-learning technologies.

4. Identify relationships between the technology and the dental educational goals.

5. Propose a guide for the implementation of learning technologies in dental education at the teaching and learning level.

1.4 Research questions

E-learning taking place on the Birmingham Dental School's e-course was assessed in three areas; efficiency, effectiveness, and relevance.

1.4.1 Efficiency

1. How did the different technical design (infra-structure, tools, IT support, etc.) of the e-course encourage use of the system?
2. At what instructional level was the e-course being used? And how did the different instructional designs (passive, active, collaborative formats) on the e-course encourage use of the system?
3. How did the e-course use differ between the various dental specialities in the school?

1.4.2 Effectiveness

1. Where e-learning for a particular subject was available, did the students and teachers use it, and in what manner was it used?
2. Do e-learning approaches on the e-course encourage more student-centred, deeper learning, or even competitive educational strategies?

1.4.3 Relevance

1. What are the students / teachers knowledge, motives and barriers towards e-learning technologies?
2. How did e-learning fit with the teachers and students' methods of teaching and learning?
3. How did e-learning change the educational activities of both teachers and students?
4. How did e-learning change the students and teachers' professional experience and skills?
5. How did e-learning fit within the dental curriculum?
6. How did e-learning fit with the School's educational strategies? And can these be translated to other dental schools to help them with their own educational challenges?

1.5 Methodology

For the purposes of the present study, the e-course was assessed in four separate stages;

- **Stage 1:** a pilot study was conducted to evaluate an online orthodontic e-course that has been developed by the author of the study. The aims of this stage were twofold; 1) to give the author the experience of developing e-learning contents using the e-course, this was seen to better help the author in approaching the research and reflecting on the findings; 2) to assess students' needs and attitudes towards the e-course as a preliminary guide to the study design.

- **Stage 2:** the different tools, components, and content delivery formats on the e-course were evaluated in order to explore its overall functionality and to assess how it is used and which parts were the most popular for access by teachers and students.

- **Stage 3:** the discussion board archive on the Prosthetic e-course was analysed as a case example. This was seen as an area where the e-course is effective in supporting higher-level teaching and learning approaches.

- **Stage 4:** students and academic teachers were interviewed to record their motives, knowledge and attitudes towards the e-course. They were asked to identify the potential, challenges and barriers in using such innovations in dental education.

1.6 Findings

The findings of this study provided an in-depth knowledge about the factors, problems, and concerns faced by dental students and teachers in using e-learning approaches. It also explored interesting tensions between students' need and teachers' work overload and support in using the technology. Gaps between demands of curriculum and institutional support for change are also recognised in the current study.

1.7 Contributions

This research adds to the growing body of literature that recognises the need for new and innovative approaches to dental education, particularly in using e-learning approaches. It raised many debates and recommendations that can help guide e-learning developers and policy makers in dental school to develop better strategies for implementing e-learning technologies.

1.8 Outline of the study

This thesis is organised into nine sections including thirteen chapters, references and appendices;

Section one provides the background and rationale for the study, the research problem, the purpose and objectives, as well as general findings of the study and their significance (chapter 1).

Section two reviews the available research in the field of study. The current concepts and trends in using e-learning approaches in education are reviewed (chapter 2). The problems, challenges and concerns facing dental education and the provisions in the dental literature towards e-learning in supporting the dental curriculum are also reviewed (chapter 3).

Section three discusses the pilot study that is conducted to explore students' needs to e-learning innovations as a preliminary guide to the current study design (chapter 4).

Section four presents the theoretical background for the different methodologies used in the study (chapter 5), the study design, the study population, the methods of data collection, as well as the methods and procedures of data analysis (chapter 6).

Section five presents the results of the study under three categories; e-course efficiency (chapter 7), e-course effectiveness (chapter 8), and e-course relevance (chapter 9). Each chapter is followed by summaries drawn from the relevant results.

Section six discusses the findings of the study (chapter 10) and the alignments of these findings with the reviewed literature (chapter 11).

Section seven provides conclusions, recommendations (chapter 12), and indications for future work (chapter 13).

Section eight lists the references used in the study (References).

Section nine presents the questionnaires and topic guides used in the study, as well as additional works done to support the study (Appendices).

Note: The term teacher in this study is used interchangeably with instructors, faculty or educator because the relevant literature reviewed uses all these terms.

SECTION TWO

BACKGROUND

Chapter 2

E-LEARNING: CURRENT CONCEPTS AND FUTURE TRENDS

Chapter 3

E-LEARNING IN DENTISTRY

Chapter 2

E-LEARNING: CURRENT CONCEPTS AND FUTURE TRENDS

2.1 Introduction

The advent of the Internet has brought about a change in how we see the world. The introduction of digital technology has significantly changed most areas of human work. Advocates of technology in education have predicted parallel changes in the future of teaching and learning. However, the reality is far behind the vision (Mishra and Koehler, 2006).

Many researchers have attempted to explain the reasons behind this slow adoption of new technology in education, and a definite answer is still missing. Part of the problem, as Mishra and Koehler (2006) argue, is that research in this area has always tended to only look at the technology and not at how it is used. Beetham (2000) also argues that learning technologists have always started from the *'practical concerns of the classroom'*, and that the majority of researchers within this area are mainly looking for a relationship between the inputs and outcomes of a learning process. These poorly theorised research methods, as Beetham (2000) indicated, might have serious consequences for the future of learning technology research and practice. As such it may not take full advantage of the benefits. The same argument has been shared by many other researchers (Beetham, 2000; Conole and Oliver, 2002; Bednar *et al.*, 2007; Siemens and Tittenberger, 2009).

Research in the area of learning technologies requires multi-disciplinary approaches and should involve stakeholders from different areas such as; educational research, cognitive psychology, instructional design, computer science, etc, as well as teaching subject-experts who engage with it as 'end users' (Figure 2.1). This approach is starting to be a common feature of emergent research areas (Conole and Oliver, 2002), which might lead to new elements for describing knowledge construction and development (Cartelli, 2006), thus leading to better implications.

However, such a wealth of expertise, which are from diverse cultures, indicated the need for a clear framework that could help them to engage with each other and thus further develop the use of learning technologies (Conole and Oliver, 2002; Bednar *et al.*, 2007).

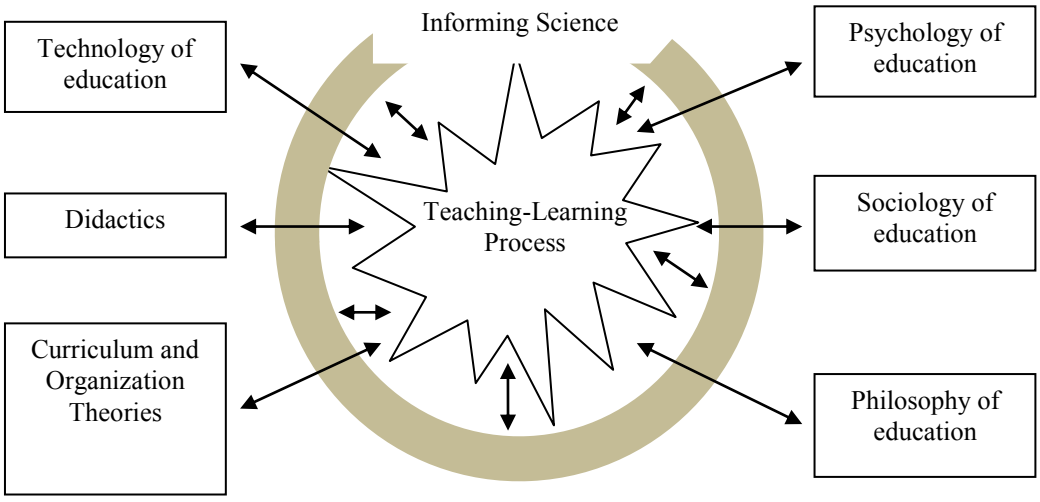


Figure 2.1 The multi-disciplinary fields in learning technology research (Reproduced from Cartelli (2006)).

The aim of this chapter is to explore the issues surrounding e-learning as a reflection of more general trends in education.

2.2 Terms and Definitions

The modern concept of e-learning, and even the term itself, is not much more than a decade old. According to the etymology in Webster's American English dictionary, the term first appeared in the year 1997. It started at a time when people were adding 'e' as a prefix to many common words, including e-mail, e-business and e-commerce. Since then, the term was very rapidly adopted, and became common currency all over the world by the turn of the century (Fee, 2009). Nonetheless, it was not in general use in education until 2002; other terms were used as being synonymous with e-learning. A search in the literature throws up 'networked learning', 'online learning', 'computer-assisted learning (CAL)', 'computer-based learning (CBL)', 'web-based instruction', and 'computer-mediated learning' to name a few. However, e-learning is increasingly becoming an umbrella term used to describe them all (Littlejohn and Pegler, 2007).

e-Learning is a broad term that includes any use of a computer to support learning, whether online or offline (Piccoli *et al.*, 2001). There are many definitions of e-learning. Many are offered by vendors, and should be treated with caution. Academic definitions, and those provided by governmental and professional bodies, are more authoritative, but still quite diverse (Fee, 2009).

The American Society for Training and Development (ASTD, 2009) is considered the world's biggest professional body for learning and development, with about 70,000 members in about 100 countries all around the world. Thus, it can be considered a reliable resource for defining learning technologies. The ASTD originally defined e-learning in 1998 as:

"e-Learning covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, Intranet / extranet (LAN / WAN), audio- and videotape, satellite broadcast, interactive TV, CD-ROM and more" (ASTD, 2009).

Online learning technology with its virtual environments is expanding the horizon of teaching and learning. The process is no longer confined to the interaction with e-digital contents only. It is a combination of e-digital resources along with local and global community engagement. In other words, the virtual learning environment (VLE) concept is broader than computer-based learning. It combines the communication dimension with the individualised learning experience and fosters communities of learners (Wilson, 1996; Piccoli *et al.*, 2001).

With this shift in the learning environment, educationalists and researchers are becoming more concerned with what these technologies actually offer. In response, Fee (2009) defined e-learning as an *"approach to learning and development; a collection of learning methods using digital technologies which enables, distribute and enhance learning"*.

Thus, e-learning is considered an approach to traditional learning that embraces new thinking associated with new technologies. Thus, as stated by Fee (2009), the "**e**" in e-learning stands for many meanings. It stands for **e**lectronic (adding technology to a process), **e**xperience (changing the character of the experience of learning by time-shifting, place-shifting, simulation, and community support, to mention a few), and **e**xpansion (the opportunity to expand learning offerings beyond the limitations of the classroom).

2.3 Background Theories

E-learning, as any learning process, has an underlying implicit or explicit learning theory. There is a wide range of educational philosophies on learning theories which can be mapped to five broad theoretical approaches: behaviourism, cognitivism, constructivism, socio-cultural and connectivism. Each of these theoretical frameworks was thought to provide a model of a learning behaviour (Roblyer *et al.*, 1997). These models provide the foundation for the design of a learning environment and ultimately its effectiveness (Leidner and Jarvenpaa, 1995; Piccoli *et al.*, 2001).

In this section, the existing concepts of what constitute a learning environment will be explored and the theoretical background that may assist in understanding how learners identify and engage with both the diversity and complexity of those environments will be considered.

In the early 20th century, researchers viewed learning through the lens of behaviourism. Skinner (1938) the "grandfather of behaviourism" and other behavioural theorists were concerned mainly with observable indications of learning (learning through observation), and what those observations could imply for teaching (Skinner, 1938; quoted by Roblyer *et al.*, 1997).

As researchers and educators probed more deeply into the process of learning, the weaknesses of behaviourism became evident. Piaget (1971) and Ausubel (1968) were among the first scientists emphasising the importance of cognitive actions of humans in their learning process. They developed the concept that; knowledge construction results from the addition of new knowledge to a pre-existing knowledge. They also emphasised the assumption of constructivism and the importance of learning through activity.

Further studies addressed the complexity of this cognitive phenomenon (Cartelli, 2006). Many concepts were then introduced including; cognitive flexibility (Spiro and Jehng, 1990), multiple intelligence (Gardner, 1993), and situated learning (McLellan, 1996).

Ecologists were more concerned with the learning environments and the dynamic nature of learning. They considered that neither behaviourist nor cognitive theories can be recognised as reliable guides on which to base a programme with a true social validity and educational value (Plu, 2006). The theory of experiential learning by Kolb (1984) was one of the first theories that emphasised this reciprocal relationship acting between the individual features, the environmental influences and the behaviour in the learning process (Kolb, 1984). This concept was also supported by Jonassen (1994), who founded the project of learning environments.

Since then the role of social and cultural interactions in knowledge construction started to be of more concern. The most comprehensive theory based on such concepts is the Wenger's (1998) 'Social learning theory'. This theory has at its basis the following two principles; individuals are social beings and are the focus of the learning action, and knowledge is the expression of the participation.

Over the last century, educators' understanding of the process of learning has advanced even further. At the close of the 20th century, the learning process was more and more conducted by means of communication instruments. The Internet, and particularly the World Wide Web, has proven to be the most sophisticated communication networks our civilisation has ever known. Through the Internet people are being connected in ways they never thought or wanted to be possible (Jolliffe *et al.*, 2001). Although the communication theory firstly

developed by Vygotsky (1962), its importance on individuals' knowledge development is still stated in many recent studies (Cartelli, 2006).

With the increasingly complex world of information, nowadays, new views of learning and teaching are starting to emerge. Connectivism (Siemens and Tittenberger, 2009), connected intelligence (de Kerckhove, 1997), and collective intelligence (Levy, 1997) have emerged as models of learning in the present age that is defined by networks. de Kerckhove (1997) defined connected intelligence as *"the set of strategies and cognitive skills developed from individuals contextually to ICT use"*. Networks and connections are deceptively simple; however, their effect on knowledge construction is immeasurable. Latent semantic analysis suggested that with networking, people have more knowledge than appears to be present after exposure to information (Landauer and Dumais, 1997). Levy (1997) indicated that collective intelligence will characterise the situation emerging from the increase in the individuals' communication speed due to the Net and from the greater amount of information freely available in it.

From this background, the complexity of the teaching and learning processes in the 21st century is explicit and embodies a range of learning theories. Learning is a social process and knowledge is an emergent property of interactions between networks of learners (Wenger, 1998). Both learning and cognition occur together within particular situations or contexts (Seely Brown *et al.*, 1989), raising the importance of educational activities mirroring actual situations of use (Siemens and Tittenberger, 2009). This means that learners require both; the time to assimilate new information, as well the opportunity to reflect on, defend, and share what they have learned if it is to become part of their skills (Merrill, 2002).

2.4 Fitting Theory into Practice: Current Views on E-learning

Learning technology seems to have considerable potential to alter the nature of the teaching and learning processes (Garrison and Anderson, 2003). However, researchers are concerned how technology will influence education? Will e-learning simply enhance and reinforce existing practices of information dissemination, or will it fundamentally alter how students approach learning and outcome expectations? (Leidner and Jarvenpaa, 1995; Piccoli *et al.*, 2001). In the following sub-sections, issues surrounding these debates will be discussed from three different perspectives; educational, technological and end-users perspectives.

2.4.1 Educational perspective

The strong influence of technology is changing the ideas and approaches to cognition and pedagogy within the educational fields (Garrison and Anderson, 2003). As Privateer (1999) stated, *"It makes little sense for academia to continue with a tradition of learning significantly at odds with technologies that are currently altering how humans learn and interact with each other in new learning communities"*.

However, educational researchers still remain concerned by technology in teaching and learning. These concerns are focussed in two areas;

At an instructional level, there is a debate on the question of whether technology is neutral or non-neutral to the teaching and learning transaction. In other words, 'Is e-learning a technology that empowers pedagogies or a pedagogy in itself?' (Kanuka, 2008).

In response to this question, two groups of thoughts were raised. The first group considered technology as having neutral effects towards the teaching and learning transaction and that it is used as a tool only. They believe that e-learning technologies can support different

philosophies. However, they claimed that the same technology can be used to support different learning models depending upon its implementation and use (Clark, 1994; Leidner and Jarvenpaa, 1995; Romiszowski and Mason, 1996). Proponents to this thought reported no significant difference between technology-supported environments and traditional face-to-face instruction in enhancing learners' achievement (Russell, 1999). They also concluded that, the instructional implementation of the technology, not the technology itself, determines its effectiveness (Clark, 1994; Collins, 1995; Leidner and Jarvenpaa, 1995).

In contrast, the second group considered learning technology as being non-neutral, embodying philosophies and ideology. They foresee the technology as a driving force towards new pedagogical approaches such as 'learning cultures' or 'learning communities' (Kovacic, 2006). Researchers of this group argued that the value-add in a 'knowledge-based future' would be a learning environment that develops and encourages the ability to think and learn both independently and collaboratively. Critical and self-directed learners will have the motivation and ability to be both reflective and collaborative and, ultimately, with the motivation to continue to learn throughout their lives (Garrison and Anderson, 2003; Tonfoni, 2003). And as Jonassen (2000) pointed out that, by encouraging learners to take control of their own learning, learning technology can help to transform learning and learners to become independent, self-regulated, lifelong seekers, and constructors of knowledge. Proponents to this thought continued to argue that, while technology itself does not determine learning outcomes; technologies foster new learning environments that are not achievable in the traditional classrooms. Therefore, different learning outcomes should be expected (Leidner and Jarvenpaa, 1995; Piccoli *et al.*, 2001).

Despite these various thoughts, the majority of educational uses of Web technology were found to be associated with a limited number of pedagogies. Mioduser and Nachmias (2001)

examined 500 educational Web sites to determine their pedagogical efficiency in achieving a desirable outcome. They found that most (94.5%) Web sites currently support processes at the level of retrieving information or rote learning. Higher-level learning skills such as inquiry-based learning were only found in 28.2% of the examined Web sites. Within the 500 cases, less than 3% supported any real form of collaborative learning. Also, only a few sites (21.8%) included feedback, either automatic or human. Researchers concluded that the new pedagogical approaches such as inquiry-based and collaborative learning are still far from being implemented in most educational sites.

There are challenges and tensions facing educators in creating learning environments that will facilitate the development of higher-order cognitive abilities (Garrison and Anderson, 2003). Research is needed to evaluate how different learning models, subject matter, and technology tools interact to produce desired learning outcomes in what has been described as the knowledge era (Alavi and Leidner, 2001; Kovacic, 2006).

At an institutional level, researchers are questioning the connection between the University's success and its use of instructional technology (Rivoltella, 2006; Amirault and Visser, 2009).

It is suggested that technologies can greatly impact on institutions. Such technologies can renovate teaching and learning practices (modernisation), build up networking systems among different schools (integration), actualise structures and processes (innovation), and also make the personalisation of learning possible (extension) outside the constraints of time, space and place (Rivoltella, 2006).

However, it was also argued that introducing technology into schools does not by itself necessarily produce such innovation and modernisation in teaching. It needs a systemic

relationship among technologies, individuals, and context variables to bring about the change (Rivoltella, 2006).

2.4.2 Technological perspective

Researchers in information science were concerned with the overall impact of such e-learning technologies on the learning environment. Technology quality and reliability, as well as easy access to appropriate hardware and software equipment, were thought by technology developers to be important determinants in making learning effective (Webster and Hackley, 1997).

Cartelli (2006) pointed out that the role these technologies can play in the educational context is what determines its actual impact. This role has been identified by Cartelli (2006) under three major areas;

1. It acts as a repository for large quantities of data, information and documents of every kind (CMS – Content Management System).

2. It is a system for the management of Learning Objects (LMS – Learning Management System).

3. It provides a virtual environment base, with its irrelevance of the place capability in communication, letting individuals interact and build communities of learners (CSCLS – Computer Supported Collaborative Learning System) and a shared memory (i.e., shared knowledge basis supporting professional communities of practices, COPs).

Technology also has a role in knowledge management within organisations (Ward, 1999). Using emerging technologies such as intelligent agents and artificial intelligence systems also

have a major impact on organisations (Bruisilovsky, 2001). These adaptive hypermedia-learning environments (AHLE) can generate customised course material (i.e., an individualised learning path) according to the individual learner's needs and preferences.

e-Learning, nowadays, is progressing from the basic use of ICT for learning (E-learning 1.0) to new forms of education and training (E-learning 2.0) which emphasise creativity, collaboration and innovation. This, in turn, requires a significant change of emphasis towards a greater consideration of the context of learning, the need for collaboration, communication and innovation, or what is becoming as "Web 2.0 philosophy" (Penna and Stara, 2009).

Technology developers are, thus, starting to focus their research more on the combination of e-learning practices with Web 2.0 philosophy. This new approach is seen with e-learning, which supports communities of practice, i.e. socio-constructivist pedagogical strategy where learners interact and learn together (Ocker, 2001; Strijker and Collis, 2002). Recently, tools such as wikis (Fucks-Kittowski *et al.*, 2004) and discussion forums (Garrison *et al.*, 2001) are being used to support such community aspects in e-learning. Another approach involves the learners in the production of learning content. This changes the role of learners from receivers of information to producers. Such e-learning is based on tools such as weblogs, podcasts, and wikis (Downes, 2005). Blog is a personal form of publishing content. Blog software usually provides the possibility for comments and trackbacks, links back from other sites. In such a way a distributed, collective and interlinked community of learners is created (Safran *et al.*, 2007).

Other tools that are changing the role of e-learning and ICT applications in teaching and learning are the two emerging technological developments, open source software (OSS) and standards (LMS, SCORM and particularly Learning Design). The importance of these

developments is that they made the process of content development easy and does not need comprehensive administration functionality. With limited knowledge of software and systems, teachers and learners themselves can produce content. This is claimed to support life-long learning approaches (Hertel *et al.*, 2003).

There is a continual introduction of new technologies in education that will continually create and expand the learning environment. The New Media Consortium (NMC) in collaboration with the EDUCAUSE Learning Initiative (ELI) conducted a five-year (from 2002 – 2007) qualitative research effort to investigate the adoption of emerging technologies into teaching and learning organisations. Their report was drawn on an extensive array of published resources, current research and practice, and on extensive surveys of online technology trends. Their findings showed that videos and collaboration webs are expected to be the first type of e-learning technologies to be adopted in education for their flexibility, ease of use and development, and low cost. This is followed by the applications of mobile broadband and data mash-ups, where combination of data from different sources are mashed up into a single tool (such as using tags). The two topics on the far-term horizon in this report are; collective intelligence (knowledge that emerges from large groups of people, such as Wikipedia) and social operating systems (which base the organisation of the network around people, rather than around content). Although these two types of systems were thought to be rare by users, there reported some examples in the worlds of commerce, industry and entertainment that hint that they are already being used in teaching and learning (Clark and Gottfredson, 2008).

2.4.3 End-user perspective

Teachers are the principal players in any learning environment, and learners are the primary participants. Both play equally important roles and their attitudes are considered crucial to the success of the teaching and learning transactions (Webster and Hackley, 1997).

2.4.3.1 Learners

Children born between 1982 and 2002 are called the 'Net Generation', 'Millennial Generation', 'Generation Y', 'iGeneration', or 'Echo Boomers' because they are the first group to grow up in the digital and Internet era. This generation was born and nurtured in an information-intensive environment that is easily accessible (Pletka, 2007). Children of this group, especially in the developed countries, are confident users of technology from an early age. As stated by Beetham (2008), *'Regardless of how institutions or individual teachers choose to use networked technologies, learning takes place in an environment saturated with information and communication. Learners are increasingly networked.'* Therefore, it is not possible to hold back the use of computers in education, as students are now used to using these tools in everyday life (Littlejohn and Pegler, 2007).

The question might be, "Are younger learners different from previous generations?" Some researchers believe that learners of this generation are different in their ways of learning. Net Genres, as claimed by those researchers, not only expect collaborative learning conditions and social online contexts, but they also expect individualised feedback to their unique needs (Pletka, 2007). Seely Brown (1999) identified four different ways in which the ubiquitous use of ICT is leading to changing ways of learning. These changes are; 1) elaboration of a new literacy of information navigation - to know how to navigate through confusing and complex information spaces, 2) increasing use of discovery-based or experiential-based learning

especially using the web, 3) substantial shift in reasoning - the ability to find something; an object, tool, piece of code, document, and to use it in a new way and in a new context, and 4) young people learn by absorbing and trying new things, rather than attending a training course or consulting a manual. The community and collaborative work in knowledge development added a self-correction component to Web-based information. The need to decide whether or not to believe or trust these 'borrowed' things is no longer an issue to the Net generation (Pletka, 2007).

While younger learners often use more technology, existing research does not support the notion that learners differ in their educational achievement based on generational distinctions (Siemens and Tittenberger, 2009). Proponents to this view claim that virtual learning environments (VLEs) depart noticeably from formal environments due to the shift of control and responsibility to the learners that they promote (Ward, 1999; Clarke, 2002). They reported that successful online learners are still the motivated, mature, and confident people who often have had a history of educational achievement. And that this does not relate directly to any generational differences (Piccoli *et al.*, 2001; Clarke, 2002).

The question might then be, "Do students expect (and want) e-learning in education?" Researchers have attempted to assess how much e-learning students entering higher education expect as part of their university course. It was found that the expectation is lower than the 'digital native' argument might anticipate. They also found that technologies do not play the same role in formal learning contexts and there are mismatches in the learning processes involved in classroom settings and social situations (Kukulska-Hulme and Traxler, 2005). A survey of students at the University of Strathclyde studied their attitudes towards ICT use over a four-year period. They found a dramatic change in students' use of ICT for informal learning, social and play activities. However, they did not find a similar shift in how they

expected e-tools to be used in formal learning at university (quoted by Littlejohn and Pegler, (2007)).

A detailed online survey was also conducted by the University of Oxford from December 2006 to February 2007 and it analysed the use of online tools associated with Web 2.0 concept. Interestingly, their findings highlighted that the general public have a poor understanding of Web 2.0 systems. The study found a high number of people from all age groups using Wikipedia being between 70% and 80%. However, only about 20% of the participants had used other wikis. The number of people using social bookmarking was found to be quite low with the highest amount of people being under 18 years of age. Weblogs were read by 50-60% of the participants from all age groups, while only a larger number of the under-18 year old and 18 to 24 year old participants wrote their own weblogs. A similar distribution was seen for the use of social networking tools (White, 2007).

Whether or not students see the e-learning activity as being something that the university or college itself provides as 'e-teaching' is still debatable. However, there is little evidence that students actively choose courses on the basis of the e-learning technology employed (Littlejohn and Pegler, 2007). Some researchers, however, claim that e-learning in a broad sense is indirectly having an impact on learning and teaching in post-16 education. For example, students may be using Google for homework without being directed to do so. This in itself was claimed to be a powerful logic to the driver that courses should look to involve the use of such tools (Golden *et al.*, 2006).

2.4.3.2 Teachers

E-learning technologies have introduced new and different pedagogies that raised some concerns among teachers (Privateer, 1999; Garrison and Anderson, 2003). These concerns

were found to be focused around the quality (technically, pedagogically, and operationally), the control and the change needed to introduce such innovations in the curriculum (Littlejohn and Pegler, 2007).

e-Learning with its virtual learning environments also requires different skills and attitudes from instructors. Instructors' positive attitude towards technology, their interactive teaching style, and their control over the technology are found to have an important influence on students' own reactions to the learning environment (Webster and Hackley, 1997; Piccoli *et al.*, 2001). This in turn may cause a substantial increase in time and energy required from instructors (Walther, 1992; Hiltz, 1995; Hara and Kling, 2000).

This highlights the importance of professional development in two main areas; technical and e-pedagogical areas (Conole and Oliver, 2002). It also highlights the significance of institutional support as e-learning would be ineffective without the necessary changes in the structure of institutions and changes to the cultural components of the working practice (Casey *et al.*, 2006).

2.5 Frameworks for Designing Effective e-Learning Programmes

There is a constant debate about the effectiveness of e-learning and this often depends on how it is deployed in the learning environment. Many frameworks and models have been proposed in the literature to help guide the design, development and evaluation of e-learning environments. Each model has a particular focus and emphasis, and is aligned with a particular set of theoretical perspectives (Masoumi, 2007). A brief overview of these models and frameworks with their underlying concepts will be discussed in the following sub-sections.

2.5.1 Educational level

Researchers from the educational field are mainly concerned with pedagogical approaches to the e-learning process. The importance of pedagogy is emphasised by Chizmar and Williams (1998) as being the drive for the choice of instructional technology, not the other way around.

Some researchers in this field focused on the learners. The philosophy of leaner-centred learning is an approach that fosters the development of learning resources and interventions that make the learner the focus. Such a pedagogical philosophy requires an in-depth understanding of humans learning styles. A comprehensive overview of the different learning style theories and instruments, by Coffield *et al.* (2004) identified 13 major models of learning styles. They further emphasised the complexity and continuing problems within this research area and did not provide an answer to how teaching should relate to the changing needs of the learners.

Other researchers focussed on the pedagogy (the teaching and learning transaction) itself. The Laurillard's conversational framework focuses on the pedagogical scenarios that should be designed in an online activity. It groups them into five basic dimensions; discussion, adaptation, interaction and reflection (Laurillard, 2002). Alternatively, Salmon's five stage model focuses on the different activities tutors may employ at different stages of the students' learning process in an online environment. These activities are; access and motivation, online socialisation, information exchange, knowledge construction, and development (Salmon, 2003).

Other ideas, such as the Technological Pedagogical Content Knowledge (TPCK) Framework; focuses more on the essential qualities of knowledge required by teachers as they integrate technology into their teaching (Mishra and Koehler, 2006). Other models that are described in

the literature include; the Acquisition – contribution model (de Boer and Collis, 2002), e-Learning instructional model (Alonso *et al.*, 2005), and many more.

This current array of approaches prevalent in e-learning can prove overwhelming to researchers and practitioners alike. The pedagogical framework that underpins technologies should build on learning communities and support student-centred curriculum. They should also effectively provide individual learning approaches in the increasingly diverse target population that now exist (Conole *et al.*, 2004).

Reflecting such diversity, Conole *et al.* (2004) proposed a model composed of six components connected by three axis of interpretation; Individual vs. Social; Reflection vs. Non-reflection; and Information vs. Experience (Figure 2.2). By mapping different learning theories against the three axis of interpretation in this model, as proposed by Conole *et al.*, practitioners are able to make the link between pedagogy and theory, which in turn, will allow their content to be used more effectively.

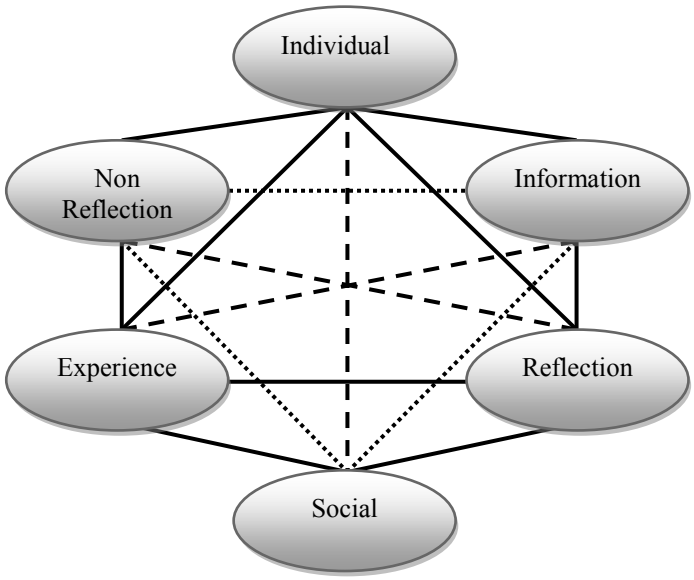


Figure 2.2 Octahedron representation of Conole *et al.*'s model (Reproduced from Conole *et al.* (2004)).

2.5.2 Technological level

Researchers from the information technology and computer science fields were concerned with developing models that can help them to learn how to develop better applications of the technology (Doll and Torkzadeh, 1991). Perceptions of information systems' (IS) success have been investigated within two primary research streams; the user satisfaction and the technology acceptance literature. The user satisfaction models (End-user computing satisfaction) (Doll and Torkzadeh, 1991) measures system and information design attributes such as; information accuracy and system reliability (Melone, 1990). By contrast, the technology acceptance model (TAM) predicts usage by linking behaviours to attitudes and beliefs such as; ease of use and usefulness (Taylor and Todd, 1995).

Integrating these two important IT research streams may improve the predictive value of each. Many models have been proposed for such integration including; the Integrated Model (Wixom and Todd, 2005), and the Task-to-Performance Chain (Goodhue and Thompson, 1995).

2.5.3 Integrated frameworks

Successful implementation of e-learning requires the integration of three main components namely; enabling technology, learning content and learning design (Britain and Liber, 2004).

In an attempt to bridge the gap between educational and computer science researches and practitioners, Piccoli *et al.* (2001) and Holsapple and Lee-Post (2006) combined the different determinants of e-learning effectiveness in virtual learning environments (VLEs) in their frameworks. Piccoli *et al.* (2001) identified two classes of determinants; human dimension and design dimension. The human dimension includes factors related to students and

instructors characteristics and attitudes towards the technology. The design dimension includes factors related to the efficiency and effectiveness of the technology in supporting the pedagogical and instructional processes. They believe that these two dimensions are equally important in achieving effective e-learning systems and will impact on students and instructors' performances.

Holsapple and Lee-Post (2006) developed another model 'The e-Learning Success Model'. Their model consisted of three dimensions; system design (technology dimension), and system delivery (learning content and user satisfaction dimensions). Both dimensions were proposed by Holsapple and Lee-Post (2006) to have equally important effect on the third dimension, which is the net performance of the users.

2.5.4 Organisational level

Many frameworks and strategies have been proposed in the literature for evaluating e-learning programmes at the institutional and organisational levels. The 'gold standard' in the evaluation stage has been the Donald Kirkpatrick's Four Levels of Training Evaluation Model. This model essentially measure; 1) reaction of students to the training programme, 2) learning - the resulting increase in knowledge or capability, 3) behaviour - extent of behaviour and capability improvement and implementation/application, and 4) results - the effects on the business or environment resulting from the trainee's performance. Kirkpatrick's enduring idea was not just to distinguish the four levels, but to demonstrate that you can consider the impact of all training activities at each of these levels. Although this model was basically meant to measure training programmes in corporate trainings, it started to be used in academia because of its simplicity (Kirkpatrick, 1998).

Khan (2005) developed another model 'The People-Process-Product Continuum or P3 Model', which maps a comprehensive picture of the various roles and responsibilities involved in developing and managing e-learning systems. It distinguishes eight dimensions of Web-based e-learning systems; Institutional, Pedagogical, Interface design, Technological, Management, Evaluation, Resources, and Ethical dimension. Khan's strategy is more academically oriented and has a distinguished dimension, which is the ethical dimension.

Casey *et al.* (2006), on the other hand, developed the "Organisational Framework for E-learning" emphasising the importance of the top-down action in implementing and managing e-learning systems within institutions and organisations. The model indicates four levels of actions in order; institutional, operational, teaching and learning and finally at a learner's level. It also shows four channels of communications around perspectives and views between these action levels. These channels are; technological, pedagogical, strategic, and organisational views.

Many other frameworks have been suggested in the literature for successful management and evaluation of e-learning systems. Fee (2009) concluded that, there are five essential considerations for effective e-learning design common to all the e-learning models. These include that the e-learning system should be; 1) a managed programme, 2) an effective learning experience, 3) a learning process, not just 'e-reading', 4) use technology to enhance learning, and 5) take advantage of the strengths of the Web. Finally the e-learning content should be designed to include all of the followings; readings, resources, activities, and assessments.

2.6 e-Learning: Potential and Drawbacks

2.6.1 Potential

Teaching with technology can be viewed as gradients within three broad categories. It can be used to augment face-to-face teaching and extend the physical classroom. It can also be used as blended e-learning, where technology partly replaces in-classroom learning. Or it can be used as a fully online medium, where technology entirely replaces face-to-face classroom teaching or paper-based distance education (Siemens and Tittenberger, 2009).

The popular press seems to assume that virtual learning environments (VLEs) are more efficient than traditional classrooms because of cost reduction and limited reliance on instructors (Kiser, 1999). However, research evidence shows that the transition to blended or e-learning is unlikely to save an institution or organisation money. It takes time and resources to get it right. Any cost savings or benefits are likely to be offset by the need to invest in resources and support services (Fielden, 2002; Littlejohn and Pegler, 2007).

The question that still needs answering is; "What are the benefits of adding 'e' to the learning process?" (Alavi, 1994; Hiltz, 1995; Jolliffe *et al.*, 2001; Piccoli *et al.*, 2001).

Many advantages have been reported in the literature on the support of learning technology to the traditional teaching and learning processes. Research suggests that technology-mediated learning environments may improve students' achievement (Alavi, 1994; Hiltz, 1995; Schutte, 1997; Maki *et al.*, 2000), their attitudes toward learning (Schutte, 1997), and their evaluation of the learning experience (Alavi, 1994; Hiltz, 1995). Technology may also help to increase teacher/student interaction, and to make teaching more student-centred (Hiltz, 1995; Schutte, 1997).

e-Learning efficiency may also be measured by its ability to widen participation, extend possibilities, innovation, and modernisation (JISC, 2001; Jolliffe *et al.*, 2001; Littlejohn and Pegler, 2007).

The advent of Internet-based learning means that the physical location of the learning institution is no longer of primary importance for the learner when enrolling in a learning event. There is at the same time a growth in accredited professional development and the demand for lifelong learning opportunities, which both bring substantial numbers of mature students into higher education. Thus, by placing the learning materials on to the Web, the potential number of users is immediately increased. Learners regardless of where they are receive the same message and are able to engage other learners and practitioners globally (Jolliffe *et al.*, 2001).

With the extension of disability discrimination legislation into education, such as the UK's SENDA - Special Educational Needs and Disability Act, (JISC, 2001), there are also now greater number of students entering higher education with some form of pre-existing disability that must be accommodated. Web-based learning seems to be a convenient and cost-effective way of providing that learning experience for these individuals (Littlejohn and Pegler, 2007).

If we think globally the challenge of meeting demand for higher education becomes even more intense. The demand in China alone is overwhelming and is beyond the ability of the world's universities to satisfy that need by physical campuses. Many universities are now engaged in 'e-China' projects to take that approach forward. Within more developed countries there is also a struggle to meet demand through full-time courses. For many potential students this delivery format is inaccessible, and in the United Kingdom the number of part-time

students now accounts for 40 per cent of all registrations. In this context, e-learning off-campus, or blends of e-learning with campus-based teaching, could provide the answer (Littlejohn and Pegler, 2007).

Thus, unlike its predecessors (TV, radios, CD-ROMs, etc.), the Internet offers far more possibilities for the bi-directional flow of information and adds an enhanced communication element making it extremely well suited for teaching and learning (Jolliffe *et al.*, 2001).

2.6.2 Drawbacks

While much of the literature emphasises the value, or potential, of technology in education, others highlight its drawbacks (Hara and Kling, 2000). Arguments against e-learning, as quoted by Mason (1998) and Piccoli *et al.* (2001) can be categorised as;

1) *Cognitive losses*, which include; a fragmented sense of time and a loss of the so-called duration experience, a reduced attention span and a general impatience with sustained inquiry.

2) *Educational argument*, which centres on a move away from analysis, discussion, and examination towards learning that, becomes a product to be bought and sold, to be packaged, advertised and marketed.

3) *Social argument* is related to the "breakdown of community", estrangement from geographic place and community, and an absence of any strong vision of a personal or collective future.

4) Finally, the *cultural argument* which centres on the 'old concerns' about imperialist attitudes, the loss of indigenous cultures and the relentless imposition of Western values.

2.7 Challenges and Concerns: The Big Picture

A more critical perspective takes us further beyond the immediate concerns and preoccupations of most educational technologists. Organisations recognise that they are facing tremendous change pressures and are looking for clarity on what is needed. These pressures, which are influencing the future design of education, can be grouped into four broad categories; global, social and political, technological, and educational (Monahan, 2005; Selwyn, 2007; Siemens and Tittenberger, 2009).

These pressures are disrupting the traditional role of universities. Selwyn (2007) and others, argue that there is misalignment in these factors that is limiting the creative adoption of technology in higher education (Selwyn, 2007; Fee, 2009; Siemens and Tittenberger, 2009). Selwyn (2007) continues to state that *"Unless the entire nature of contemporary higher education is radically realigned, then we would argue that there is little hope that the narrow shaping of academic computer technology use can ever be meaningfully challenged"* and that *"It is the non-technological politics rather than the technological practices of higher education which should now be of primary concern to education technologists"*.

Thus, although e-learning have the potential to provide the kinds of flexibility required by learners, there are still some major obstacles such as; 1) the drivers for change should be identified and capitalised on, 2) new possibilities in delivery are available at a cost, so we must find sustainable approaches to these learning methods, 3) new methodologies add a layer

of complexity for all those preparing for e-learning, and 4) new ways of interacting and the free exchange of information require careful consideration of ethical issues (Littlejohn and Pegler, 2007).

2.8 Looking to the Future

The acknowledgement that learning permeates all aspects of our lives has resulted in the emergence of concepts such as "learning society" (Nonaka and Teece, 2001), "knowledge workers" (Rifkin, 2000; Pillay *et al.*, 2006), and "learning communities" (Shapiro and Levine, 1999). These concepts challenge the traditional idea of learning environments as they are all underpinned by principles of lifelong learning and continuous learning (Pillay *et al.*, 2006).

However, higher education is facing a "re-balancing" in response to such changes. Although the current technological revolution promises greater impact, it raises questions about the end and purpose of education "education or business?" The networking model of e-learning systems also raises the questions about the future learning characteristics and level of expertise (Siemens and Tittenberger, 2009).

Learning is also becoming a more complex process reflecting the view that another type of skills, sometimes referred to as 21st century skills, is needed for the society of tomorrow. New literacy, based on the abundance of information and the significant changes brought about technology, is needed. Developing expertise and the depth and quality of learning in a network also requires sustained attention and focus (Siemens and Tittenberger, 2009). There is a paradigm shift from e-learning being seen as a narrow set of isolated learning activities, unsuitable for many learners and many learning situations, to a new vision of e-learning as a

broad approach to learning in the digital age, encompassing rich and dynamic possibilities, engaging learners and looking to the future (Fee, 2009).

This shift in how work processes are viewed in a knowledge economy poses a further significant challenge to existing educational goals and methodologies. The “e” in learning will remain for many years to come. Universities will struggle to maintain a leading educational role among a group of alternate educational ‘‘suppliers’’. It needs a significant structural changes to the manner in which it prepares today’s future learners (Amirault and Visser, 2009).

It can thus be concluded that, only by identifying the full range of these underlying relations and structures can we hope to identify a basis for meaningful and sustained change in the learning environment (Selwyn, 2007).

Chapter 3

E-LEARNING IN DENTISTRY

3.1 Introduction

Dental education is facing many challenges to thrive in this era that is marked by globalisation and an information-intensive environment (Brown, 2001; Abbey, 2002). In addition, there are many internal pressures on dental schools including the reduction in academic staff. These pressures are requiring new ways to deliver dental education (Rushton and Horner, 2008). The important role of learning technology in dental education did show some promising solutions to such challenges and pressures (Abbey, 2002; Andrews and Demps, 2003).

This chapter will start by putting dental education in historical context. It will then discuss several major educational and curriculum concerns with changes. Finally it will look at the role of learning technologies in supporting dental education.

3.2 The Role of Dental Education

The mission of dental education is to train future general dental practitioners. Its basic goals are to (1) educate students to serve their patients and communities well, and (2) prepare students to continue to grow in skill and knowledge over their lifetime in practice (Field, 1995; Baum, 1997; Haden et al., 2006).

However, dental schools are facing many problems that make their job of delivering a balanced curriculum difficult. Four primary factors are quoted as having a critical impact on dental education (O'Neil and Barker, 1989; Field, 1995; DePaola and Slavkin, 2004; Donoff, 2006; Pyle *et al.*, 2006; Farmicola *et al.*, 2008; Cohen and Tedesco, 2009). These factors are;

- Environmental,
- Educational,
- Patients-care,
- Research.

Developments in dentistry and dental education mirror the larger societal patterns of growth and realignment. In addition to the social and economical influences, pressures specific to oral service is altering expectations and opportunities in dentistry. Most importantly are the demographical changes in patients' profile and demands. There are significant improvements in areas such as; the preventive measures, the management of the health care needs for elderly patients, and the management of patients with complex medical problems such as cancer and AIDS (Field, 1995; Haden *et al.*, 2006). However, inequalities in health care still persist and are widely documented (Haden *et al.*, 2006; Petersen, 2008; British Dental Association, 2009).

The accreditation and licensure process for dentists is facing equal challenges. This is reflected in the need for profile and competencies for the general dentist (Plasschaert *et al.*, 2002; Swift, 2008). Several organisations are working toward creating a profile for the international dental professional (Donaldson *et al.*, 2008). These changes call for parallel

changes in dental education to help prepare their students to face the challenging future that they will be working in (Haden *et al.*, 2006; Swift, 2008).

The rapid advances in science and technology are also changing the medical aspects of dental practice. New or improved preventive, diagnostic, and pharmacological interventions are challenging procedure-oriented dental education, and thus altering the face of the dental curriculum even further (Valachovic, 2005; Haden *et al.*, 2006; Pyle *et al.*, 2006; Swift, 2008).

The reduction in clinical academics has been highlighted recently in the United Kingdom and this is also compounding the problems that dental schools are facing (Rushton and Horner, 2008). A survey conducted by the Council of Heads of Medical Schools and Council of Heads and Deans of Dental Schools in 2000 found that staff numbers in UK dental schools were at the minimum viable level (Silke, 2004). Unfortunately, in the UK, this erosion of staff has continued within the last 5 years despite the 25% increase in dental student numbers from October 2005 (Department of Health, 2004). Reasons cited for this severe loss of staff ranged from dental school closures and mergers in the 1990s, financial shortfalls in pay compared to their practitioner colleagues (Margerison and Morley, 2007), and the pressures of staff to produce research for the Research Assessment Exercise (RAE) (Rushton and Horner, 2008). All this is against a global world that is undergoing recession and there are continual difficulties with funding of dental schools (Petersen, 2008).

The importance of basic biomedical and clinical sciences in the dental curriculum is accepted, but there is also a place for economics, social sciences, and ethics (Haden *et al.*, 2006; Pyle *et al.*, 2006; Swift, 2008). This means that, in becoming professionals, students must learn to think about a wide variety of issues (Haden *et al.*, 2006). Dentistry will be at

risk if it does not find a way to accommodate these rapid changes that are affecting all segments of the healthcare professions (Baum, 1997; Haden *et al.*, 2006). It also means that dental curriculum reform and change is needed (Rushton and Horner, 2008; Swift, 2008). E-learning with its ability to expand opportunities may be a solution to these challenges (Cowpe *et al.*, 2009).

3.3 The Need for Change

The last decade of the twentieth century has seen remarkable changes in the curricula of dental schools in the developed countries (Hendricson *et al.*, 2006a). Pressures for change in dental education have driven the Institute of Medicine (IOM), in 1995, to announce its report, *Dental Education at the Crossroads: Challenges and Change*. It highlighted five broad concerns thought to affect the future of dental education, and thus, called for immediate change. These concerns are (Field, 1995);

- Basic science concepts and methods were weakly linked to students' clinical education and experience.
- The curriculum was insufficiently attuned to current and emerging dental science and practice.
- Many problems remained in implementing comprehensive patient care as a model for clinical education.
- Linkages between dentistry and medicine were weak.
- The overcrowded dental curriculum was giving students too little time to consolidate concepts and develop critical thinking skills that prepare them for lifelong learning.

Several attempts in changing dental education approaches have then been made. These attempts ranged from; problem-based and case-based approaches for teaching and learning, outreach programmes, to technology assisted and distance learning (Scott, 1997; Garvey *et al.*, 2000; Abbey, 2002; Rushton and Horner, 2008). Results reported different opinions in the overall impacts of these approaches on dental education (Kelly *et al.*, 1997; Gianni and Martone, 1998; Albanese, 2000; Mofidi *et al.*, 2003; Rosenberg *et al.*, 2003; Eaton *et al.*, 2006).

The need for global communication, together with the fast increase and doubling of scientific information that accompanied the development of the Internet is presenting a challenging situation. The nature of medical and dental education demands that the content be current and evidence based and that educational methods be highly pragmatic and experiential (Hendricson *et al.*, 2006a). This means that, in this era, a dentist will need to be able solve complex patient problems employing more data than is currently available (Abbey, 1992; Eplee *et al.*, 2002).

The American Dental Education Association's Commission on Change and Innovation in Dental Education (ADEA CCI), in 2005, comprehensively addressed all the challenges facing dental education in an attempt to propose a framework for changes in dental curriculum. Three important skills were thought to be of significance in helping dental students overcome the many complex educational and diverse clinical experiences that they will face in the coming century. These skills are; self-directed learning, critical thinking development, and lifelong learning (Swift, 2008).

Although a decade after the IOM report, the same issues still persisted in dental education (Kalkwarf *et al.*, 2005). The pace, approach or degree to improvements in dental curriculum

deemed to be inadequate (Hupp, 2008). A survey conducted in 2002-03 on the state of dental education found that 80% of dental schools still have a traditional-discipline, lecture-based, non-integrated curriculum. Interestingly, 87% of the schools surveyed felt that faculty development related to curriculum, evaluation, and assessment was needed to support desired reforms and sustain educational changes already in place. This highlights the importance of Faculty development and support as a first step towards successful curriculum reform (Kassebaum *et al.*, 2004).

Researchers continued to address the problems of dental education from many perspectives. E-learning and learning technologies were thought to be one of the alternative novel approaches that can support dental education in adapting to these competitive challenges. The latter will be explored in the following section.

3.4 E-learning in Dentistry

The impact of e-learning and learning technologies on dental education have been addressed in the literature from four main domains; 1) technology, 2) students experience, 3) teachers experience, and 4) supporting curriculum change.

3.4.1 Technology

The use of computer-assisted learning (CAL) in dentistry dates back to the 1980s. Initial studies have shown that there is a considerable potential for effective CAL in undergraduate pre-clinical (Lindquist *et al.*, 1997) and clinical dental programmes (Fouad and Burleson, 1997; Plasschaert *et al.*, 1997; Yip *et al.*, 2001). It has also been shown that it can be used as an adjunct to traditional education or as a mean of self-instruction (Wenzel and Gotfredsen,

1997; Perryer *et al.*, 2000; Lowe *et al.*, 2001; Schittek *et al.*, 2001; Rosenberg *et al.*, 2003; Aly *et al.*, 2004).

Some reported advantages of CAL are worth considering such as; a) providing interactivity with the content, thus, supporting the pedagogical approach, especially problem-based learning (PBL) (Plasschaert *et al.*, 1997; Welk *et al.*, 2006), b) visualising concepts in the form of patient simulations and multi-media instructions, thus supporting the preclinical and clinical teaching (Mulligan and Wood, 1993; Wallen *et al.*, 1997), c) providing immediate feedbacks, thus augmenting the self-paced and self-directed learning approaches (Welk *et al.*, 2006), and d) the reported speed of gaining knowledge and the increasing motivation towards learning (Plasschaert *et al.*, 1997; Welk *et al.*, 2006). However, major disadvantages of CAL were the high costs of investments, and their comparatively low flexibility (Scott, 1997). Whilst CAL may have many merits; the teaching of good interpersonal skills, which are essential for successful practice in dentistry, was also difficult via computers alone (Oliver *et al.*, 2002).

The type of technology used in these studies is outdated (Walmsley, 2006), however, a steady improvement in technology is believed to ensure that this electronic method is being adopted in dental education (Hu *et al.*, 2009). This has been reflected in the shift in the literature from comparing technology with traditional instruction to comparisons of different ways or modes of using the technology to support teaching and learning in dentistry (Bednar *et al.*, 2007).

The rapid advances in the internet, digital imaging, videos, multi-media programmes, and computer simulations showed a promising impact on dental education (Mattheos *et al.*, 2001; Packer *et al.*, 2001). However, their cost, time effort, faculty skills and interest, the

difficulty to keep up-to-date (Nattestad and Attstrom, 1997), and the data transmission speed capabilities (Ludlow and Platin, 2000) often prevented their early adoption. The difference between developed and developing countries on the necessary infrastructure for learning technology is also considered a problem (Nattestad and Attstrom, 1997).

Today, with the wide spread use of virtual learning environments (VLE) for teaching and learning, education is changing. This has been accompanied by a surge in the amount of published research within the academic literature. Many pressures have forced higher education to introduce such technologies in education. These pressures include; the increase in computer-based educational activities, the need to improve the quality of the educational experience, improvements in web technology, a shortage of teachers, and an increasing pressure from the government to provide flexible training (Shah and Cunningham, 2009).

However, in dental education, e-learning is a recent phenomenon. A survey undertaken in 2005 for the JISC indicated a high take-up of VLE in all types of institutions, with 86% of further education colleges, 97% of pre-1992 universities and 90% of post-1992 universities reporting the use of at least one type of VLE. However, the use across various subject areas was inconsistent. It was found that medicine, dentistry and veterinary medicine constituted only 16% of the schools using such technology (JISC, 2009).

In the health professional fields, VLE were originally introduced by medical schools to find a way to represent and explain the complexity of the subject and to improve communication with the increasing number of students based at clinical sites distant to the host institution. However, within dentistry, the VLE was mainly introduced to support teaching and learning and compensate for a decreasing number of clinical academics (Shah and Cunningham, 2009). Cook (2005) noticed that although the range of activities carried out with VLE's had

increased within UK medical and dental schools, the main role was still the delivery of the programme and administrative information.

Creating new opportunities for distance learning in dental education was one of the recommendations of the Report of the AADS President's Task Force on the Future of Dental School Faculty (Haden *et al.*, 2000). The major technical obstacles to distance learning have been largely overcome with the availability of high-speed Internet connections among major universities and the development of dual-streaming equipment so that images and data can be transmitted simultaneously. Thus, distance education is becoming part of the solutions to the challenges facing dental education (Bednar *et al.*, 2007; Engilman *et al.*, 2007)

In 2003, Andrews and Demps conducted a survey reporting the opinions of academic deans and faculty members of US and Canadian dental schools in using distance learning and online technology. The primary benefits reported were; the ability to support anytime-anyplace learning, improved communications with students, ability to use multimedia content, and improved management of classroom activities. The primary disadvantages, however, included; lack of faculty development programmes to help faculty acquire e-learning skills, the absence of face-to-face contact with students, lack of instructional design and development support, lack of incentives (e.g., no faculty release time), lack of rewards (e.g., web-based learning development does not always count towards promotion and tenure), lack of interest among some of the faculty, and lack of time to develop and maintain web-based materials. Intellectual property right was also seen as an important issue (Andrews and Demps, 2003).

With the introduction of Web 2.0 technologies, the horizon of teaching and learning has expanded even further. Nonetheless, there does not seem to be significant demand for these

technologies within the health science domain, especially as a global educational approach. It appeared as if they were still focused on using e-learning and Web 2.0 technologies to support blended learning and local populations. They felt better able to maintain current student support using limited functions of the VLE and long standing delivery methods used for distance learning and face-to-face provision, rather than aiming at markets as a further field (Ward *et al.*, 2009).

The use of simulator technology has received much attention in health care education. The virtual reality-based technology (VRBT) designed for the instruction of dental procedures was introduced in the late 1990s. The simulation systems such as, the Haptic technology and the Virtual reality-based technology (VRBT), are interactive computer programmes that simulate real-life clinical scenarios in which the student acts as a health care professional. In these scenarios, the student obtains a history, performs physical examinations, orders and interprets lab and/or imaging tests and finally makes diagnostic and therapeutic decisions (Bergin and Fors, 2003; Zary *et al.*, 2009). To date, the most extensive research on the use of this technology in dentistry has been conducted by Buchanan who found that student use of VRBT resulted in increased productivity in the lab (Buchanan, 2004). This has also been confirmed by others (Gluch *et al.*, 1999; Buchanan, 2001; Kneebone and ApSimon, 2001; Abbey, 2002; Quinn *et al.*, 2003; Jasinevicius *et al.*, 2004; LeBlanc *et al.*, 2004; Schittek Janda *et al.*, 2004; Welk *et al.*, 2006; Steinberg *et al.*, 2007; Zary *et al.*, 2009).

Virtual worlds, such as Second Life (SL) are also finding their ways in dental education. The International Virtual Dental School (IVIDENT), initiated in 2007, is one of the first attempts in this area. It is created by King's College London Dental Institute to become a repository for globally distributed online dental education. Recently, it has changed its name to

Universal Dental E-learning (UDENTE) (King's College London Dental Institute, 2007). Because SL is a three-dimensional global network, recently, it is also being used collaboratively for educational research between UDENTE and the University of Michigan, School of Dentistry's SL environment in an area called Wolverine Island (Phillips and Berge, 2009).

Despite these wide applications of technology in dental education, academic programme administrators and some faculty in dental schools acknowledge that the progress has been slow. Efforts to revise the curricula have found that there is still a lack of faculty development that allows educators to take advantage of such new developments (Dharamsi *et al.*, 2000; Bertolami, 2001; Hendricson and Cohen, 2001; Kassebaum *et al.*, 2004; Hendricson *et al.*, 2007).

3.4.2 Students experience

Students learning experience using e-learning or web-based learning was evaluated in the literature using two different measures; students' performance and students' preference or attitude. Initial concerns in using the technology was to measure its impact on students performance as an indication of knowledge gained, and was measured mainly by comparing pre- and post-exam tests (Ludlow and Platin, 2000; Rosenberg *et al.*, 2003). Although this evaluation method was mainly used with old technologies such as CAL, it is still one of the main approaches used in recent studies. Teasdale and Shaikh (2006) used this approach to assess the efficacy of a geriatric oral health CD as a self-instruction learning tool. Bednar *et al.* (2007) also used it to assess interactive distance seminar instruction in orthodontic residency programme. And Hu *et al.* (2009) assessed the effects of dental 3D multimedia

system on the performance of junior dental students in preclinical practice. These studies have shown positive results in students' learning when using such technologies (Ludlow and Platin, 2000; Schittek *et al.*, 2001; Rosenberg *et al.*, 2003; Teasdale and Shaikh, 2006; Bednar *et al.*, 2007; Hu *et al.*, 2009).

However currently, the most pragmatic approach in educational evaluation is to focus on students' perception of their experience with a learning programme. It is becoming more apparent, that enjoyment and success is a winning cycle in the learning environment. If teaching resources can involve students and lead them to be successful in their endeavours, they are more likely enjoy their tasks and want to become even more involved (Lechner, 2001; Mattheos *et al.*, 2001).

Students' experience in technology use has been assessed under two broad areas of dental education; in supporting the didactic and instructional components, and in supporting the pre-clinical and clinical components of the dental curriculum. In supporting the didactic and instructional components, many positive findings on students' learning experience were reported. The interactivity and engagement were significant when compared to textbooks, articles, or even lecture-based instructional approaches (Ludlow and Platin, 2000; Mattheos *et al.*, 2001; Teasdale and Shaikh, 2006). Visualising concepts was also reported to have a great impact on the procedural skills of students (Aragon and Zibrowski, 2008). These and other advantages can drive the learning attitude towards self-directed learning, which is seen as an important approach for their life-long learning future (Jasinevicius *et al.*, 2004). Self-motivation and self-directed learning were also reported to be critical factors in the success with distance learning approach (Mattheos *et al.*, 2001).

In supporting the pre-clinical and clinical component, virtual patients (VP) and the simulation systems have been evaluated, and proved to be highly effective in developing the students' preclinical and clinical skills (Gluch *et al.*, 1999; Buchanan, 2001; Kneebone and ApSimon, 2001; Abbey, 2002; Quinn *et al.*, 2003; Buchanan, 2004; Jasinevicius *et al.*, 2004; LeBlanc *et al.*, 2004; Schittek Janda *et al.*, 2004; Welk *et al.*, 2006; Steinberg *et al.*, 2007; Zary *et al.*, 2009).

Students fully agreed that the virtual patient technology improves manual skills, improves minor movements with a hand-piece, and increases speed. Students view this technology as having a positive role in preclinical training and feel that they learn faster, arrive at the same level of performance, accomplish more practice procedures per hour, and request more evaluations per procedure or per hour than in traditional laboratories (Buchanan, 2001; Buchanan, 2004; Jasinevicius *et al.*, 2004; Zary *et al.*, 2009). It has also been suggested that this technology could be used to predict which students may need additional tutoring in preclinical operative courses (Buchanan, 2004).

Another use of the virtual patients is for practicing history taking. This approach has been reported to improve the capability of dental students to take a relevant oral health history. Students who undertook history taking with a virtual patient were found to; ask more relevant questions, spend more time on patient issues, and perform a more complete history interview compared with students who had only undergone standard teaching. These students also seemed to have more empathy for the patients than the students who had not been exposed to virtual patients (Schittek Janda *et al.*, 2004).

Studies reported different findings on the significance of feedback from simulation systems. Some studies found it to be very important in enhancing self-directed learning approaches

(Zary *et al.*, 2009). Other studies, on the other hand, found that the extensively detailed and frequent computer feedback from these systems are discouraging to students and, therefore, might be of limited value, especially for the inexperienced student with little understanding of the underlying concepts (Quinn *et al.*, 2003; LeBlanc *et al.*, 2004). An interesting finding in some studies was that students preferred the feedback of a real person or a combination of virtual systems and human instruction (Quinn *et al.*, 2003; Buchanan, 2004).

A students' mindset is critical in the successful adoption of learning technologies. Students demonstrated engagement in Web 2.0 technologies for social use and were able to clearly articulate their use of social networking sites such as, Facebook and YouTube, in other aspects of their lives. However, when students were asked for their willingness to incorporate these tools within their educational process they expressed cautions. They were keen to maintain a distinction between their use of social networking sites and their use of e-learning to support professional development and education. Students wanted to keep their social networking activities separate from the university, seeing this as their social and 'off work' space (Ward *et al.*, 2009).

One important variable not included in most studies assessing students' experience, is students' learning styles. It is possible that certain types of learners do better in a more conventional environment, while others prefer independent, self-directed learning (Jasinevicius *et al.*, 2004). The University of Pennsylvania has noted differences in attitude and skill development based on learning styles. Students with learning styles that place a stronger emphasis on learning from individuals appear to have less enthusiasm for virtual reality technologies (Gluch *et al.*, 1999). This suggests that the technology may be more beneficial for different student groups and allow for individual teaching programmes adapted

to a student's ability and learning style (Buchanan, 2001). However, some have translated it differently and interpreted the high students' interest in participating in these types of educational approaches regardless of learning style might reflect the ability of technology to accommodate different learning styles. This in turn may support the self-directed learning approach (Mattheos *et al.*, 2001; Jasinevicius *et al.*, 2004).

3.4.3 Teachers experience

Very few researchers have included faculty time, efforts, attitudes or teaching experience as variables in their studies. Jasinevicius *et al.* (2004) were one of the few research teams who assessed the faculty instructional time. They performed a controlled study using the DentSim virtual simulation system and showed that dental simulators aided in decreasing faculty time in instruction and facilitated student training of technical skills. They found that students exposed to faculty instructions only received five more instructional times from faculty than did students exposed to virtual systems (Jasinevicius *et al.*, 2004). It was also noticed that the virtual reality (VR) technology offers objective, consistent evaluation of preparations easily obtained at any time during the process of preparing the tooth. The evaluation given included both formative (corrective feedback) and summative (resulting in a final grade) evaluation. This is in contrast to an evaluation given by faculty that consists, for the most part, of evaluation of an end product (Buchanan, 2004). Although teacher-led seminars were still considered important for providing credibility to the virtual systems (Packer *et al.*, 2001; Zary *et al.*, 2009), these findings do suggest a great role of technology in supporting the dental curriculum to overcome some of the faculty shortage problems (Jasinevicius *et al.*, 2004).

Educators and leadership attitudes were also found to be critical in the successful adoption of learning technologies. The majority of researches that assessed teachers' attitudes towards the use of technology reported that the majority of teachers still hold reservations about engaging with innovative pedagogical tools and have not yet realised what can be achieved with these tools. A variety of reasons for such attitudes were reported including; limited skills to explore new e-learning approaches, lack of the requisite IT skills to engage, lack of students' maturity, and the concerns of shifting the balance of power between academics and students (Boulos and Wheeler, 2007; Ward *et al.*, 2009). Other reported concerns were; the incentive to develop educational software to fit specific educational needs (Hendricson *et al.*, 2004; Welk *et al.*, 2005), the cost-advantage ratio (Welk *et al.*, 2005), the effect on lecture attendance, the feedback from students on existing online materials and the reluctance of staff to share their materials online (Gupta *et al.*, 2004). The introduction of a third modality for dissemination of information in addition to textbooks and journal articles also raised a dilemma for quality control (Spallek *et al.*, 2000).

Zemsky and Massy (2004), investigated e-learning application at six universities that had major investments in information technology. They explored three assumptions of the use of information technology:

1) if we build it, they will come;
2) students will take to e-learning like ducks to water; and
3) e-learning will force a change in the way we teach.

Surprisingly, it was found that all three assumptions were not true. They then concluded that e-learning will only become pervasive when faculty change how they teach – not before.

Faculty's concerns may require significant changes in attitudes and culture before potential benefits can be achieved.

From this review it seems that the biggest constraint to moving education to the Internet is not technical resources, but Faculty development. Thus, colleges and universities must address the need to assist Faculty members in their efforts to integrate technology into instruction. And perhaps the focus of Faculty development needs to be on pedagogical issues, as opposed to technological issues (Palloff and Pratt, 2002; Andrews and Demps, 2003).

With this proviso, it seems difficult to see how the new goals are to be accomplished in the currently available structures. Further research is needed to explore the impact of learning technologies on the teaching experience of dental educators.

3.4.4 The impact of e-learning on dental education

E-learning technologies do not change how human beings learn. What technology does, as explained by Harden and Hart (2002), is that it removes constraints and expands possibilities of the learning experiences that we create. Any technology that enables students to learn with significantly less supervision from faculty and in less time than using traditional methods could have major implications for dental education (Jasinevicius *et al.*, 2004).

Problem-Based Learning (PBL), designed for small tutor guided groups, demands a high level of communication and interaction among students (Mattheos *et al.*, 2001). Web-based virtual environments are likely to support such collaborative activities, which often can achieve a higher level of interactivity than the one prevailing in traditional face-to-face

classrooms (Cravener, 1999). Significant improvements in skills have been noted among virtual classroom students, indicating the learning effectiveness of the method. Also the ability to record and categorise each discussion and intervention during the learning sessions allows the tutor and the students to re-examine the whole learning process and single out, for example, the most important or most difficult concepts (Gianni and Martone, 1998; Mattheos *et al.*, 2001; Jasinevicius *et al.*, 2004). However, some knowledge of the problem-based learning method was seen necessary when this technique is applied to a virtual classroom scenario (Mattheos *et al.*, 2001). This supports the argument by Hannum, that media in itself does not produce learning effects and that the pedagogy, not the technology, matters when learning through technology (Hannum, 2007).

In the past, the available distance learning media did not easily allow satisfactory level of interaction between students and teachers. It was found that such approaches were much more demanding for staff members than in-classroom teaching and requires much more time and careful planning (Mattheos *et al.*, 2001). Nowadays, with the advances in the technology and the invention of videoconferencing has made it easy to originate seminars from locations outside academic institutions. This might have a great impact in reducing the problems associated with decreasing numbers of experienced full-time faculty. Part-time clinical faculty can conduct interactive seminars from a computer at a private practice and focus their physical time more on treating patients (Bednar *et al.*, 2007).

Technology related to the presentation of case-based scenarios and simulation technology is also increasingly available, enabling schools to more easily access and develop electronic case scenarios (Buchanan, 2001; Abbey, 2002; Jasinevicius *et al.*, 2004; Kramer *et al.*, 2009; Zary *et al.*, 2009). Dental schools are beginning to see a variety of new ways in which

simulations can help improve and change the way dentistry is taught (Abbey, 2002; Jasinevicius *et al.*, 2004; LeBlanc *et al.*, 2004; Zary *et al.*, 2009). These benefits included;

1) Making basic science clinically relevant.
2) Preparing for clinical problem solving.
3) Teaching new clinical content.
4) Making hard-to-find patients available.
5) Providing opportunities for practice and remediation.
6) Creating standardised patients for measuring competency.
7) Teaching self-evaluation using the self-assessment tools.

Virtual patient and simulation technologies may also support dental schools in overcoming many of their problems such as; the difficulty in recruiting faculty for preclinical courses, the need to reduce costs while maintaining or improving student learning, and the difficulty in obtaining sufficient patient pools to address student needs. It also aids in providing a smoother transition for students into the clinic and improve the delivery of supporting material such as demonstrations, diagrams, manuals, etc (Buchanan, 2001; Zary *et al.*, 2009).

Thus, the net advantage in using simulation technology would be more efficient knowledge gain with less students and faculty time (Zary *et al.*, 2009). This is consistent with Dental Education's Response to Curriculum Reform Initiatives, which among many recommendations includes a call to "increase learning of clinical skills at chair-side and decrease time spent in preclinical laboratories" and to "utilise technology . . . including informatics and operatory simulations" (Hendricson and Cohen, 2001).

Many studies reported considerable potential for learning technology in dental education. However, investigating how these technologies are being employed in the health profession suggested that e-learning development and its use did not seem to have reached the full potential of these technologies. The main engagement was found to be with instructive learning approaches managed through a virtual learning environment (VLE) and had not been used extensively to support higher-level teaching and learning (Ward *et al.*, 2009).

3.5 E-learning: Where Are We Now?

In an attempt to follow the current trend of evidence-based e-learning approach in dental education, it is increasingly evident that synthesising and reviewing evidence is a complex and challenging matter (Wolf, 2000). The professions seem still struggling to find valid methods of evaluating the explosion of new innovation in teaching/learning strategies (Lechner, 2001). Parallel to that, the difficulty of evaluating any educational philosophy in a scientific manner is highlighted by the many different methodologies used in attempts to prove its efficacy (Albanese, 2000). The rapid advances in the technology are complicating the situation even further (Khan, 2005).

Kassebaum *et al.* (2004) surveyed US dental schools and found that increased use of computer-based technology was the 'most often selected curricular innovation. IT specialists, also predicted a rapid rate of change (Hillenburg *et al.*, 2006). However, Hendricson *et al.* (2004) reported that, *'E-curriculum implementation among North American dental schools is following the classic innovation pattern in which a few early adopting institutions proceed rapidly while the majority of potential adopters make*

modifications slowly'. They also noted that few dental schools use online courses, and at most schools, few faculties have received training in online instructional techniques.

University administrators predicted that the change to a more technologically advanced curriculum will take time, particularly in dental schools. Reasons cited for a slow implementation included funding, caution and reluctance on the part of the faculty, potential for loss of local control of the didactic curriculum and students who, although competent in the use of computers, are used to learning the 'old way'. The attitude of students who might expect significant contact with faculty in return for paying high tuition is also becoming an obvious issue (Hillenburg *et al.*, 2006).

3.6 Conclusion

Change in the dental educational world means having to rethink the way we teach. Increasing competition and globalisation bring new challenges to an institution's management. At the same time, the expectations of students, the dental environment and society with respect to academic institutions and their actions have increased. Under these considerations, sustainability is becoming a challenge for all dental schools (Haden *et al.*, 2006; Donaldson *et al.*, 2008).

In light of these dramatic findings it can be stated that, learning technology does show a promising solution in supporting the dental curriculum (Abbey, 2002). New technological tools are being developed every day, but the pace of change was found to be determined by teachers and their willingness to explore new solutions based upon technology. It was also found to be limited by funding and leadership priorities (Hillenburg *et al.*, 2006).

Faculty development is where most of the challenges lie (Haden *et al.*, 2006; Thomas, 2009). True curriculum change designed to develop students who are active and self-directed learners will require dental schools to implement comprehensive faculty development programmes. These programmes should concentrate on expanding the role for faculty in learning new educational methodologies to create a new student learning environment (Licari, 2007). These developments need also to be balanced with the inherent risks and challenges of present day education, and further research undertaken to explore them (Ward *et al.*, 2009). Dental school administrators must fully understand the need for change and make a commitment to provide the resources to facilitate this faculty development process and subsequently alter the criteria used to evaluate faculty for promotion and tenure (Licari, 2007).

As Novak (2009) identified; 1) to be agents of change, we need not only a roadmap for change, but also the time to focus on the roadmap and the tools to implement it, 2) we need to recognise and appreciate that new, young faculty members represent a new generation and therefore may approach their careers differently from most mid-career faculty members, and 3) we need to maintain enthusiasm for our careers and project this enthusiasm to both our students and our new, young faculty members (Novak, 2009).

SECTION THREE

A PILOT STUDY

Chapter 4

POTENTIAL USE OF ONLINE LEARNING IN TEACHING ORTHODONTICS (A PILOT STUDY)

Chapter 4

POTENTIAL USE OF ONLINE LEARNING IN TEACHING ORTHODONTICS (A PILOT STUDY)

4.1 Introduction

Early concerns that electronic learning (e-learning) or computer assisted learning (CAL) might be inferior to traditional teaching methods have been disproved by number of studies (Turner and Weerakone, 1993; Clark *et al.*, 1997; Lowe *et al.*, 2001; Rosenberg *et al.*, 2005). The use of (CAL) programmes has been reported to enhance dental education and provide learning opportunities that could not be taught by traditional strategies (Schittek *et al.*, 2001). In 2002, the University of Birmingham, School of Dentistry outlined a policy for all teaching staff highlighting the aims and benefits of developing an on-line e-course. It included suggestions on how to blend CAL into the teaching process (Gupta *et al.*, 2004). Since then several departments have provided e-learning material. After the initial enthusiasm of material being placed on the e-course, orthodontics was identified as an area which would benefit from the provision of such approach.

4.2 Aims

The purpose of this pilot study was to develop an online undergraduate orthodontic e-course and assess its success as a learning resource from the students' perspective.

4.3 Objectives

The orthodontic e-course was developed to supplement the undergraduate orthodontic teaching curriculum. Its primary objectives were to;

1) Provide an interactive teaching method,

2) Allow anytime and anywhere access,

3) Help students test their knowledge with immediate feedback, thus motivating the learning attitude of the students towards self-directed learning,

4) Strengthen the undergraduate students' clinical skills by presenting a variety of orthodontic cases which students can assess, diagnose and treatment plan. The latter objective might potentially overcome the limited clinical time and exposure that undergraduate dental students have to orthodontic patients.

Other secondary objectives included facilitating easy updating of course content, providing students with faculty-reviewed resources online and providing an accessible way for student-teacher interaction through e-mails and discussion boards, thus strengthening student-teacher relationships.

4.4 Materials and Methods

4.4.1 Development phase

An on-line orthodontic e-course was built as a virtual learning environment (VLE) supporting the didactic and clinical components of the undergraduate orthodontic curriculum at Birmingham University, School of Dentistry. It was made compatible with the web platform used by the School of Dentistry at the University of Birmingham, using the software Bespoke (Bespoke Microsoft Interdev 6. Microsoft Certified Partner, UK).

The developed orthodontic e-course was composed of eight main components;

1) Welcome page
2) Course overview
3) Modules
4) Photo gallery
5) Clinical consultations
6) Glossary
7) Reading lists
8) Resources

These components and their subdivisions were accessed from a main menu bar positioned to the left of all orthodontic e-course pages (Figure 4.1).

Orthodontic e-course "Main Menu"

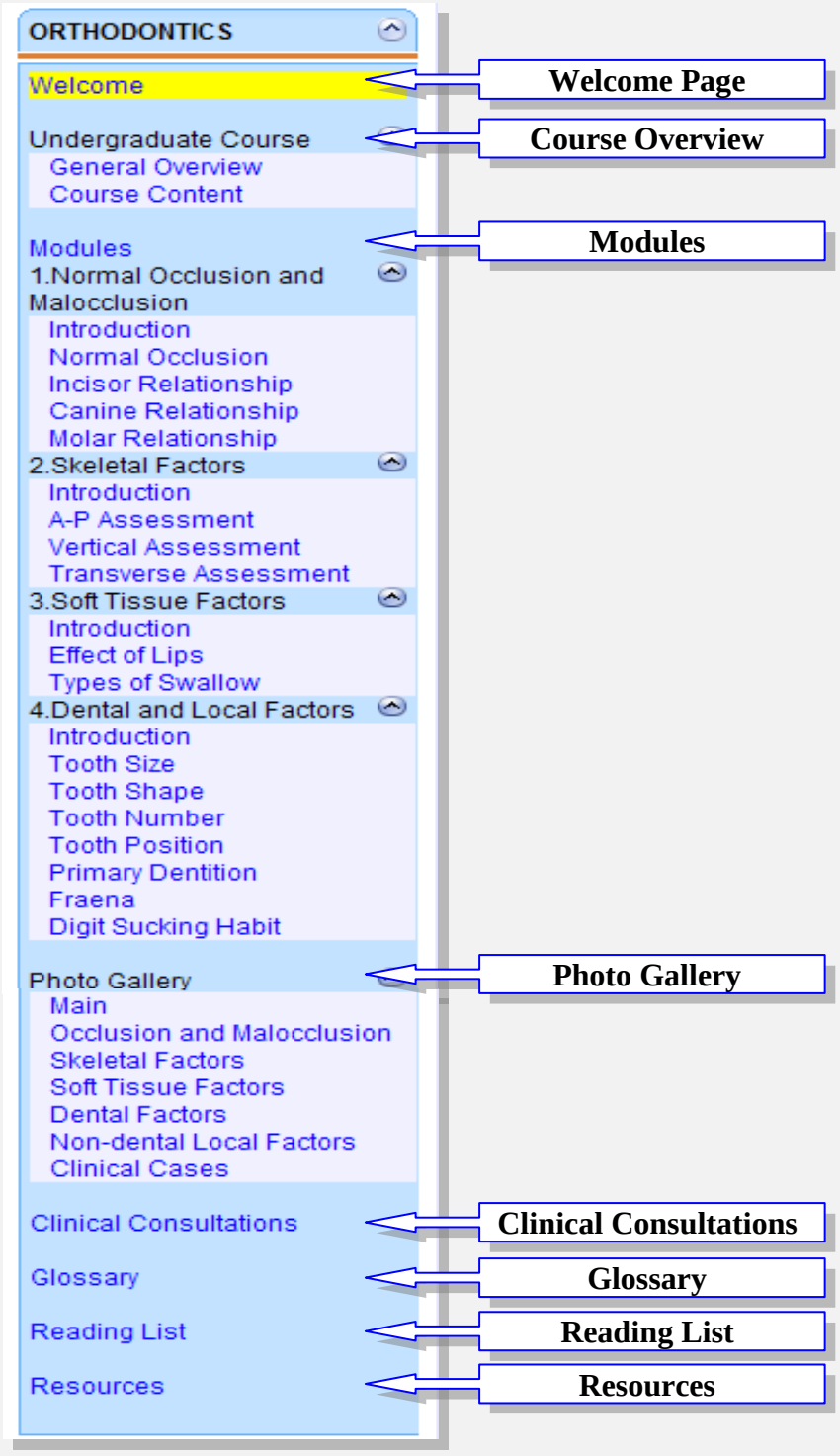


Figure 4.1 An enlarged view of the "Main Menu" bar showing the main components of the orthodontic e-course and their sub-divisions.

Photographs and radiographs presented in the orthodontic e-course were reproduced from a number of resources. Intra-oral photographs and radiographs were reproduced from photographs taken of patients attending for orthodontic treatment at the Birmingham Dental Hospital. Prior consent was gained from patients or parents / guardians. Extra-oral photos were made anonymous by masking patients' eyes. Other resources used included; The Color Atlas of Dental Medicine (Rakosi *et al.*, 1993) and Imagines Demonstrandae (Weisner, 1964). Both were appropriately referenced within the e-course. Radiographs were reproduced so that they could be enlarged for better viewing via a link labelled 'Click to enlarge'.

Illustrative figures were used in different parts of the orthodontic e-course to aid in the explanation and visualisation of some orthodontic principles. A number of illustrative figures were developed by the author using the software packages Adobe Photoshop and Macromedia Flash (Macromedia Flash Release 6.0 for Windows and Macintosh. Macromedia incorporated, 600 Townsend Street, San Francisco, CA 94103, USA). Others were reproduced from the Color Atlas of Dental Medicine (Rakosi *et al.*, 1993) and Imagines Demonstrandae (Drum, 1970) and were appropriately referenced within the e-course.

Animations were developed by the author using two software packages; Macromedia Flash and Adobe Image Ready (Adobe Image Ready Release 7.0. for Windows and Macintosh. Adobe Systems Incorporated, 345 Park Avenue, San Jose, California 95110, USA). Their main aim was to allow some orthodontic concepts to be visualised more readily, thus allowing better understanding.

One PowerPoint presentation describing the six keys to normal occlusion (Andrews, 1972) was developed using the software Microsoft Office PowerPoint 2003. It included intra-oral photographs and illustrative figures.

Each component of the orthodontic e-course will be described briefly in the following sub-sections.

4.4.1.1 The “Welcome page”

The "Welcome page" provided an introduction to the orthodontic e-course and a brief explanation of its main components.

4.4.1.2 The “Course overview”

The "Course overview" component was composed of two subdivisions; the general overview and the course contents. The "General overview" page presented the aims, objectives and learning outcomes of the undergraduate orthodontic curriculum. The "Course contents" page presented outlines of lectures, seminars, course work and assessments during each term of the undergraduate orthodontic curriculum.

4.4.1.3 The “Modules”

The "Modules" presented the didactic component of the undergraduate orthodontic curriculum in an interactive manner.

Four undergraduate orthodontic lectures were chosen for the present study and converted into a web-based format using text, photographs, PowerPoint presentations and animations. The topics covered in these lectures were; “An introduction to normal occlusion and

malocclusion" and "The aetiology of malocclusion". The latter topic was divided into three lectures entitled; Skeletal factors, Soft tissue factors and Dental and local factors.

Each module was composed of an introduction page and subheading pages. The introduction page of each module listed the learning outcomes required and links to other subheading pages within that module.

In addition, each module was supported with two interactive parts; "Self-test" and "Fill in the patient's file". The "Self-test" part presented questions where students were allowed to test their knowledge and were provided with immediate feedback (Figure 4.2).

In the "Fill in the patient's file" part, the provided learning material was applied to an actual clinical case. A single patient's records 'NH' was used throughout the modules and different assessments were required according to each module (Figure 4.3). The aims of this part were to help develop the logical thinking of students and help build their clinical skills.

At the bottom of each page of the "Modules" component, students were provided with links to other areas of the orthodontic e-course. The aim of these links were to supplement each specific module with further learning materials, photographs, radiographs and clinical cases. They were linked to the relevant pages on the following sections; the learning outcomes, photo gallery, clinical consultations and reading list.

There was also a "Contact Us" icon which is an e-mail link to academic orthodontic staff at the School of Dentistry, University of Birmingham. The aim of this link was to strengthen student-teacher relationships and help teachers become aware of student needs to allow further development of the programme.

Self-test formats

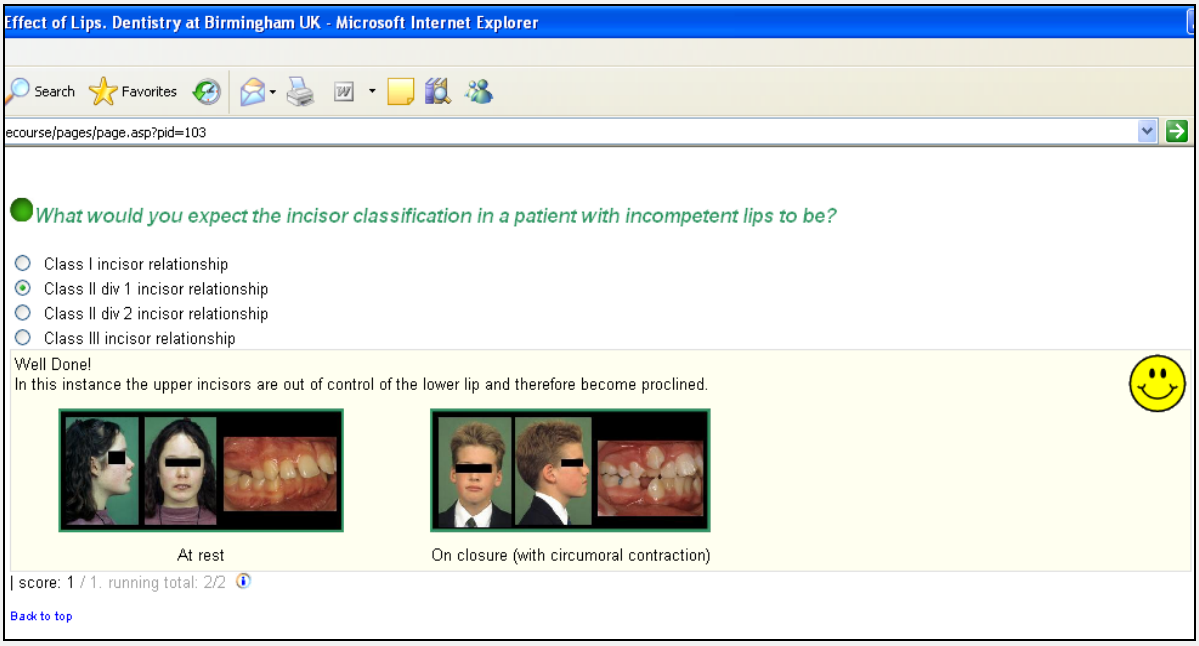


Figure 4.2 An example of a self-test question with one of the feedback formats.

"Fill in the patient file" format

a) **"NH" patient presented in the "Canine Relationship" section.**

b) **"NH" patient presented in the "A-P Skeletal Assessment" section.**

Figure 4.3 Two examples of the "Fill in the patient's file" format showing the presentation of the patient's 'NH' problem in two different modules.

4.4.1.4 The "Photo gallery"

The aim of the "Photo gallery" component was to supplement the "Modules" with more photographs and radiographs (Figure 4.4). It was composed of seven sections; "Main page", four pages corresponding to each subheading of the modules, and a "Clinical cases" page. In the latter section, extra-oral and intra-oral photographs of five clinical cases with varying malocclusions were presented. Assessments and diagnoses of these patients were also described at the appropriate level for undergraduate dental students.

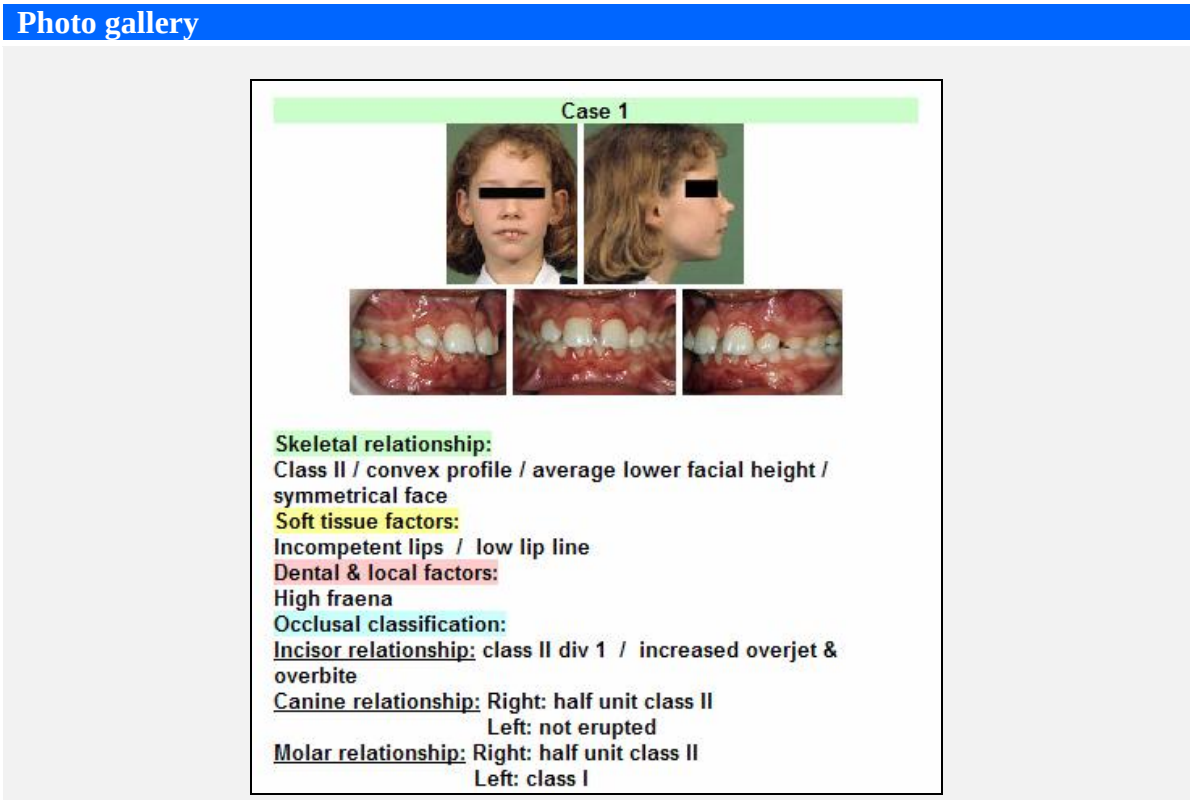


Figure 4.4 An example of a format of a clinical case in the "Photo Gallery" component.

4.4.1.5 The “Clinical consultations”

The “Clinical consultations” component simulated a virtual clinical environment where students can assess, diagnose and propose treatment plans for a variety of patients with orthodontic problems. This would potentially allow them to carry out orthodontic assessments of patients and consequently be able to answer three important questions:

1) Is the patient in ***need*** of orthodontic treatment? And if so,

2) Can I as a ***GDP*** carry out this treatment if I wish to do so? or,

3) Should the patient be ***referred*** to a specialist?

These aims were achieved through links to three orthodontic patients. Each clinical case was fully illustrated including intra-oral and extra-oral photographs (Figure 4.5).

In each case, a file pro-forma was designed to provide information on the patient's medical history, soft tissue morphology and any relevant dental and local factors. Students were then required to fill in the information related to the patient's skeletal relationships using short answer boxes which allowed them to check their answers and get immediate feedback (Figure 4.6).

This was followed by a section where students would describe how the various etiological factors contributed to the patient’s malocclusion. The "Skeletal factors" section was presented with short answer boxes for students to fill and check their answers (Figure 4.7).

Clinical consultation (Photographs and file pro-forma sections)

Figure 4.5 Extra- and intra-oral photographs of the "Case 2" patient.

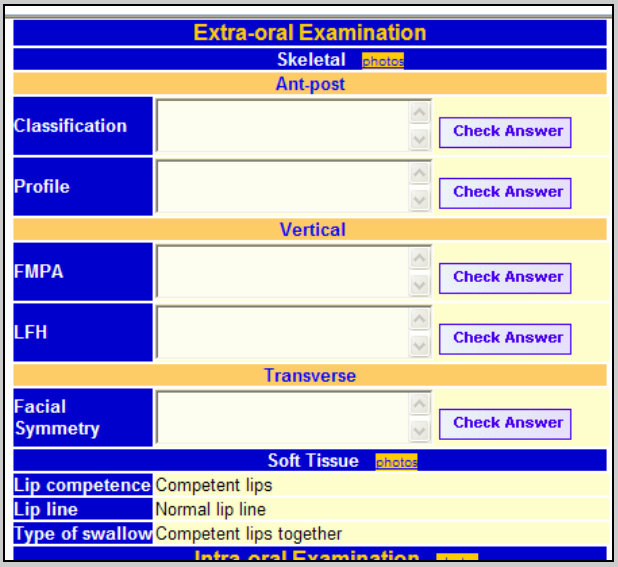


Figure 4.6 A section of the file pro-forma of "Case 2" demonstrating the "Skeletal factors" section presented with short answer boxes.

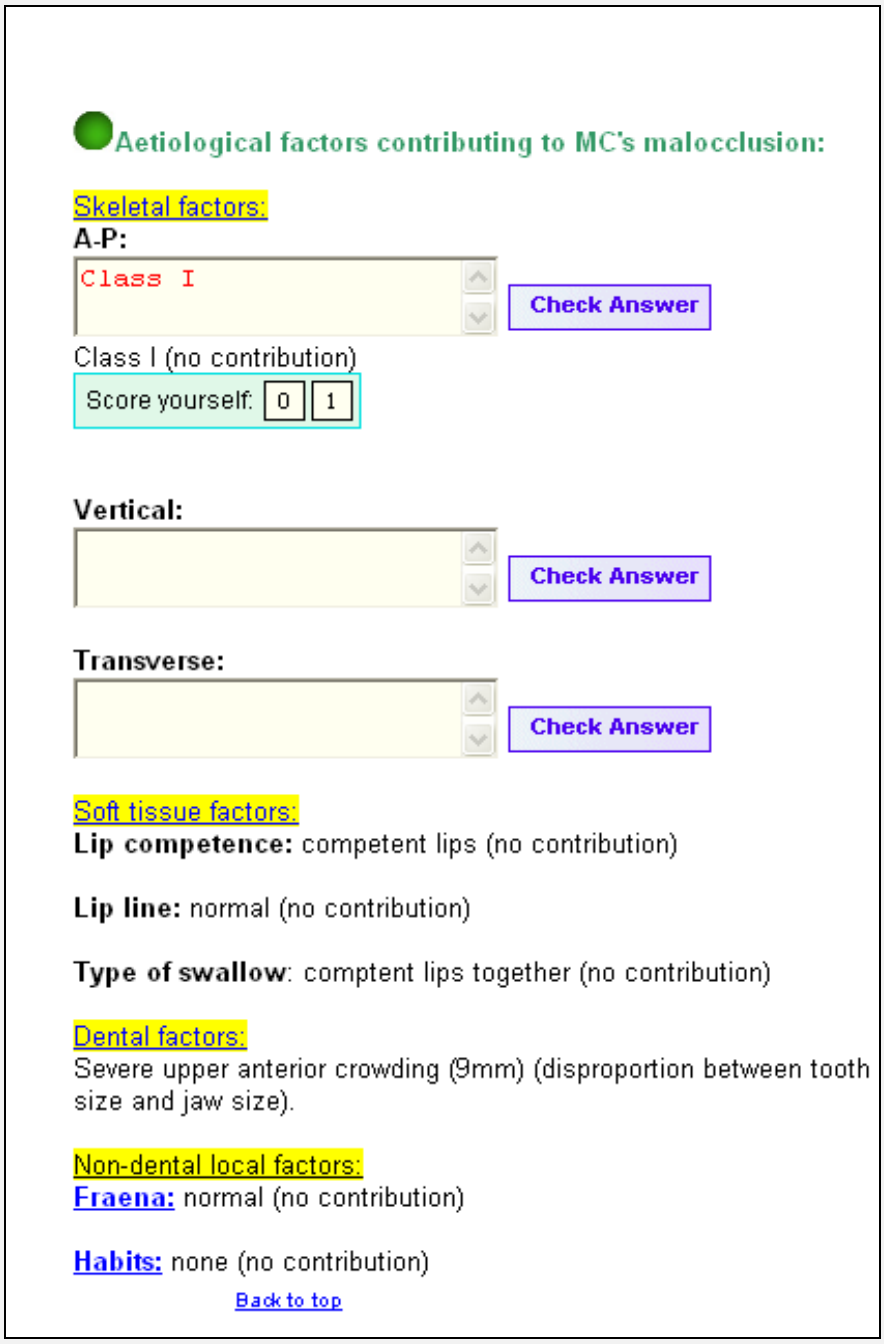


Figure 4.7 The "diagnosis" part for "Case 2" demonstrating the "Skeletal factors" section presented with short answer boxes.

4.4.1.6 The “Glossary”

In the “Glossary” component, definitions of some orthodontic terminology were provided with illustrative figures (Figure 4.8).

4.4.1.7 The “Reading list”

The "Reading list" page included links to the undergraduate orthodontic lecture hand outs and other reading material required for each module.

4.4.1.8 The “Resources”

The "Resources" page provided a list of references from which the orthodontic e-course material had been reproduced.

Glossary

Class I molar relationship	The tip of the mesio-buccal cusp of the upper permanent first molar occluding in the buccal groove of the lower. *(Handout)*	
Class II molar relationship	The mesio-buccal cusp of the upper first molar is mesial to the buccal groove of the lower first molar. It can range from: 1. Half unit class II molar relationship 2. Full unit class III molar relationship	
Class III molar relationship	The mesio-buccal cusp of the upper first permanent molar is distal to the buccal groove of the lower permanent first molar. *(Handout)*	

Figure 4.8 A section of the "Glossary".

4.4.2 Assessment phase

4.4.2.1 Subjects

Sixty-four third year undergraduate dental students (26 males and 38 females) attending the School of Dentistry at the University of Birmingham were selected as the study sample. Their average age was 20.7 years (age range: from 20-25 years). Their previous orthodontic experience was five months of traditional orthodontic teaching and their clinical experience was limited to assessing patients with orthodontic problems and taking the proper records and radiographs. They had a previous experience in using the schools' e-course in different subject matters.

Students were divided into six groups of 10-12. Each group was given a 15-minutes introduction to the orthodontic e-course by the author in one of the School's computer labs. The introduction included a general overview of the orthodontic e-course including its main components, subheadings and the left main menu bar.

Students were then given 30-minutes to navigate through the programme. They were asked to navigate only through one of the modules and visit the other components of the orthodontic e-course. And then they were required to fill in a questionnaire.

4.4.2.2 Evaluation method

Following an extensive review of the literature, a questionnaire was designed for the quantitative assessment of the undergraduate orthodontic e-course (Appendix I).

A brief introduction was included which described the aims of the study and instructions on how to answer the questions. This was followed by a section where students were asked to fill out their demographic data including gender, year of study and age.

The main part of the questionnaire was divided into four main categories according to the "E-Learning Success Model" developed by Holsapple and Lee-Post (2006). These categories were; course design, course delivery, course outcome and general overview. The latter category was designed specifically for the current study. The questionnaire was comprised of thirty one questions which included twenty four Likert scale questions, six open-ended questions and one multiple choice questions. At the end of each category the open-ended question 'Do you have any other comments?' was included (Appendix I).

Responses to Likert scale questions were based on scores from 1 to 5, with 1 representing a very positive response, up to 5 representing a very negative response.

The objective of the ***"Course design"*** section was used to assess the overall design of the programme and the content. It comprised of eleven Likert scale questions and one open-ended question for comments. Four of these Likert scale questions were designed to assess the programme for; its ease of use, ease of access, ease of searching for information and clarity of navigation through screens. The other seven Likert scale questions were designed to assess the content for; the ease of understanding information, clarity and motivation, relevance of the content to learning outcomes, interactivity and helpfulness in testing knowledge and providing feedback.

The objective of the ***"Course delivery"*** section was to assess the effectiveness of the different methods used for delivering learning material. It consisted of six Likert scale questions and one open-ended question for comments. Likert scale questions were designed

to assess; the helpfulness of the photo gallery, helpfulness and clarity of the glossary, clarity and informative nature of the images, and the relevance of the animations to content.

The objectives of the ***"Course outcome"*** section were to assess the effectiveness of the undergraduate orthodontic e-course as a learning resource and the net benefit of the programme. It consisted of seven Likert scale questions and one open-ended question for comments. Likert scale questions assessed whether the orthodontic e-course was informative, well presented, easy to learn, enjoyable, more interesting than reading books, a significant learning resource and helpful in understanding orthodontic principles.

The ***"General overview"*** section consisted of three questions with different objectives. These questions were;

1) A multiple choice question to assess the potential use of the undergraduate orthodontic e-course as a teaching method. It stated that 'In your opinion, this material is best suited as'. Four options were provided; (a) an optional supplement to traditional lectures (revision, make up for absences, etc.), (b) an integrated component of the undergraduate orthodontic course, (c) useful to replace some of the traditional lectures, and (d) other, where students were required to explain further why they chose this option.

2) The objectives of the second and third open-ended questions were to assess the students learning needs by asking them 'What do you consider to be the best things about the programme?' And 'Do you have any suggestions for improving the on-line course?'

4.4.3 Statistical analysis

Results were analysed using Microsoft Office Excel 2003 and Special Package for Social Science (SPSS Release 12.0.1 for Windows 2003. SPSS Inc., 233 S. Wacker Drive, Chicago, Illinois 60606, USA). They were first analysed for the overall responses to each Likert score using Frequencies and Descriptive Statistics, and then gender differences were tested using Mann-Whitney test with significant levels set at ($p<0.05$).

4.5 Results

The subjects' response rate was 100%. None of the subjects gave a very negative response (score 5). The negative response (score 4) was only given by 1-2 subjects in 8 questions. Furthermore, a Mann-Whitney test revealed no significant difference between genders for all questions answered ($p=0.05$), the data was therefore pooled for further analysis. Results are shown in percentages and displayed in graphical forms in the following sections.

4.5.1 Course design

The efficiency of the e-course programme in terms of; ease of use, ease of access, ease of searching for information and the clarity of navigation through screens was positively accepted by students. However, 16% reported undecided responses when assessing the ease of searching for information (Figure 4.9).

When students were asked to assess the content design, overall positive responses were reported for the ease of understanding information, the clarity of the content, its relevance to the learning outcomes, its interactivity, and its helpfulness in testing their knowledge. They were also asked "Did the module motivate you to acquire further knowledge?" 33% reported very positive, 44% reported positive and 20% reported undecided responses. Students also positively accepted the helpfulness of the feedback provided in the "Self-test" part; however, 14% reported undecided responses (Figure 4.10).

Course design

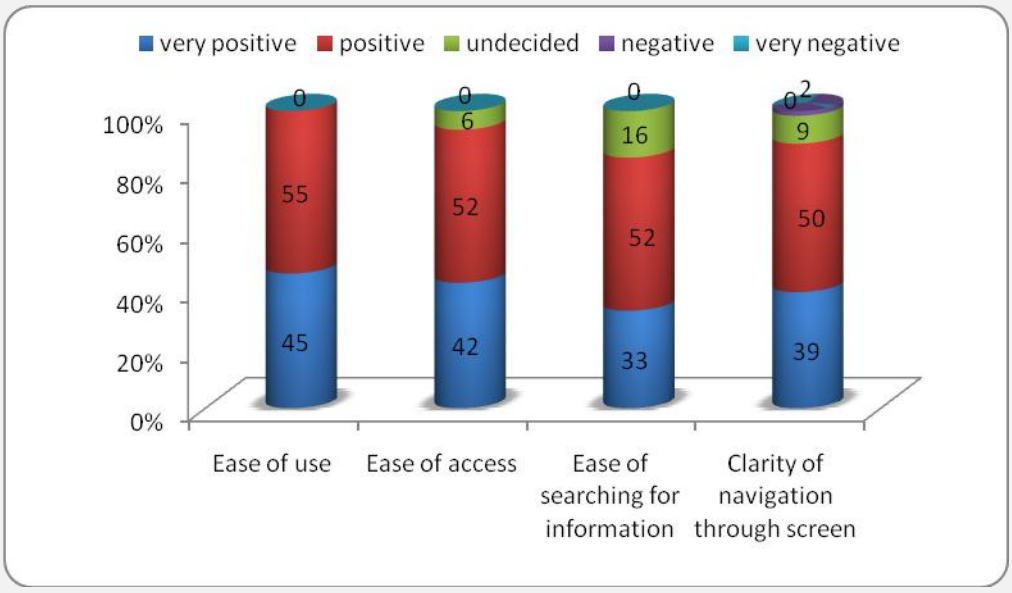


Figure 4.9 Programme design: questions designed to assess the design of the programme and their percentage of responses (From very positive - up to - very negative responses).

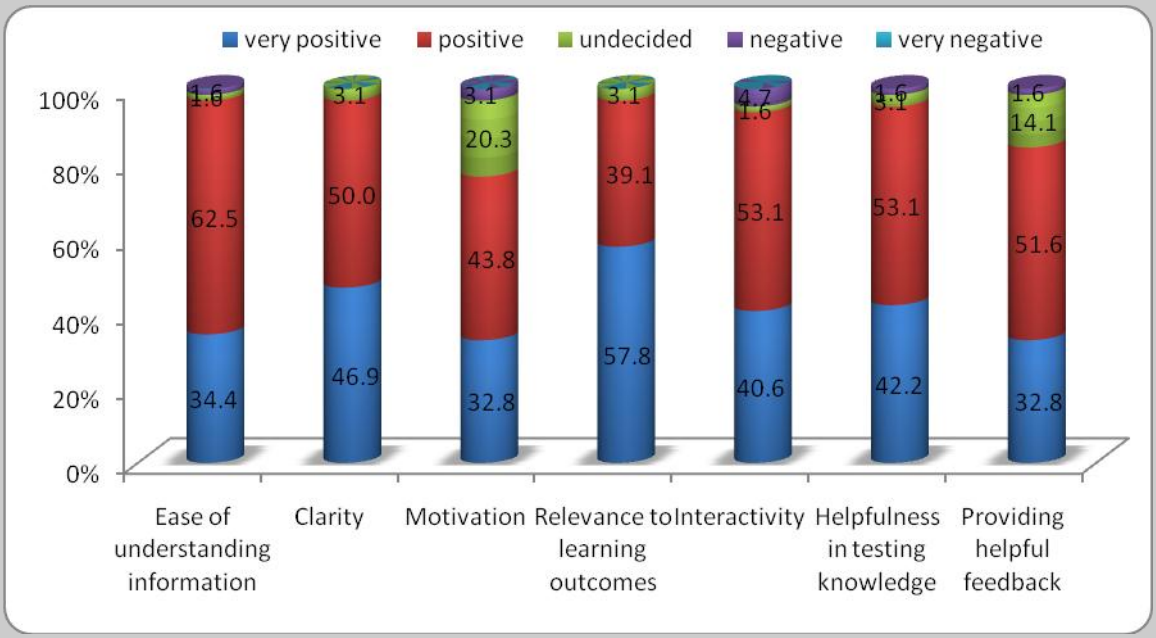


Figure 4.10 Content design: questions designed to assess the design of the content and their percentage of responses (From very positive - up to - very negative responses).

4.5.2 Course delivery

The objectives of the course delivery section were to assess the effectiveness of the different methods used for delivering the learning material. These methods included; the photo gallery, the glossary, the images and the animations. Students were highly satisfied with these methods and reported overall very positive responses (Figure 4.11).

4.5.3 Course outcome

The significance of the orthodontic e-course as a learning resource is highlighted by the overall positive responses allocated in all questions designed to assess the course outcome and the net benefits of the programme (Figure 4.12).

4.5.4 Potential use as a teaching method

Students were also asked to assess the e-course as a teaching method. Almost half of the subjects (52%) felt that the orthodontic e-course should be an integrated component of the undergraduate orthodontic course. 34% of them indicated that it should be an optional supplement to traditional lectures and should be used as an aid in revision for exams or to make up for absences. However, only 5% indicated that the orthodontic e-course was useful in replacing some of the traditional lectures and 9% chose the option of 'other opinion'. The latter group explanations were generally that the orthodontic e-course fulfilled more than one of the previous options (Figure 4.13).

Course delivery

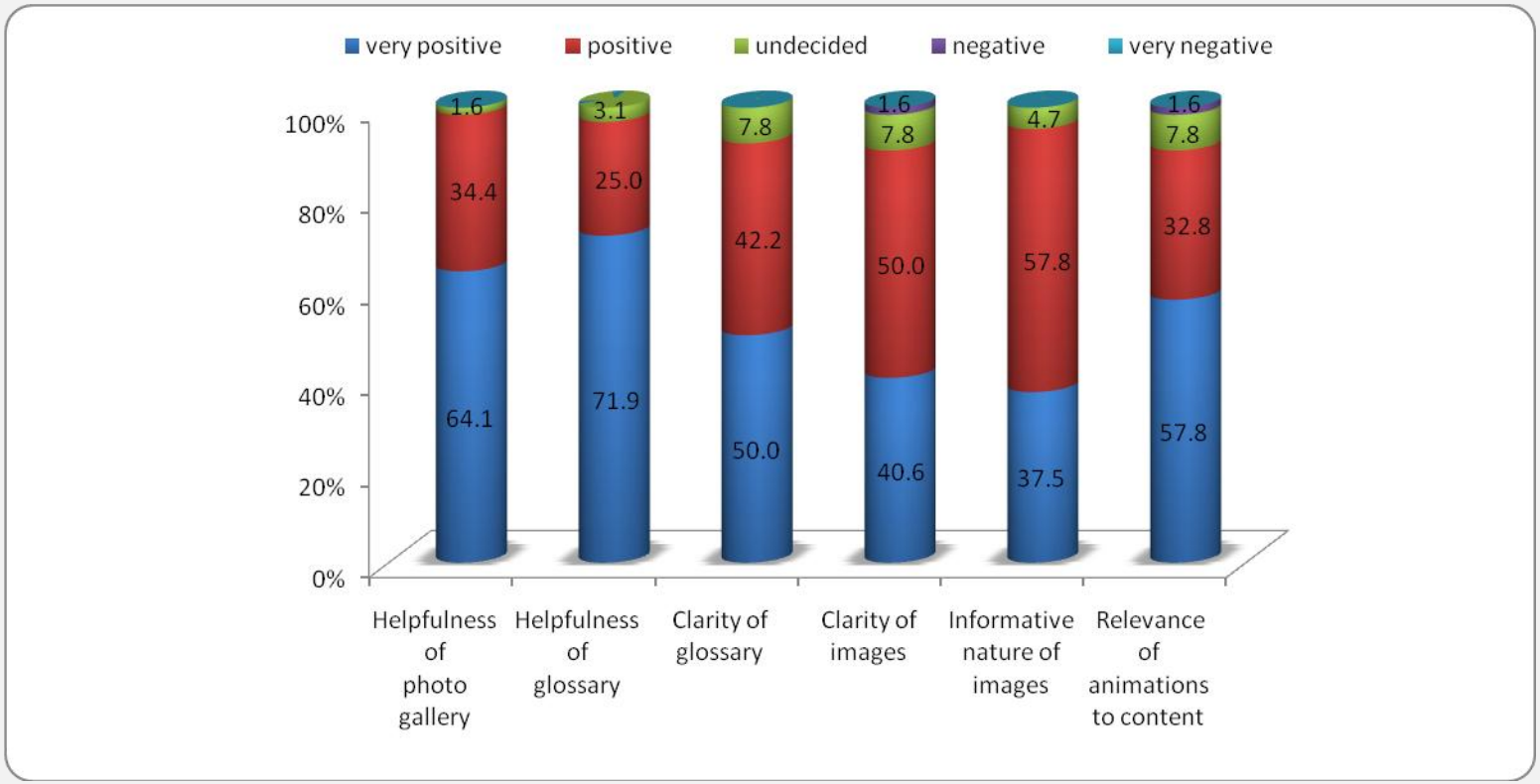


Figure 4.11 Course delivery: questions designed to assess the effectiveness of the different methods used for delivering the learning material and their percentage of responses (From very positive – up to - very negative responses).

Course outcome

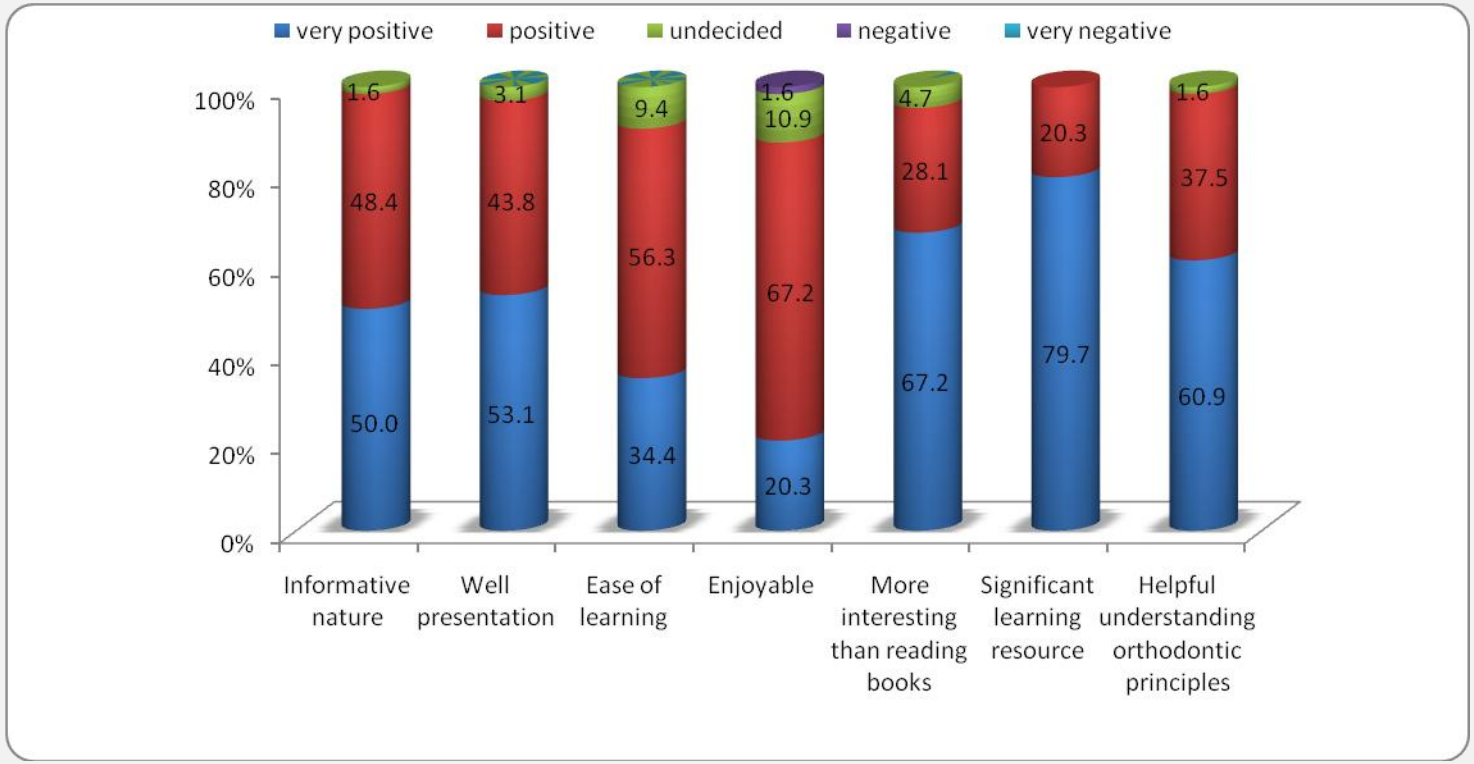


Figure 4.12 Course outcome: questions designed to assess the effectiveness of the orthodontic e-course as a learning resource and their percentage of responses (From very positive – up to - very negative responses).

Potential use of the orthodontic e-course as a teaching method

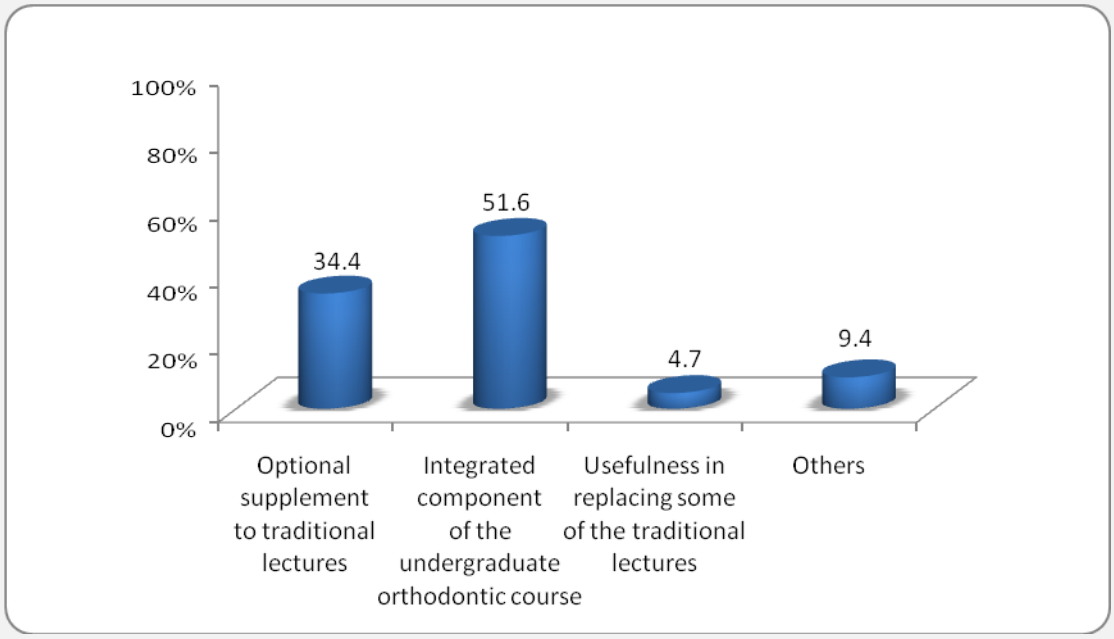


Figure 4.13 Percentage of responses for four options of a multiple choice question designed to assess the potential use of the orthodontic e-course as a teaching method.

4.5.5 Other comments

Major benefits were rated by 97% of the students that the orthodontic e-course was considered a significant learning resource and a good supplement to traditional lectures and books. Students reported that it had the added advantages of being interactive, easy to use and to understand, visualised concepts with images and animations, concise and provided good assessment of gained knowledge. In addition, it presented information in a variety of methods such as the photo gallery, the glossary and the clinical cases. The advantage of being able to 'do it at your own pace and time' was also considered an important feature of the on-line orthodontic e-course.

Students suggested improvements they thought would benefit the on-line orthodontic e-course which could be summarised as follows;

1) Enriching the orthodontic e-course with more complex clinical cases, self-assessment questions, animations and in-depth information.

2) The need for more sections for assessments, past exam questions and viva revisions.

3) The inclusion of podcasts and videos for patient assessments, occlusal examinations and the inclusion of functional and removable appliances.

4.6 Discussion

The overall success of the Schools' e-course in supporting the major features of on-line education; dialogue, involvement, support and control has been investigated by other researchers (Walmsley *et al.*, 2003; Gupta *et al.*, 2004). The present study focused on assessing the developed on-line orthodontic e-course in overcoming some of the problems facing the traditional orthodontic teaching. Most importantly are limited clinical time, interactive teaching and promoting life-long learning dentists.

The developed online orthodontic e-course was assessed from a student (end-user) perspective. Based on theories of a user-centred information system development paradigm, end-user satisfaction was found to be a significant measure that helps learn how to develop better applications and, thereby, realize social and economic benefits of investments in information technology (Doll and Torkzadeh, 1991).

Several attempts have been made to identify the critical success factors for evaluating e-learning programmes. The "E-learning Success Model" posits that the overall success of an e-learning initiative depends on the attainment of success at each of the three stages of e-learning systems development: system design, system delivery, and system outcome (Holsapple and Lee-Post, 2006). The same overall categories have been followed in the present study with some modifications to meet its aims.

The developed on-line orthodontic e-course was reported by students to be a good supplement to the traditional learning methods in orthodontics such as; lecture handouts, books and articles. The added advantages of being interactive, easy to use and to understand, concise, and provided good assessment of gained knowledge reflect current trends in education. By reducing the amount of information students required to memorize, more

focus on the appropriate skills and attitudes required for continuing education and long-term fulfilment of professional tasks is made possible (Welk *et al.*, 2005).

The different methods used to present information in the orthodontic e-course such as; the photo gallery, the images, the animations and the glossary were considered as important features in visualizing concepts and in better understanding the orthodontic subject matter. This finding is consistent with a previous report by Thatcher (2006), who found that animations had the potential to make it easier for students to understand difficult scientific concepts.

The clinical cases were reported to be an important component that helped in building the clinical skills of students and in overcoming the shortage of clinical exposure in the undergraduate orthodontic curriculum.

The other learning resources were still acknowledged by students. Books were still seen as a valuable learning resource for attaining a greater depth of information. The importance of lectures and lecture handouts was reflected in the relatively low percentage of students (5%) preferring the replacement of traditional lectures by the online format. This is in consistent with the findings of Pilcher (2001) and Walmsley *et al.* (2003). Both studies reported that students generally have a positive response to web based instructional formats but that classroom interaction and participation are still seen as a necessary component in dental education.

The results of the present study support current views on e-learning. It was found to be a flexible media that could support the traditional teaching methods whereby students can learn in their own time, pace and preferred environment (Botelho, 2001). The interactivity

and providing feedback was found to be important features of online learning and could help to promote life-long learning dentists.

4.7 Conclusion

The delivery of web-based material as a course supplement to traditional teaching in the undergraduate orthodontic curriculum was determined to be an overall success. Improvement of the orthodontic e-course in the following areas were suggested; (1) the ease of searching for information, (2) increasing motivation, enjoy-ability and ease of learning, (3) improving the clarity and informative nature of the images, and (4) enriching the orthodontic e-course with more complex clinical cases, self-test questions, animations and in-depth information.

It is believed that the future of delivering the majority of the undergraduate orthodontic material via the Web is a realistic possibility and will be a good supplement to the traditional teaching. The results of the present study will help direct the design of the future online orthodontic materials.

This work was published in the European Journal of Dental Education (Linjawi *et al.*, 2009)

4.8 Recommendations for Further Development

- Further development and improvement of the on-line orthodontic e-course and inclusion of the entire undergraduate orthodontic curriculum.
- Addition of two important components; assessments and assignments, to complement the teaching process.
- Enhancement of multiple levels of communication (synchronous and asynchronous) via discussion boards and e-mails for a better virtual learning environment.
- A qualitative assessment of the learning outcomes with a control group and pre- and post-test exams.
- Further assessment of the orthodontic e-course from teacher, course material and technological perspectives as advocated by Chen and You (2003).

SECTION FOUR

METHODOLOGY

Chapter 5

E-LEARNING EVALUATION

Chapter 6

MAIN STUDY

Chapter 5

E-LEARNING EVALUATION

5.1 Background

Virtual learning environments (VLEs) are defined as "computer-based environments that are relatively open systems, allowing interactions and encounters with other participants, and providing access to wide range of resources (Wilson, 1996). Thus, a defining characteristic of using (VLEs) is not just to employ a single intervention but to change the nature of the students' experience in their learning environments. This in turn calls for changes in the pedagogical aspects of teaching and the strategic management of institutions (Casey *et al.*, 2006; Ellaway, 2006).

Evaluating the quality and impact of such innovations in teaching and learning is a complex process and throws up many challenges. Such evaluation requires making value judgment about the educational impact of innovations in introducing new teaching and learning experiences or resources (Oliver, 2000).

One of the main reported challenges for such evaluation is the involvement of stakeholders from a wide range of background with varied interest and perspectives. For example, teachers might be concerned more with the educational value of innovations, whereas software developers maybe more interested in the impact of the technology (Oliver, 2000; Harvey *et al.*, 2002). All studies attempted to identify what may improve learning. However, they approached the problems differently, thus, resulting in varied outcomes.

Oliver identified five roles of evaluation (Oliver, 1997);

- **Illuminative evaluation** uncovers the important factors latent in a particular situation of use and what the important underlying issues maybe.

- **Integrative evaluation** is concerned with how to make the best use and integration of the technology into varying local situations and courses.

- **Formative and summative evaluations** describe different stages of the evaluation process.

- **Quality assurance** refers directly to evaluating what is being changed (i.e. the course) and ensuring that learning objectives are met by students in an appropriate manner (Draper, 1997; Dyson and Campello, 2003).

Another important factor is the aims of the evaluation process. Four main areas for evaluation have been identified in the literature to assess technology-based learning (Crompton, 1997);

- **Efficiency:** is related to factors that measure the procedures for the design and development of the course itself. It includes; cost, structure, resources, organisational strategies and technological infrastructure.

- **Effectiveness:** is related to factors measuring the success of the technology in achieving course aims and objectives such as cognitive and physical skills.

- **Relevance:** is measuring the applicability and appropriateness to the intended users of the technology.

- **Impact:** measuring impact on learning is a complex process and lacks clear definition in the literature. Whilst studies within the educational field aim to assess students' learning outcomes, others believes that the way a student completes a task should be considered as important as the final product (Oliver and Harvey, 2002). An alternative objective was to measure usability of the system and its tools, drawing on "Human and Computer Interaction" research (Dyson and Campello, 2003).

In classifying the methodologies used for evaluation, there has been much debate on qualitative versus quantitative techniques (Oliver, 2000). Different methodologies have their own strengths and weaknesses, thus, several authors have advocated using qualitative and quantitative methodologies in order to triangulate results, thus enhancing the credibility of evaluation findings (Jones *et al.*, 2000). Another equally important debate is the difference between subjective judgements versus objective performance. Thus, while users' opinions matter, assessing their performance was also important (Dyson and Campello, 2003).

Web 2.0 and collaborative environments are another challenging issue to the evaluation process. Although they produce text-based data, evaluating their impact on learning considers the circumstances surrounding the learning environment. More than fifteen methods of text-based data analysis were identified in the literature including; grounded theory, discourse analysis, taxonomy, quasi-statistics, content analysis, and many more. Lowes *et al.* (2007) compared some of the methodologies used to analyse data collected from discussion forums. Content analysis was found to be the most potentially rewarding methodology that can provide important insights into why a session on the discussion forum is successful. However, the process is highly labour intensive.

This complex nature of studies evaluating learning technologies mandates a strong research plan with clear objectives, methodologies and data analysis in order to provide meaningful findings. A useful framework has been devised by Oliver (1997), which provides a comprehensive planning process to the evaluation of such innovations. The framework consisted of six steps;

- Step 1: Identifying the audience for the evaluation
- Step 2: Selecting an evaluation purpose and question
- Step 3: Choosing an evaluation methodology
- Step 4: Choosing data collection methods
- Step 5: Choosing data analysis methods
- Step 6: Selecting an appropriate format to report the findings

Considering these steps in evaluating virtual learning environments seems crucial and will be considered in the current study.

Chapter 6

MAIN STUDY

6.1 Introduction to the e-course

The e-course is the Birmingham University School of Dentistry virtual learning platform. It is developed using the software Bespoke (Bespoke Microsoft Interdev 6. Microsoft Certified Partner, UK), and is designed as an open system e-learning site accessible to all members of the school at all times. Its main objectives are to support students learning and needs and to augment the conventional teaching methods within the school.

The e-course is developed and being managed by an e-course team, who are also clinicians teaching within the school. The main drive for developing the e-course was to create supplementary web-based materials for all the modules delivered by the school. The site is supplementary, it did not replace any part of the modules and its use is kept voluntary. It is designed as a place for students to access all the relevant materials they need such as; module information, course materials and further resources. Examples may be found online at www.dentistry.bham.ac.uk/ecourse.

The e-course encompasses a wide range of tools and supports the development of a variety of content formats. These tools range from simple page editing, uploading of external files, interactive content development tools such as Mind-map, animations and Mag-scope; to a multi-media development tools for videos and podcasts. It also encompasses Web 2.0 tools such as; Wikis, Blogs and Discussion boards. All these have made the e-course to become an

interactive learning environment and an important component in the teaching and learning transaction in the school.

In 2007, the University of Birmingham, School of Dentistry, for its innovative development of the e-course, was recognised as being a national leader in e-learning and was awarded the "Times Higher Award for the Outstanding ICT initiative of the year" (JISC, 2007).

6.2 Introduction to the Study

The current study is designed to inform e-learning developers and stakeholders who want to gain a greater understanding about the adaptive challenges facing dental teachers and students in implementing online learning strategies. It also aims to contribute to the debates around the future of e-learning in dental education through the exploration of on the ground experiences. The University of Birmingham School of Dentistry e-course was chosen as a case to study such issues.

To fully evaluate the implementation of new approaches within an institution, three levels of institutional organisation should be targeted. These levels, as indicated in the TrustDR framework (Casey *et al.*, 2006), from top-to-down order are; institutional, operational, teaching, and learning managements. While each would have their own priorities, their views to e-learning implications are found to be connected through four channels; pedagogical, technological, strategic and organisational perspectives (Figure 6.1).

The current study is an illuminative evaluation aiming to explore in-depth; factors, problems and concerns faced by dental students and teachers in using online learning approaches. Such

issues will be evaluated at the teaching, learning and curricular management levels and from the technological and pedagogical perspectives (Figure 6.1).

Level / View	Teaching & Learner Management	Operational & Curricular Management	Institutional Management
Pedagogical	The levels	investigated	
Technological	in the	current study	
Organisational			
Strategic			

Figure 6.1 Simple Analysis Grid derived from the TrustDR Organisational Framework (Reproduced from Casey *et al.* 2006).

6.3 Study Design

At the beginning of the study, the e-course team was invited by the author of the study to discuss the aims and research methods. The team made the following suggestions, which were clustered around three main concerns;

- What are the potential and challenges faced by students and teachers in using the e-course?
- At what level does the e-course support the teaching and learning transaction in the school?
- Any recommendations or suggestions for further improvement of the e-course?

Views and suggestions from the e-course team were then considered in designing the study. Progresses from the research were also reported back to the e-course team for further suggestions and guidance.

The study was then designed to assess the e-course at three dimensions; efficiency, effectiveness and relevance. A multi-method approach was chosen based on their appropriateness in investigating the different dimensions of the research. The study was conducted at three stages as follows;

Stage 1: e-course efficiency: to assess the e-course structure and components and to evaluate its functionality and use in supporting the teaching and learning in the school. The web-site was evaluated using quantitative data and analysis.

Stage 2: e-course effectiveness: to evaluate the effectiveness of the e-course in expanding the teaching and learning possibilities by supporting higher level of teaching and collaborative learning. A representative discussion board archive was evaluated using qualitative data and content analysis method.

Stage 3: e-course relevance: to assess teachers and students' motives, knowledge and attitudes towards the e-course in supporting their teaching and learning. Interviews and focus groups (qualitative data) were conducted and analysed using a discourse analysis method.

6.4 e-course Efficiency: Quantitative Assessment

In October 2008, the e-course was evaluated for its functionality using a quantitative approach. Two categories were designed for such evaluation; e-course design and use. The e-course design was assessed at two levels; technical design, and instructional design. The technical design level was designed to investigate the technical tools and components of the e-course. The instructional design level was designed to investigate the content delivery format used on the e-course. The e-course was also assessed for its overall use by each department in the school. The evaluation methods of each category will be further detailed in the following sub-sections.

6.4.1 Technical design

The e-course was investigated for the different tools available. These tools were available and distributed among four main toolbars available on the e-course home page (Figure 6.2). Seven categories were designed to assess the technical design of the e-course;

1. Content management tools.
2. Personalisation tools.
3. Search tools.
4. Communication tools.
5. Collaboration tools.
6. Tools for tracking students' needs and progress.
7. External links.

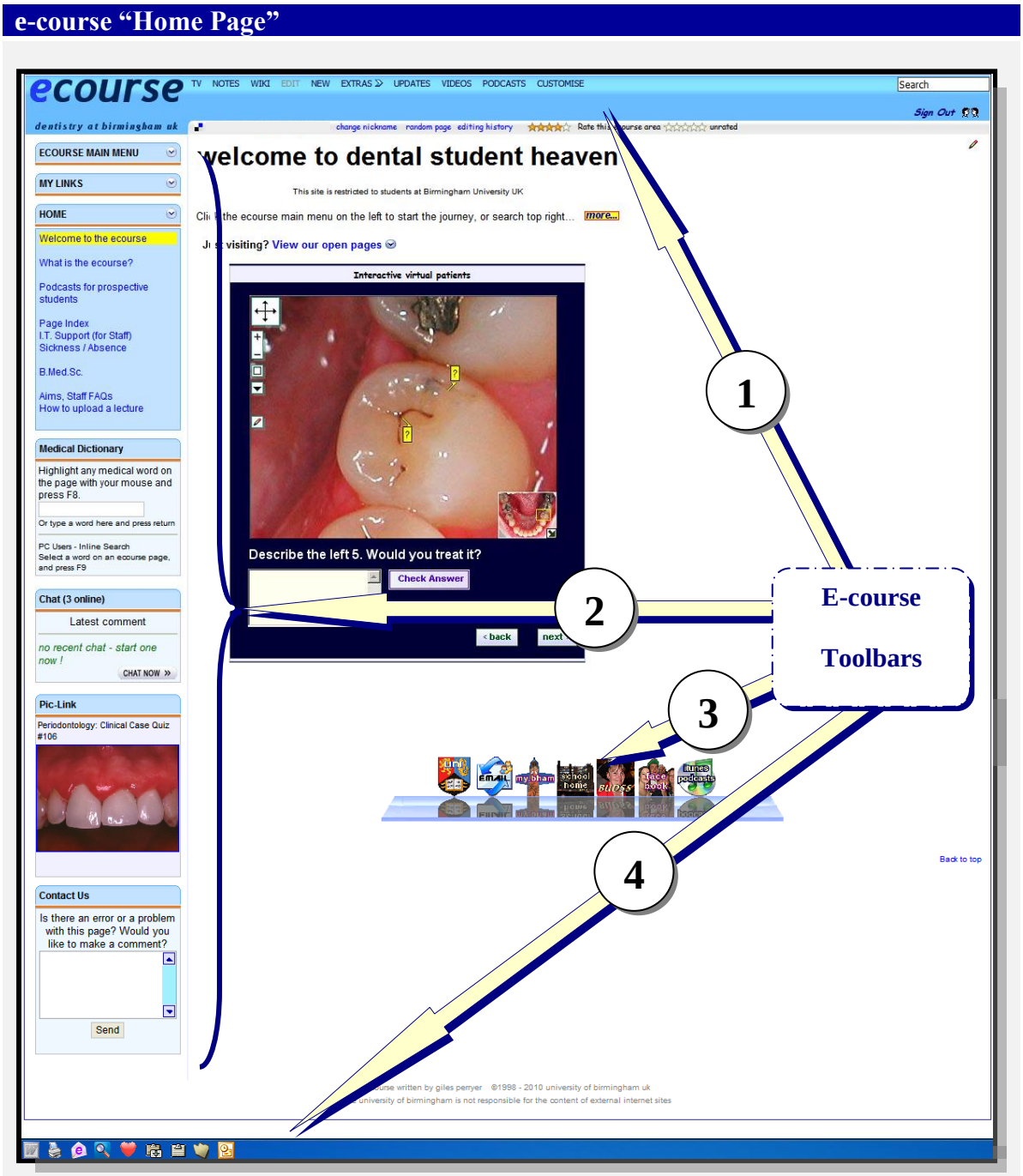


Figure 6.2 A picture of the e-course "Home Page" showing the different toolbars.

6.4.2 Instructional design

The e-course was assessed for the various methods and formats used to deliver its contents. The methods used for delivering contents on the e-course were categorised according to the type of learning experience, which depends on the way learners acquire knowledge. Learning experience is classified in terms of the amount of control that the student has over the content and the nature of the learning activity.

This dimension of learning-experience type is closely linked to the concept of learner control explored by Zhang (2005). It divided the learning activities into; expository instructions, active learning, and interactive learning. In expository instruction, the technology delivers the content or transmits the knowledge. In active learning, the technology allows students to control digital artefacts to explore information or address problems. The learner builds knowledge through inquiry-based manipulation of such artefacts such as simulations, games, or micro-worlds. Thus, learners have control of what and how they learn. In interactive learning, the technology mediates human interaction either synchronously or asynchronously; learning emerges through interactions with other students and the technology. The learner builds knowledge through inquiry-based collaborative interaction with other learners; teachers become co-learners and act as facilitators. Thus, the nature of the learning content is emergent as learners interact with one another and with a teacher or other knowledge sources.

The content delivery methods used on the e-course were thus categorised into five categories designed for this study and contents on the e-course were assessed accordingly. These categories are;

1. ***Passive information delivery methods;*** used to describe pages designed for delivering information with no control of the learner on their learning experience. These included pages with; PowerPoint, lecture notes, videos, podcasts, glossary, CAL resources, recommended readings, online instructions, case studies, and pages with more than one of these formats (Figure 6.3).

2. ***Active information delivery methods;*** used to describe pages designed to give the learner control over their learning experience through inquiry-based manipulations of digital artefacts. These included pages with; animations, Mind-maps, Mag-scope, and games (Figure 6.4).

3. ***Interactive information delivery methods;*** used to describe pages designed for transmitting knowledge through collaborative interactions between the learners. Thus, the learners get a role in developing the contents in such methods. These included; Wiki pages, Blogs, and discussion boards (Figure 6.5).

4. ***Self-assessments methods;*** used to describe pages designed for self-assessment tests. This category was further classified into; self-assessments with feedback provided to the learners, and self-assessments with no feedback provided. The self-assessment with feedback pages were further categorised according to their content delivery formats into; "Questions and answers only" and "Questions and answers with other information delivery formats". The latter category included pages were information was provided using different formats such as; texts, animations, videos, etc., followed by questions (Figure 6.6).

Pages with feedbacks such as; “Well done” and “Try again” were considered of no learning value and where thus classified under the “self-assessment with no feedback” category.

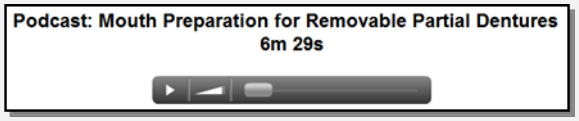
5. ***General pages;*** used to describe pages that did not fit in other categories.

Passive information delivery formats

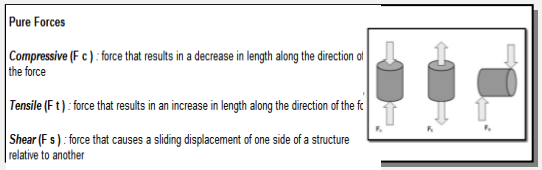
PowerPoint presentation

Lecture notes

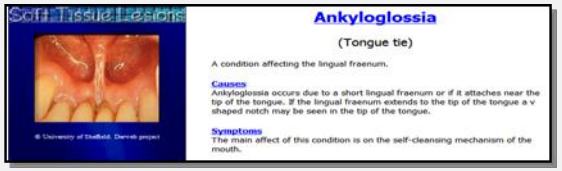
Videos



Podcasts

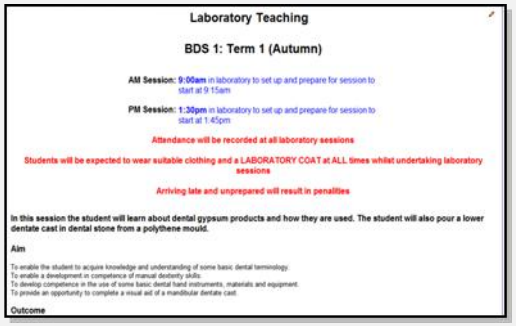


Glossary

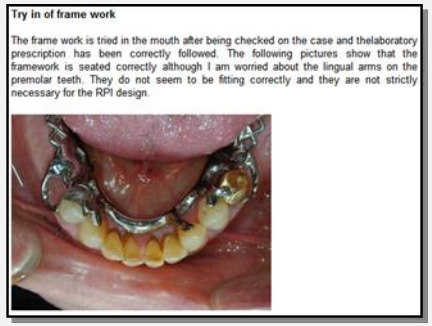


CAL resources

Recommended readings



Online instructions



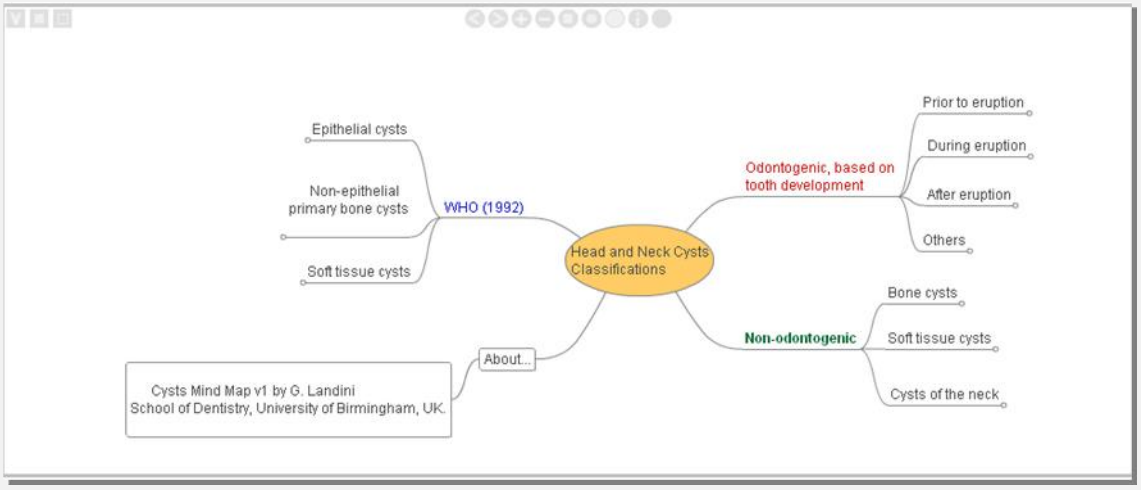
Case study

Figure 6.3 Representative samples of the "Passive information delivery formats" on the e-course.

Active information delivery formats

Animations

Mag-scope

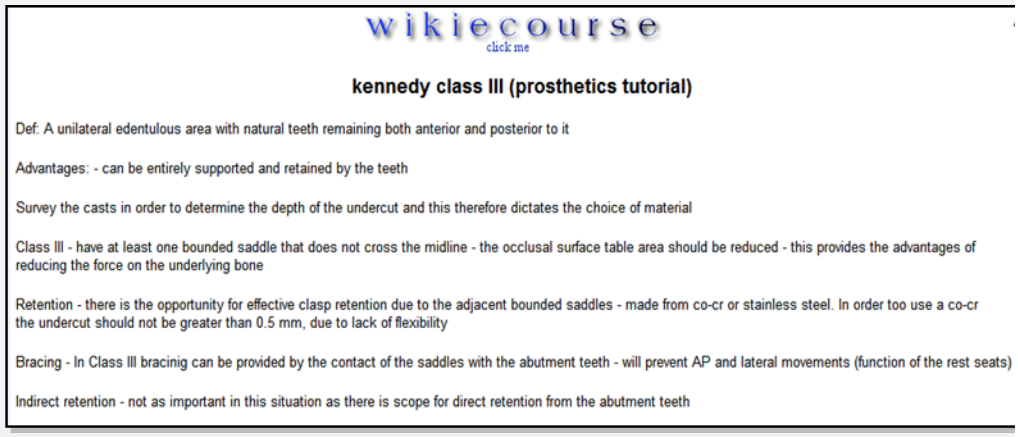


Mind-map

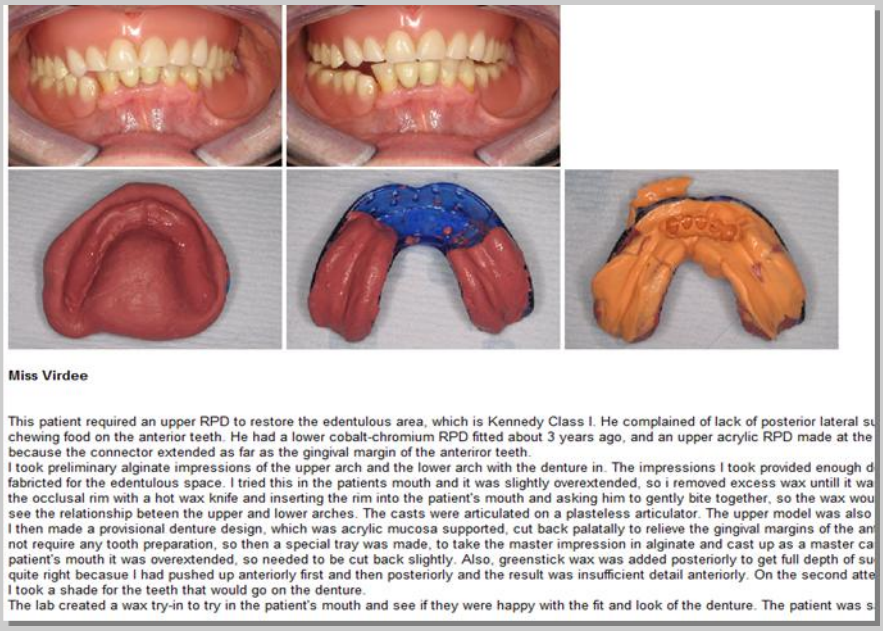
Figure 6.4 Representative samples of the "Active information delivery formats" on the e-course.

Interactive information delivery Formats

Wiki pages



Blogs

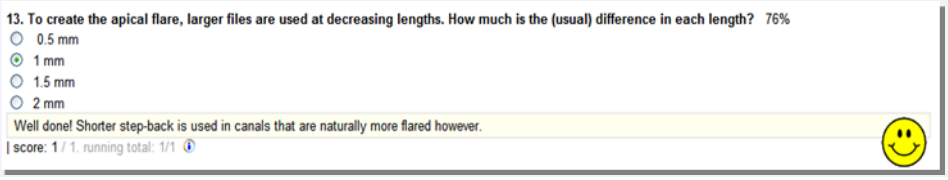


Discussion boards

Figure 6.5 Representative samples of the "Interactive delivery formats" on the e-course.

Self-assessment formats

Different formats for self-assessments with feedbacks



Q & A only

Q & A + other formats

Self-assessment with no feedback

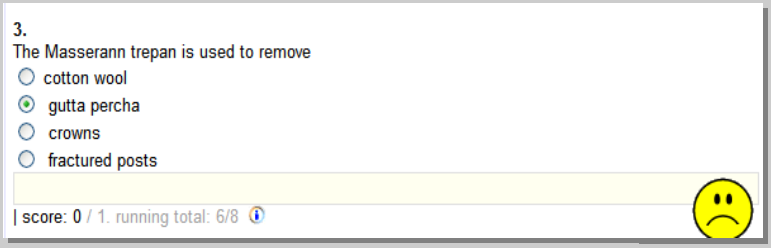


Figure 6.6 A representative samples of the "Self-assessment formats" on the e-course.

6.4.3 Departmental use

The e-course was also investigated for its use by the different specialities in the school. The overall use and the contribution of each speciality to each instructional design method were assessed. Its utilisation was categorised according to the undergraduate (BDS) courses into the following three categories; 1) BDS pre-clinical departmental use, 2) BDS clinical departmental use, 3) Non-BDS departmental use, and 4) General pages.

6.4.4 Data collection and analysis:

The tools on the e-course toolbars were analysed according to the seven categories designed to assess the technical design and a brief description of each tool was then provided.

The number of pages was counted for each category investigated in the two sections of this part of the study; instructional design and departmental use sections. The "e-course Index" page was used as a guide to follow in the current analysis (Figure 6.7). It had links to all the pages available on the e-course and distributed according to departments. Percentages were then calculated and data were analysed for Descriptive Statistics using Microsoft Office Excel 2003.

Discussion boards were designed to be part of every page on the e-course and were accessible to all members of the school. Selective samples from the discussion boards' archives were chosen for analysis in the current study. These archives were from the BDS clinical e-courses only and which had ten or more threads posted in 2008. The number of threads and messages posted in the selected archives were then calculated and data were analysed for Descriptive Statistics using Microsoft Office Excel 2003.

e-course Index

Figure 6.7 A section of the "e-course Index" page.

6.5 e-course Effectiveness: Content Analysis

Discussion boards were designed to be part of every page on the e-course website and were accessible to all members of the school. They were considered as a special format of the collaborative interactive learning tools available on the e-course. Their main objectives were to; facilitate student-to-teacher interactions and feedbacks, and promote student-to-student collaborative thinking and interactions. Studying the interactions between the usability and the nature and extent of learning using such methods was the aim of this part of the study.

6.5.1 Sample

The online discussion board archive on the Prosthetic e-course for 2008 was selected for such assessment because it showed the highest postings among all other archives on the e-course. Each year the discussion boards are archived for future reference.

Participation in the online discussion board on prosthetics is voluntary. It is used by both undergraduate dental students and teachers and does not attract any grading criteria. Three teachers moderated the board. These teachers were confident in IT skills and had been operating the educational and dental components of the forum for three years. Students were advised to title their messages with their year of study. Posting names was left to the students' preferences.

6.5.2 Data collection

All messages posted on the Prosthetic's discussion board in 2008 were collected and coded for 15 variables. These variables are; thread number, message number, message level, author

type, author level, response time (days), posting time, number of words, primary purpose of posted messages, external resources used, student interaction level, message clarity, content type, message type processing level, and resolution of discussion thread. In order to make the coding scheme as transparent as possible, a detailed rubric for the key variables used in this study, is provided in Appendix II.

6.5.3 Data analysis

Review of the literature on discussion boards and cognitive theory revealed 12 promising areas for evaluating discussion boards: social learning, cognitive processing, quality of discussion, the initial question in a thread, role of teacher, navigation issues, challenges for students, types of users, attitude towards online discussion, response time, learning outside of school and learning performance (Kay, 2006).

Accordingly, a multi-component metric, comprising of 5 dimensions, was created for analysing the Prosthetic discussion board archive. These dimensions were; participation, quality of discussion, social learning, cognitive learning, and role of teacher. A description of each dimension and the variables used for their assessment is presented in (Table 6.1-6.2).

Data were then analysed accordingly using content analysis method. Content analysis is defined by Seale (2004) as any technique for analysing texts in terms of the presence and frequency of specific terms, narratives or concepts. Even though the data is qualitative, the analysis is quantitative. Inferences can then be made by comparing and looking for patterns and trends. A complete message was used in the current study as the unit of analysis.

Descriptive and Inferential Statistics were reported using SPSS (Special Package for Social Science, Release 12.0.1 for Windows 2003. SPSS Inc., 233 S. Wacker Drive, Chicago, Illinois 60606, USA), with significant levels set at $p<0.05$. Intra-examiner reliability was also measured for the variables coded using Kappa statistics. These variables are; message clarity, content type, external resources used, resolution of discussion threads, primary purpose of posted messages, students' interaction level, knowledge type, and processing level.

Dimension	*Description*	*Variables used*
Participation	The overall participation on the discussion board was assessed from different angles.	Six variables were designed for assessing participation; • Total number of threads and messages • Number of messages / thread (length of discussion threads) • Number of words / message • Authors of posted messages • Number of posted messages / academic period • Posting days
Quality of discussion	The actual quality of discussion in individual thread has been looked at from different angles.	Nine variables were designed to assess the quality of discussion; • Threads' level • Primary purpose of posted messages • External resources used • Knowledge depth in the starting-messages (opening message), assessed using 2 variables; o knowledge type o processing level • Message clarity • Content type • Response time • Resolution of discussion thread

Table 6.1 A rubric for the dimensions designed to assess the Prosthetic discussion board.

Dimension	*Description*	*Variables used*
Social learning	The aim of this dimension is to assess the interaction with peers (student–to-student interaction and reflection). The criteria for this dimension included messages from students in threads which included four or more messages.	Two variables were designed to assess social learning; • Students' interaction level • The percentage of social comments in the posted messages.
Cognitive learning	As a measure of the level of interaction with the content. The criteria for this dimension included messages from students with course-related information only.	Two variables were designed to assess cognitive learning; • Knowledge type • Processing level
Role of teacher	To assess the role of teachers in using such innovations to promote higher level discussion.	• The primary purpose of messages posted by teachers was used as a key variable to assess their presence. The latter was compared between two types of threads; a) threads with four or more messages and b) threads with less than four messages.

Table 6.2 A rubric for the dimensions designed to assess the Prosthetic discussion board (continued).

6.6 e-course Relevance: Qualitative Assessment

6.6.1 The interviews

Academic teachers and students were interviewed to assess their motives, knowledge and attitudes towards using the e-course and its relevance to their professions. The potential and challenges of using such technologies in their teaching and learning were also explored. The interviews included face-to-face interviews with teachers and focus group with students from different year groups.

All interviews were conducted by the author of the study. A time frame of 30 minutes was assigned for face-to-face interviews and 1 hour for focus groups. However, time was managed according to the flow of discussions.

The interviews followed a semi-structured method that focused on gathering information at three levels; technological, pedagogical and curriculum design. An interview topic guide was designed and presented in Appendix III. The general scheme and primary criteria designed for each level of evaluation followed certain models or frameworks presented in the literature.

Technological evaluation followed the "Technology-to-Performance Chain Model" (Staples, 2004). It was designed to assess students and teachers' satisfaction with the e-course at three areas; system quality, service quality, and information quality. It was also designed to assess their use of the e-course, its compatibility with their teaching and learning, and the impact of its use on their professional performance.

Pedagogical evaluation followed the "Seven Principles for Good Practice in Undergraduate Education" framework (Chickering and Gamson, 1987). It was designed to assess students

and teachers attitudes towards the effectiveness of the e-course in facilitating and supporting the teaching and learning transaction in the school. Six levels of the transaction process were found to be applicable to the e-course and were assessed in this study; contact, communication, collaboration, active learning, feedback, respecting diverse learning styles.

Curriculum design evaluation followed the "Collin's Course Design Model for Online Teaching" (Collins and Berge, 2006). It was designed to assess the potential and challenges faced by students and teachers in using the e-course to support the curriculum. Five areas of the curriculum were assessed; learning goals and outcomes, learning resources, learning activities, discussion activities, and assessments and assignments.

6.6.2 Subject selection

An e-mail letter was written by the author of the study introducing the research aims and objectives and inviting members to participate in the study. It also emphasised the importance of their views in further improvement of the e-course, which will have positive returns on their teaching and learning. It was then sent to students from selected years and academic teachers that fulfilled the designed selection criteria. Participants were continuously invited until data saturation was reached. Data saturation is considered an important indication of data adequacy, comprehensiveness, and completeness. However, there are no specific published guidelines for identifying such measures. The author in the current study followed the general operational definition of saturation, as indicated by Bowen (2008); *"saturation is reached when the researcher gathers data to the point of diminishing returns, when nothing new is being added"*.

6.6.2.1 Students' samples

All dental students from second, third and fourth year undergraduate levels (from a five year programme) were invited to participate in the study. First year dental students were excluded from the study because it was decided that they would not have enough experience in using the e-course. Fifth year dental students were also excluded due to timings of examinations and infrequent attendance at the school. Interested students from the selected years were then grouped into one or more focus groups depending on their number or time preference.

6.6.2.2 Teachers' samples

A critical-case purposeful sampling method was used in selecting academic teachers. This method depends on selecting information rich cases for in-depth study (Marshall, 1996). The selection criteria was; full-time teachers in the school, and who had a chance to use the e-course. Other criteria were based on distributed cases from the following variables; age, gender, position, department, and teaching experience. A detailed description for each variable is presented in (Table 6.3).

Criteria	*Description*
Age	The selected samples should include teachers from the following two categories; • =< 30 years old (Younger teachers) • > 30 years old (Older teachers)
Gender	The selected samples should include both male and female teachers
Position	The selected samples should include teachers with different positions; Professors, Associate Professors, Assistant Professors, and Lecturers
Department	The selected samples should include teachers from different departments
Teaching experience	The selected samples should include teachers from the following three categories; • < 5 years (Minimum teaching experience) • 5-10 years (Intermediate teaching experience) • >10 years (Maximum teaching experience)

Table 6.3 A detailed description for the variables used to select academic teachers

6.6.3 Data collection, processing and statistical methodology

The demographic background of all participants was also collected. Participants were asked to report their age, gender, and computer literacy. Academic teachers were further asked to report their; position, department, and teaching experience.

Consent was sought and recorded at the beginning of the interviews. Subjects were assured that any information provided would be used in a confidential form and their views would be anonymous.

Data collection involved gathering information from the interviewees in the form of a recorded interview using "Olympus DSS Player" digital recorder device. Data were then transcribed verbatim into scripts and then coded and categorised using NVivo 8 Statistical Software. The coding method followed the "Grounded Theory" and the constant comparison method (Bowen, 2008). Nodes and categories used to code the transcriptions are presented in (Figure 6.8). Data were then analysed for emerging themes and patterns.

Nodes and categories designed for coding the transcripts

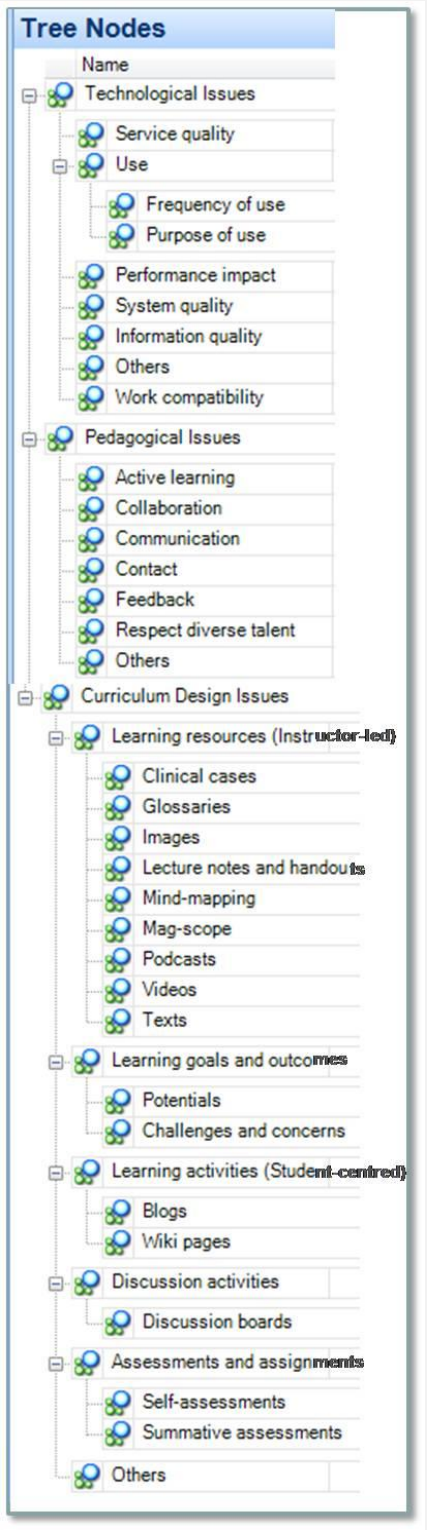


Figure 6.8 A snapshot of the "Tree nodes" designed in NVivo 8 for coding the interviews transcripts.

SECTION FIVE

RESULTS

Chapter 7

e-COURSE EFFICIENCY: QUANTITATIVE ANALYSIS

Chapter 8

e-COURSE EFFECTIVENESS: CONTENT ANALYSIS

Chapter 9

e-COURSE RELEVANCE: QUALITATIVE ANALYSIS

Chapter 7

e-COURSE EFFICIENCY: QUANTITATIVE ANALYSIS

7.1 Introduction

The e-course was evaluated as an online learning environment exploring its different tools, components, contents and departmental use using quantitative analysis. A representation of the e-course design for the different dental specialities and courses is presented in Appendix IV. In the following sub-sections, however, results will be presented following two main categories; 1) e-course design, 2) departmental use. The e-course design will be further categorised into technical and instructional designs.

7.2 Technical Design

The e-course was evaluated according to the seven categories designed to assess its technical design. The e-course was found to be powerful in providing tools for managing contents in a variety of ways such as; developing, editing, uploading and downloading contents. It also included tools for customising its contents to meet users' needs. The e-course was also found to have strong searching, communication, and collaboration capabilities using different tools. It also provided links to external sites such as the University Home Page, e-mailing browsers, and some social networks to expand its capabilities. However, the e-course contained only one "Wish list" tool for tracking students' needs. Discussion boards were another area that could be used for such purpose. However, tracking students' learning progress was not strongly supported by the e-course (Table 7.1).

Components	*Description*
Content management tools	
File store	A space to upload contents to the e-course's library
Edit	A tool that allows members to edit pages on the e-course under permission from the e-course manager team
New	A tool that allows members to create new e-course pages
Word	A tool to download an e-course page as a word document
Personalisation tools	
My links	A toolbar used for customising links and sites
Customise	A tool that allows members to customise the view of the e-course according to their preferences
Notes	A private space for notes taken by each member and is available as he/she logs into the e-course
Scrapbook	A private space where members can select any contents from the e-course and paste it in
Search tools	
Home	A toolbar with links for all the general pages on the e-course.
Main menu	A toolbar with links to the e-course home page of each department.
Search box	A tool for searching things and terms on the e-course
Updates	An index to all the new and updates on the e-course
Videos	An index to all videos on the e-course
Podcasts	An index to all the podcasts on the e-course
Picture link	A tool for searching pictures available on the e-course
Medical dictionary	A tool that search for definitions to any highlighted medical terms
Communication tools	
TV	The Dental School Bulletin Board
Chat	A space for members to chat together
Contact us	A space for reporting problems or comments on the e-course
Collaboration tools	
Discussion boards	A space for members to share queries, thoughts and experiences
Wiki	A tool for developing Wiki pages
Blogs	A tool for developing Blogs
Tools for tracking students' need and progress	
Wish list	A space where members can report any comments or things he/she wishes to have on the e-course
External links	
• University Home page • Dental School Home Page • University e-mail • Microsoft Outlook	• Birmingham University Dental Students' Society (BUDSS) • Face book • iTunes Podcasts

Table 7.1 Components of the e-course

7.3 Instructional Design

In October 2008, the e-course was assessed for the various methods and formats used to deliver its contents. It was found to be composed of (2085) pages with five different content delivery formats. Half of the pages on the e-course (n=1059/2085 pages, 51%) were designed for passive information delivery formats, followed by self-assessment formats (n=481/2085 pages, 23%) and the pages with general information (n=410/2085 pages, 20%). Only few pages were built using interactive formats (n=89/2085 pages, 4%), and to a lesser extent pages designed with active information delivery formats (n=46/2085 pages, 2%) (Figure 7.1). Each of these delivery formats will be further analysed in the following sub-sections.

7.3.1 Passive information delivery formats

Pages with passive information delivery formats were mainly in the form of; lecture notes (n=389/1059 pages, 37%), and PowerPoint lectures (n=303/1059 pages, 29%). Other formats constituted only small percentage of the e-course pages. These formats are; videos, podcasts, glossary pages, CAL resources, recommended readings, online instructions and case studies. Few other pages consisted of a multiple passive delivery formats (n=96/1059 pages, 9%) such as a combination of PDF, Word documents, texts and PowerPoint formats (Figure 7.2).

e-course content delivery formats

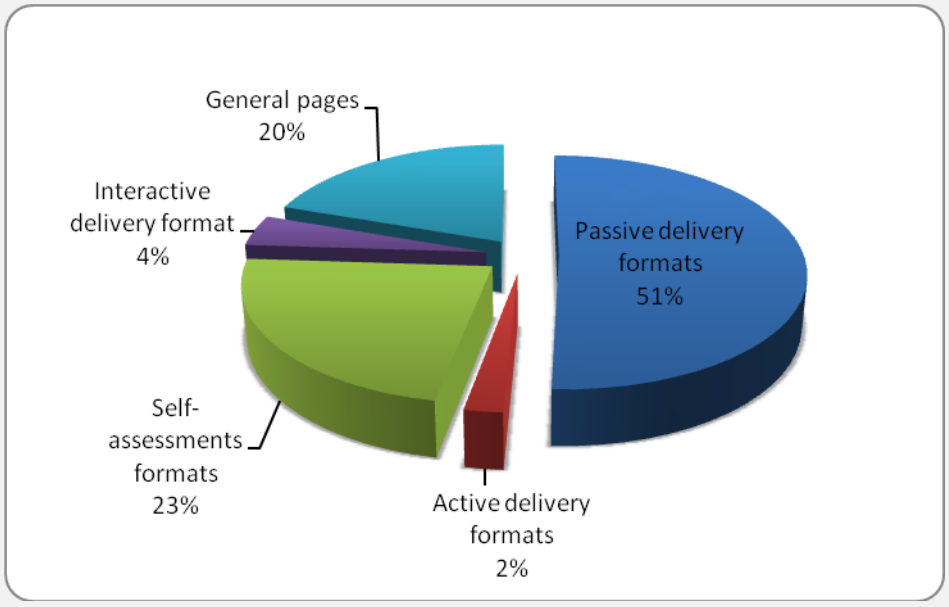


Figure 7.1 Types of content delivery formats used on the e-course and their page distributions.

Passive information delivery formats

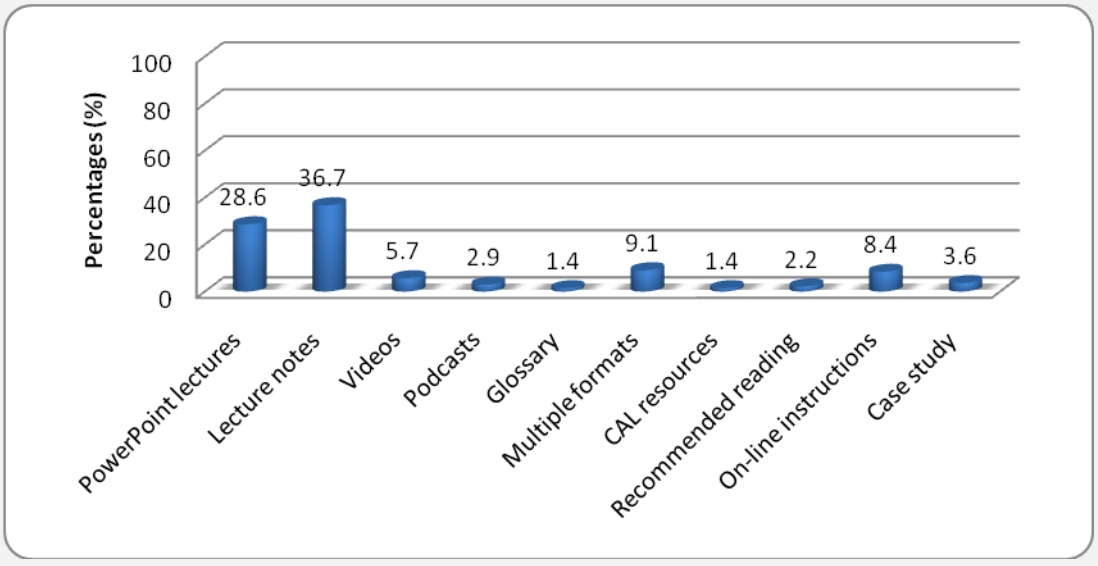


Figure 7.2 Types of passive information delivery formats used on the e-course and their page distributions.

7.3.2 Active information delivery formats

Active contents were mainly in the form of; Mag-scope (n=19/46 pages, 41%), and animations (n=15/46 pages, 33%). Few pages, however, contained Mind maps (n=9/46 pages, 20%) and only 3/46 pages (7%) were in the form of games (Figure 7.3).

7.3.3 Self-assessment formats

Self-assessments were presented in the form of "MCQ", "Check your answer", and "True and False" questions. Most self-assessment tests (n=459/481 pages, 95%) were designed with immediate feedbacks. Few pages (n=22/481 pages, 5%) were designed as self-assessments with no feedback responses (Figure 7.4).

The self-assessment with feedback pages were designed in two different formats. The majority of these pages (n=382/481 pages, 79%) presented questions in relation to other information delivery formats such as; clinical cases, Mag-scopes, virtual patients, texts and others. A few of these pages were, however, designed as questions and answers only (n=77/481 pages, 16%) (Figure 7.4).

Active information delivery formats

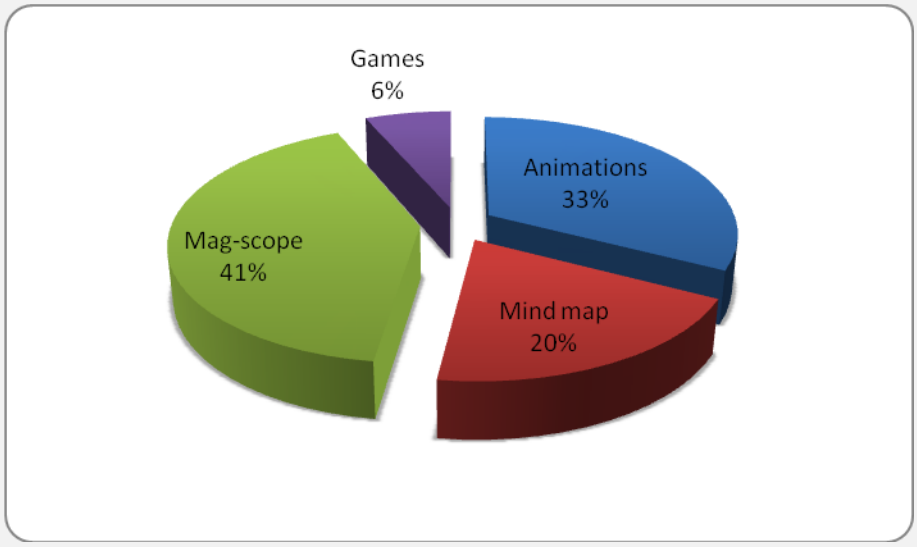


Figure 7.3 Types of active content delivery formats on the e-course and their page distributions.

Self-assessment formats

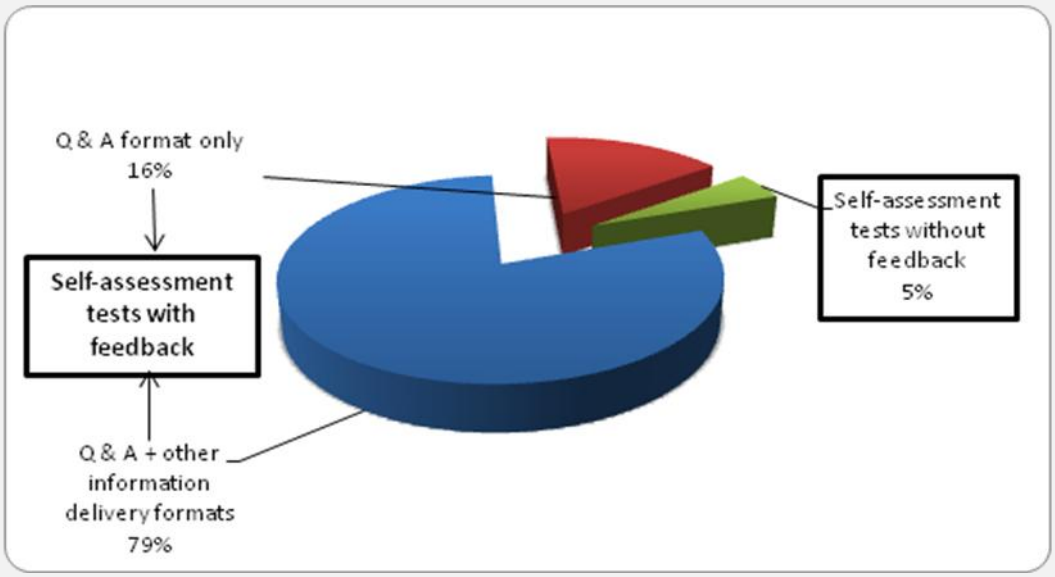


Figure 7.4 Types of self-assessment delivery formats and their page distributions.

7.3.4 Interactive information delivery formats

Some of the e-course contents were developed using interactive collaborative tools such as; Wikis, Blogs and Discussion boards. Wiki pages were pages developed by students and checked by their teachers. They constituted 99% (n=88/89 pages) of the pages developed using collaborative tools. Blogs were used in one page (1%) only as an e-course blog (Table 7.2).

The main objectives of the discussion boards were to; facilitate student-to-teacher interactions and feedbacks, and promote student-to-student collaborative thinking and interactions.11/22 BDS clinical e-courses fulfilled the selection criteria designed to assess such tools. These departments are; Conservative Dentistry, Dental Biomaterials, Dental Pathology and Immunology, Dental Public Health, Endodontics, Oral Pathology, Oral Surgery, Orthodontics, Paediatric Dentistry, Periodontology, and Prosthetics (Table 7.3).

The highest number of posted threads was reported on the Prosthetic Department's discussion archive (n=108 threads), closely followed by the Conservative Department (n=99 threads) and the Dental Public Health Department (n=86 threads). The average length of most selected discussion threads consisted of 2 messages. It was only the Periodontology, and Prosthetic discussion archives that had threads with an average length of 3 messages (Table 7.3).

Types	*No. of pages*	*Percentage (%)*
Wikis	88	98.9
Blogs	1	1.1
Discussion boards	Part of every page on the e-course	
Total	**89**	**100**

Table 7.2 Types of collaborative contents on the e-course and their page distributions.

BDS Clinical Departments	*No. of threads*	*No. of messages / thread*		
		Median	Minimum	Maximum
Conservative Dentistry	99	2	1	6
Dental Biomaterials	59	2	1	8
Dental Pathology and Immunology	13	2	1	5
Dental Public Health	86	2	1	7
Endodontics	13	2	1	7
Oral Pathology	16	2	2	3
Oral Surgery	18	2	1	3
Orthodontics	15	2	2	3
Paediatric Dentistry	24	2	1	4
Periodontology	53	3	2	6
Prosthetics	108	3	1	15

Table 7.3 Number of threads and messages / thread posted on the discussion boards of the selected BDS Clinical Departments.

7.3.5 General pages

The general pages were categorised as pages for; Welcome pages, Course outcome, Lecture list, Timetables, FAQ, Contacts, IT support, and others. The latter included Bulletin Boards and other formats that was not included in previous categories. Half of the pages (n=210/410 pages, 51%) in this group were for course outcomes and 14% (n=59/410 pages) from the category "others". Lecture lists counted for 13% (n=55/410) of the pages. The other formats constituted only a few pages on the e-course (Figure 7.5).

General pages

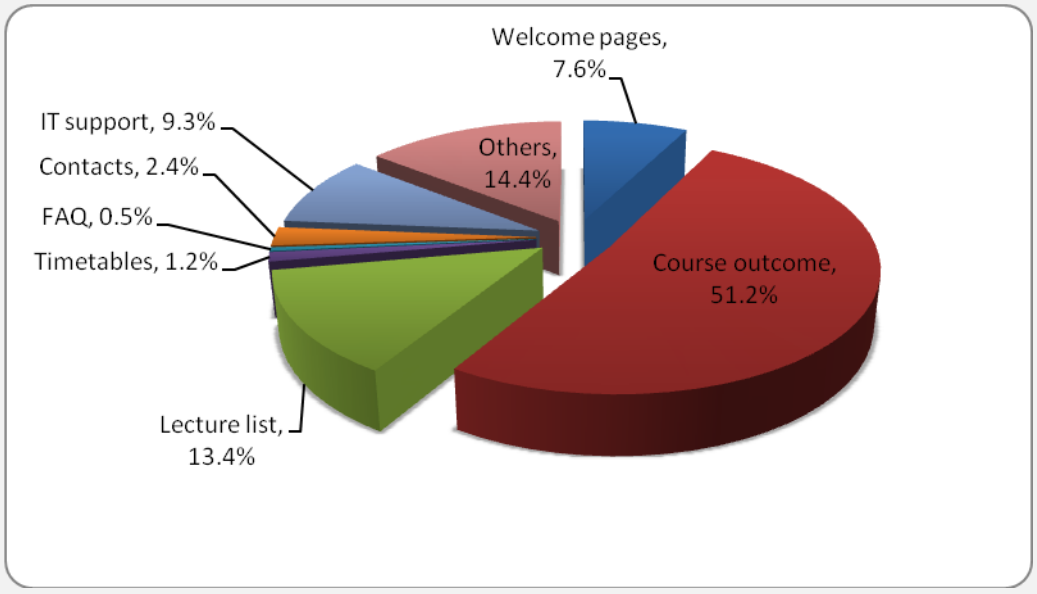


Figure 7.5 Categories of general pages on the e-course and their page distributions.

7.4 Departmental Use

Results indicated that most of the pages on the e-course were developed for the undergraduate dental students (n=1772/2085 pages, 85%). These pages were arranged under 3 main categories on the e-course; pre-clinical courses (n=288/2085 pages, 13.8%), clinical courses (n=1455/2085 pages, 69.8%) and self study pages (n=29/2085 pages, 1.4%). There were also some pages designed for non-BDS courses (n=179/2085 pages, 8.6%) such as Advanced Biomaterials course, Postgraduate courses and Staff updates. The remaining pages (n=134/2085 pages, 6.4%) contained general information that did not fit into any other category (Figure 7.6).

The BDS pre-clinical and clinical courses were further assessed to evaluate the use of the e-course by the different undergraduate dental specialities. In the BDS pre-clinical courses, the Oral Biology Department developed the greatest number of pages (n=89/2085 pages, 4.3%), closely followed by the Ethics course (n=75/2085 pages, 3.6%) (Table 7.4).

In the BDS clinical courses, the Prosthetic Department developed the greatest number of pages (n=265/2085 pages, 13%), followed by the Conservative Department (n=169/2085 pages, 8%) and the Paediatric Dentistry Department (n=158/2085 pages, 8%) (Table 7.5).

Dental e-courses

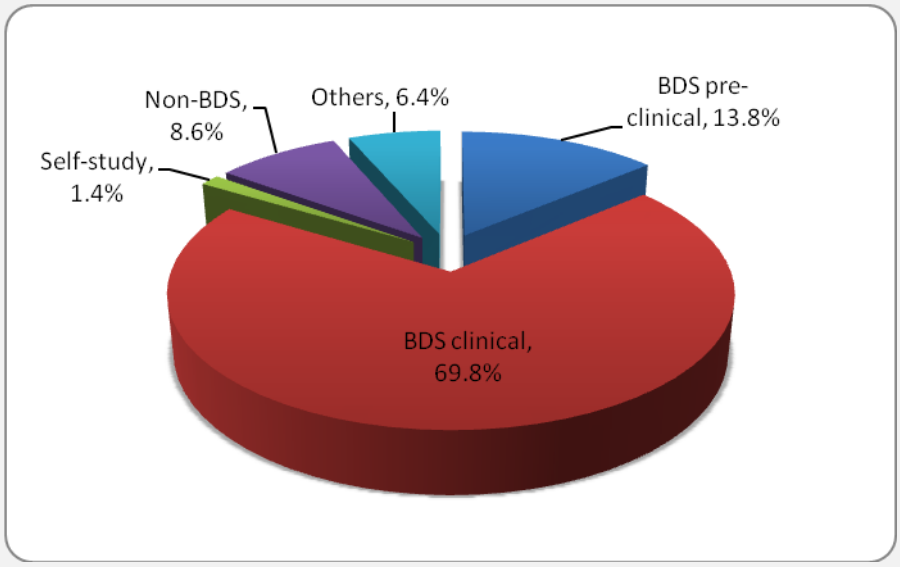


Figure 7.6 The different dental e-courses and their page distribution.

Courses	*No. of pages*	*Percentage (%) Out of 2085 (total e-course pages)*
Biomedical Science	8	0.4
Cardiovascular Respiratory Module	7	0.3
Craniofacial Biology	25	1.2
Dental Public Health	Same pages as "Clinical Dental Public Health"	
Digestive Renal Endocrine	46	2.2
Ethics	75	3.6
Introduction to Clinical Dentistry	3	0.1
ICT	25	1.2
Learning Dentistry	1	0.1
Neuro-Musculo-Skeletal	7	0.3
Oral Biology	89	4.3
Para-clinical Skills	1	0.1
Practical Dental Skills	1	0.1
Total	**288**	**13.9**

Table 7.4 The different BDS pre-clinical e-courses and their page distribution.

Courses	*No. of pages*	*Percentage (%) Out of 2085 (total e-course pages)*
BASHD	85	4.1
Clinical Governance	43	2.1
Clinical Practice	18	0.9
Conservative Dentistry	169	8.1
Cons Lab Course	74	3.6
Dental Biomaterial	64	3.1
Dental Pathology & Immunology	11	0.5
Dental public health	99	4.8
Electives	10	0.5
Endodontics	129	6.2
Forensic Dentistry	9	0.4
Occlusion	16	0.8
Oral Medicine	13	0.6
Oral Pathology	20	1.0
Oral Surgery	95	4. 6
Orthodontics	50	2.4
Paediatric Dentistry	158	7.6
PDS Outreach	13	0.6
Periodontology	73	3.5
Prosthetics	265	12.7
Radiography / Radiology	36	1.7
Sedation	5	0.2
Total	**1455**	**70.0**

Table 7.5 The different BDS clinical e-courses and their page distribution.

7.5 Summary

The presented quantitative results highlighted the extensive capability of the e-course in supporting the teaching, learning, professional and communication skills among all school members. It also highlighted the extensive use of different components by different departments and school members. The latter could be an indication of the flexibility and functionality of the e-course as a technology in supporting different teaching and learning needs.

Results also highlighted the level of use of such innovation in teaching and learning. The major content area was lecture notes and PowerPoint handouts. Self-assessments were found to be the second major content area.

In conclusion, the e-course was shown to be highly efficient in supporting the teaching and learning in the school. However, teachers do not utilise its maximum potential at the present time.

Chapter 8

e-COURSE EFFECTIVENESS: CONTENT ANALYSIS

8.1 Introduction

The effectiveness of discussion boards as a collaborative tool in supporting teaching and learning in dentistry was assessed. The online discussion board archive on the Prosthetic e-course for 2008 was selected as a sample for such assessment. Data were analysed using content analysis and a complete message as the unit of analysis. Results are presented under the following categories;

1) Intra-examiner reliability for the coded variables
2) Participation
3) Quality of discussion
4) Social learning
5) Cognitive learning
6) Role of teachers

8.2 Intra-examiner Reliability Test

After repeated measures, the final Kappa statistical value for all the coded variables ranged from (0.9 to 1), thus, indicating high agreement levels (Table 8.1).

Coded variables	*Kappa statistical value*
Message clarity	1.0
Content type	1.0
External resources used	1.0
Primary purpose of posted messages	1.0
Students' interaction level	1.0
Knowledge type	0.9
Processing level	0.9
Resolution of discussion thread	1.0

Table 8.1 Kappa statistical values for the coded variables.

8.3 Participation

Participation on the Prosthetic discussion board in 2008 was assessed using the following 6 variables; 1) total number of threads and messages, 2) average length of discussion threads, 4) average number of words per message, 5) authors of posted messages, 3) number of posted threads and messages per academic period, 6) posting days (learning location).

A total of 108 threads consisting of 330 messages were posted by both teachers and undergraduate dental students on the Prosthetics discussion archive in 2008. There were an extra 2 threads consisting of one message each posted by visitors. The latter group was not of interest to the present study and was excluded.

The average length of a discussion thread consisted of 3 messages (range: 1-to-15 messages). The average number of words per message was 54 words (range: 1-to-464 words) (**Table 8.2**).

Variables	Median	Minimum	Maximum
Messages / thread	2	1	15
Words / messages	36	1	464

Table 8.2 Number of messages / thread, and words / messages.

The Prosthetic discussion board was made available to all members of the school. Two main authors' level were identified; teachers and students from different dental undergraduate levels. Due to the anonymous nature of posting messages on the discussion board it was not possible to measure the proportion of the full student cohort who used the discussion board. Thus, messages from students were grouped according to their year of study only.

Out of the 330 messages; 154 messages (47%) were posted by teachers and 176 messages (53%) by students (Figure 8.1). Mann-Whitney U test (Asymptotic significant value=1.000) revealed no significant difference ($p<0.05$) in the number of posted messages between both authors. However, when the messages posted by students were further analysed, Kruskal-Wallis test (Asymptotic significant value=0.000) revealed that there is a significant difference ($p<0.05$) with the majority of messages (n=146/176, 83%) being posted by 4th year students in a five year undergraduate programme (Figure 8.2).

Data were further classified according to messages' level (start, in-between and end-message). Pearson Chi-square test (Asymptotic significant value=0.000) revealed a significant difference ($p<0.05$) between the number of messages posted by the two authors (teachers and students) at different messages' level. All "Start-messages" (n=108/330 messages) were posted by students, and none by teachers. Most of the messages at the "End-messages" level (n=97/330 messages) were posted by teachers (n=83/97 messages, 86%), while students posted only 14/97 messages (14%). At the level of "In between messages" (n=125/330 messages), the teachers had slightly more contribution than the students. Teachers posted 71/125 messages (57%), while students posted 54/125 messages (43%) (Figure 8.3).

Authors of posted messages

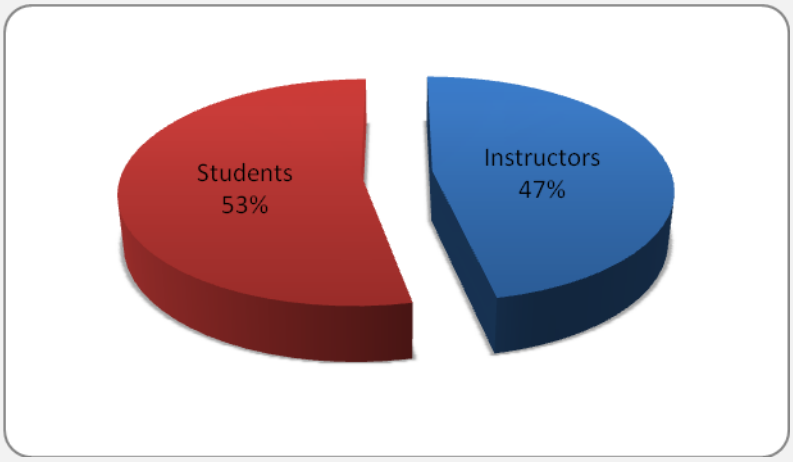


Figure 8.1 Percentages of messages posted by the two authors (teachers and students).

Messages posted by students

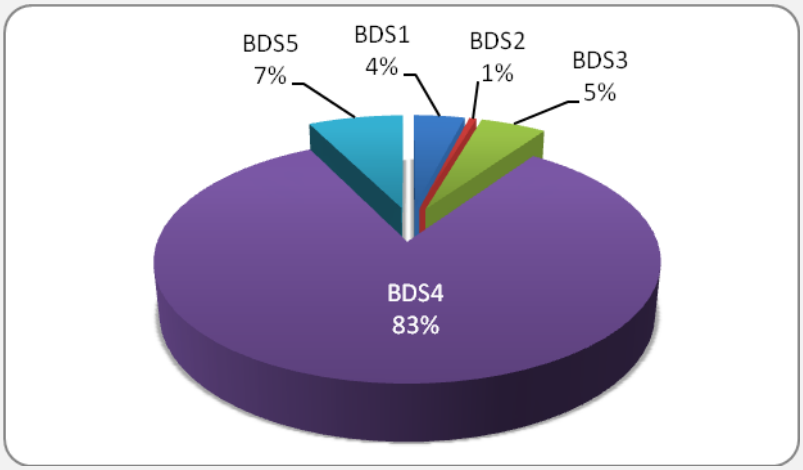


Figure 8.2 Percentages of messages posted by students from different undergraduate level; BDS1 (1st year), BDS2 (2nd year), BDS3 (3rd year), BDS4 (4th year), and BDS5 (5th year).

Authors / messages' level

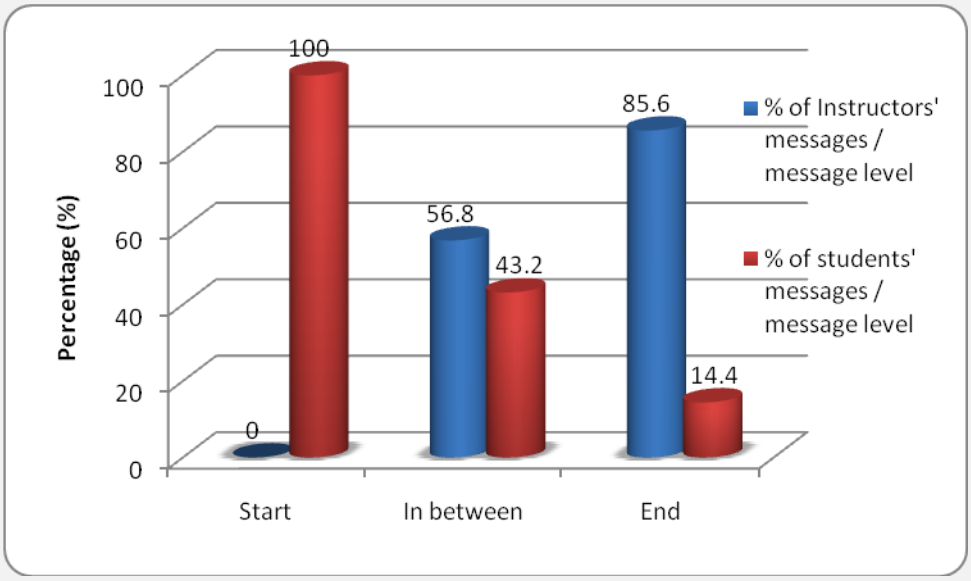


Figure 8.3 Percentages of messages posted by the two authors (teachers and students) at the three levels designed to assess messages' level; start, in-between and end-messages.

The year 2008 was divided into three academic periods and a one month (August) end of year holiday. These periods were considered as follows;

- 1st period: from January to March.
- 2nd period: from April to July.
- 3rt period: from September to December.

Contribution to the Prosthetic discussion board was further analysed according to each academic period. Results indicated that the greatest number of threads (n=79/108 threads, 73%) and messages (n=255/330 messages, 77%) were posted in the 3rd period. This was followed by the 2nd period which had 17/108 of posted threads (n=45/330 messages, 14%), and then the 1st period which showed 11/108 posted threads (n=28/330 messages, 9%). Only 1/108 thread (n=2/330 messages, 1%) was posted during August (Holiday) (Figure 8.4).

Results also indicated that the Prosthetic discussion board was used both during weekdays and weekends or holidays. 190/330 messages (58%) were posted during weekdays and 140/330 messages (42%) were posted during the weekends and holidays (Figure 8.5).

Academic periods

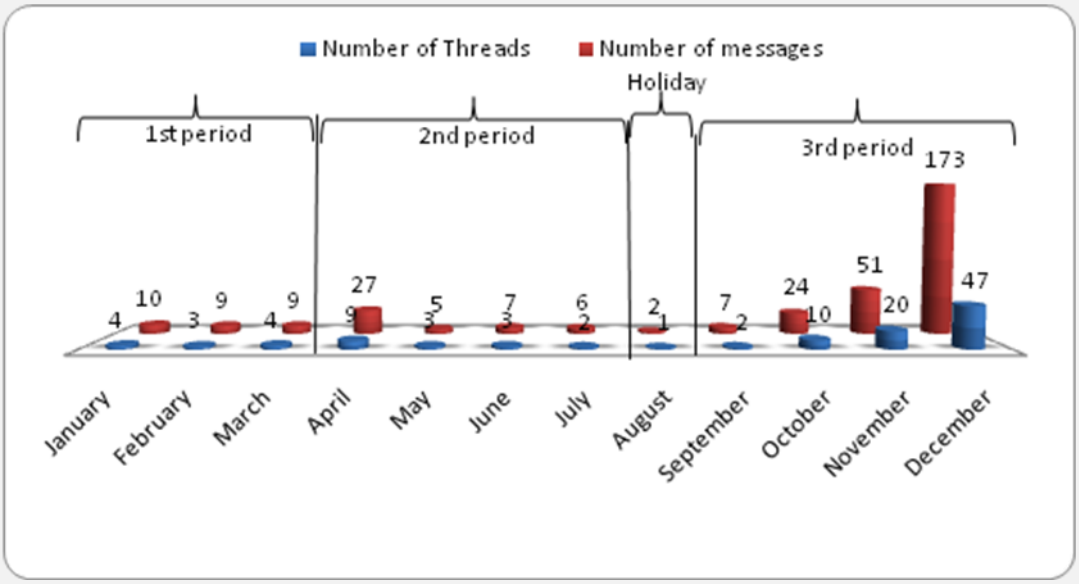


Figure 8.4 Number of posted threads and messages / academic period in 2008.

Posting days

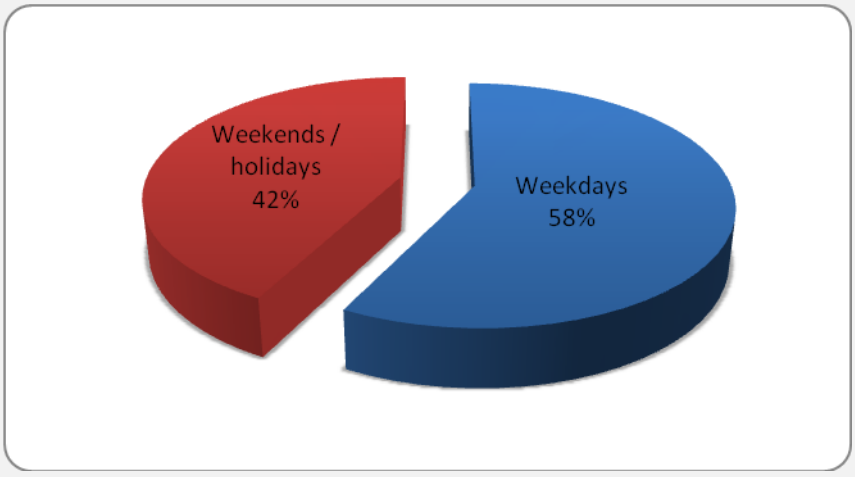


Figure 8.5 Percentages of messages posted in the two categories designed to assess posting days; weekdays and weekends or holidays.

The 3rd period of the year 2008 (September - to - December) was chosen for further analysis since it showed the greatest contribution to the Prosthetic discussion board archive in that year. Four dimensions were then assessed; quality of discussion, social learning, cognitive learning, and role of teachers.

8.4 Quality of Discussion

The quality of discussion was assessed using the following variables; threads' level, primary purpose of posted messages, external resources used, knowledge depth (knowledge type and processing level) in the starting-messages (opening message), message clarity, content type, response time and resolution of discussion threads.

The 3rd period (September – to - December) showed 79 threads posted on the Prosthetic discussion board. Those threads were divided into two main levels; threads with less than 4 messages and threads with 4 or more messages. The first level was designed to represent short discussion, thus, considered as a question and answer format. The second level was designed to represent longer discussions and considered as a discussion forum format.

Results indicated that the number of threads representing long discussion constituted less than third (n=23/79 threads, 29%) the total number of threads posted in the 3rd period of the year 2008. However, the number of messages posted in those threads constituted almost half (n=137/255 messages, 53.7%) the total number of messages posted in that period (Figure 8.6). The range of messages in those threads was from (4 -to- 15 messages / thread). Half of those threads (n=12/23 threads, 52%) consisted of 4 messages only (Table 8.3). Thus, indicating that most of the long discussions consisted of four messages only.

Thread's level

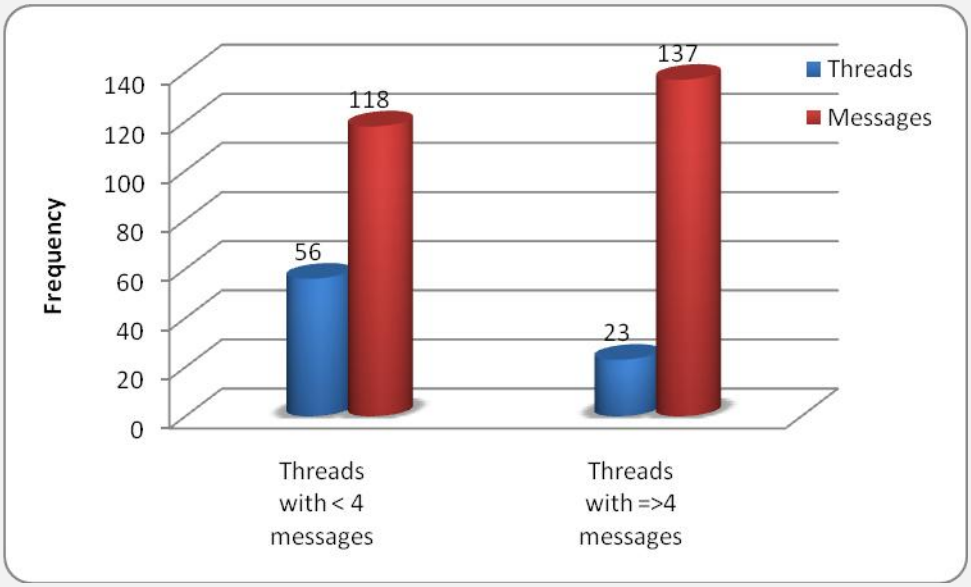


Figure 8.6 Frequency of messages and threads posted at the two levels designed to assess threads' level; 1) threads with <4 messages, and 2) threads with =>4 messages.

No. of messages	4	5	7	8	12	14	15	Total
Frequency of threads	12	5	1	2	1	1	1	**23**
Percentage (%) of threads	52.2	21.7	4.3	8.7	4.3	4.3	4.3	**100**

Table 8.3 Number of messages in threads with 4 or more messages.

The primary purpose of most messages posted on the Prosthetic discussion board in the 3rd period of the year 2008 was found to be for two main purposes; asking questions (n=81/255 messages, 31.8%), or offering an answer (n=127/255 messages, 49.8%). The discussion board was also used to a lesser extent for independent comments (n=34/255 messages, 13.3%). However, it was rarely used for non-academic issues (n=13/255 messages, 5.1%) (Figure 8.7).

Messages posted for asking questions were two types; a) messages with open questions for all school members to reply (n=65/255 messages, 25.5%) and they constituted the majority of this type of messages, and b) messages with specific questions directed to a specific person (n=16/255 messages, 6.3%). The messages posted to offer an answer were also two types; a) messages posted to offer an answer only (n=67/255 messages, 26.3%), and b) messages posted to offer an answer followed by an action such as; a question, suggesting further readings or referring to another teacher (n=60/255 messages, 23.5%) (Figure 8.7).

Messages were further analysed according to authors' level. Pearson Chi-Square test (Asymptotic significant value=0.000) revealed a significant difference ($p<0.05$) between the two authors (teachers and students) in the primary purpose of their posted messages. The majority of messages posted by teachers were for offering an answer (n=54/120 messages, 45%) and offering an answer followed by an action (n=49/120 messages, 40.8%) such as suggesting further readings or asking questions. They did not post any messages for either open or specific questions (Figure 8.8). On the other hand, almost half of the messages posted by students were mainly for open questions (n=65/135 messages, 48.1%) (Figure 8.8).

Primary purpose of posted messages

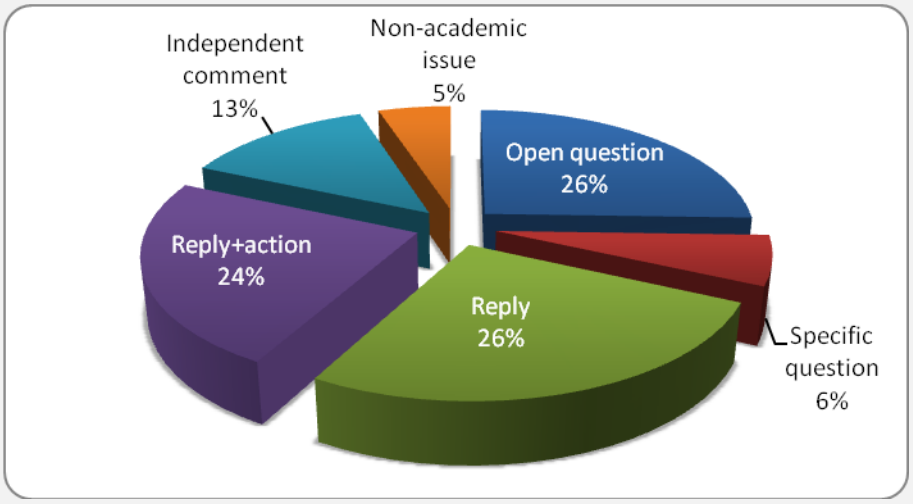


Figure 8.7 Percentages of messages posted for the six categories designed to assess the primary purpose of posted message.

Primary purpose of posted messages / author level

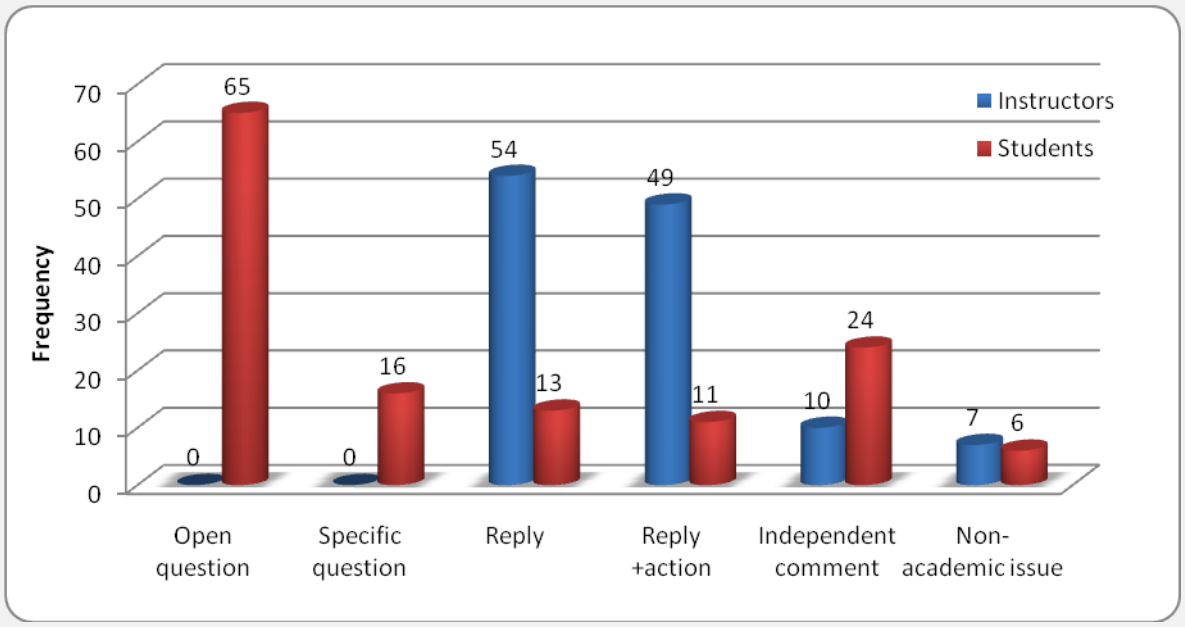


Figure 8.8 Number of messages posted by the two authors (teachers and students) at the six categories designed to assess the primary purpose of posted messages.

The primary purpose of posted messages was also compared between the two threads' level. Pearson Chi-Square test (Asymptotic significant value=0.137) revealed no significant relationship ($p<0.05$) between the primary purpose of posted messages and thread's level (Table 8.4).

However, when data were further analysed according to author's level (teachers and students), results varied. For messages posted by teachers, Pearson Chi-Square test (Asymptotic significant value=0.311) showed no significant relationship ($p<0.05$) between the two variables (primary purpose and threads' level).

For messages posted by students, Pearson Chi-Square test (Asymptotic significant value=0.001) showed a significant relationship ($p<0.05$) between both variables. Messages posted for asking open questions was significantly greater in threads with less than four messages. In contrary, messages for offering an answer and offering an answer followed by an action were significanlty greater in threads with 4 or more messages (Table 8.5).

Primary purpose of posted messages	No. of messages in threads with <4 messages	No. of messages in thread with =>4 messages	Total	Pearson Chi-Square Asymp. Sig. (2-sided)
Open question	38	27	**65**	**0.137**
Specific question	6	10	**16**	
Reply	28	39	**67**	
Reply followed by an action	22	38	**60**	
Independent comment	16	18	**34**	
Non-academic issue	8	5	**13**	
Total	**118**	**137**	**255**	

Table 8.4 Messages posted for the different categories designed to assess the primary purpose at the two thread's level; threads with <4 messages, and threads with =>4 messages.

Primary purpose of posted messages	Messages posted by students		Messages posted by teachers	
	No. of messages in threads with <4 messages	No. of messages in threads with =>4 messages	No. of messages in thread with <4 messages	No. of messages in thread with =>4 messages
Open question	38	27	0	0
Specific question	6	10	0	0
Reply	1	12	27	27
Reply followed by an action	1	10	21	28
Independent comment	14	10	2	8
Non-academic issue	4	2	4	3
Total	**64**	**71**	**54**	**66**
Pearson Chi-Square Asymp. Sig. (2-sided)	**0.001**		**0.311**	

Table 8.5 Number of messages posted by students and teachers for the different categories designed to assess the primary purpose at the two threads' level; threads with <4 messages, and threads with =>4 messages.

A majority of the messages (n=203/255 messages, 79.6%) had no reference to any external resources. Only 52/255 messages (20.4%) referred to one or more external resources to support the information provided (Figure 8.9). Results highlighted nine types of external resources used. Those were; teachers or course information (n=17/255 messages, 6.7%), other messages in the prosthetic discussion archive (n=4/255 messages, 1.6%), web pages (n=5/255 messages, 2%), books (n=6/255 messages, 2.4%), articles (n=1/255 messages, 0.4%), and e-course pages (n=11/255 messages, 4.3%). Referral to more than one resource had been used in only 8/255 messages (3.1%). However, none of the posted messages referred to past-exams or coursework and assignments (Figure 8.9).

Out of the 255 messages, 244 messages (95.7%) were clear and appeared to be understandable by the participants in the discussion thread. The other 11 messages (4.3%) were somewhat clear with some confusing or vague points that needed further clarification. However, none of the posted messages appeared to be unclear or confusing (Figure 8.10).

A majority of the messages were course related (n=203/255 messages, 79.6%) in which the provided knowledge supported the course curriculum. Other messages provided administrative knowledge as; due dates, requirements and clinical issues (n=3/255 messages, 1.2%) or knowledge that was unrelated to the course curriculum as technical support issues (n=10/255 messages, 3.9%). However, 39/255 messages (15.3%) had social knowledge that was considered to have indirect influence on the learning community (Figure 8.11).

External resources

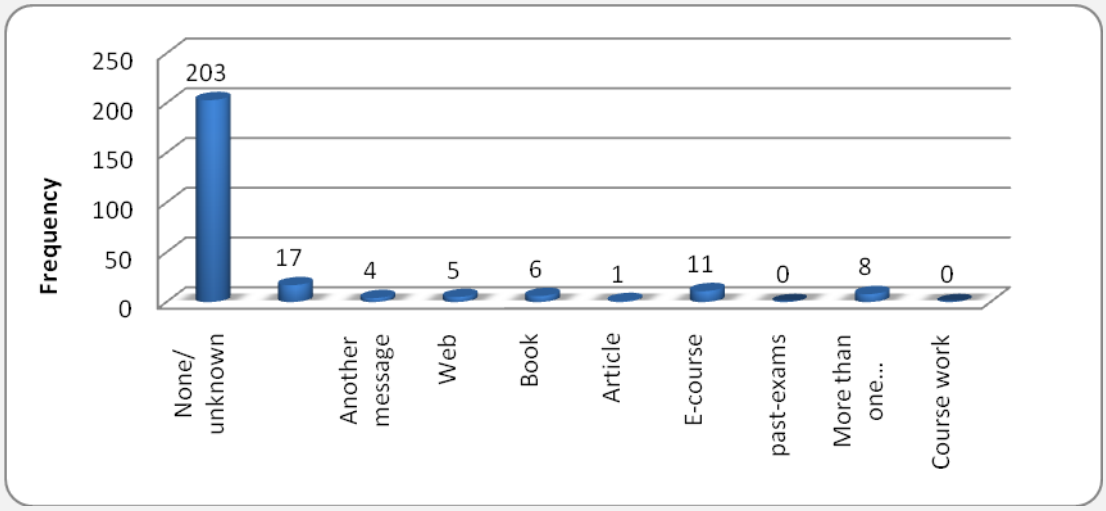


Figure 8.9 Frequencies of messages posted according to different types of external resources used.

Message clarity

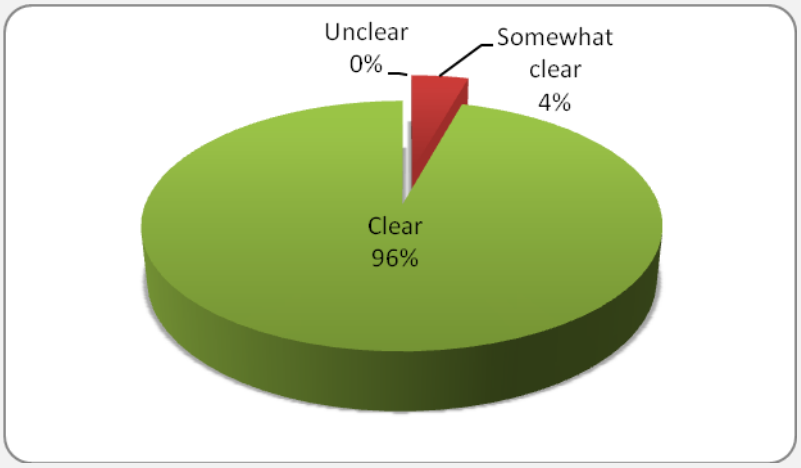


Figure 8.10 Percentages of messages posted at the three levels designed to assess messages clarity; unclear, somewhat clear and clear.

Content type

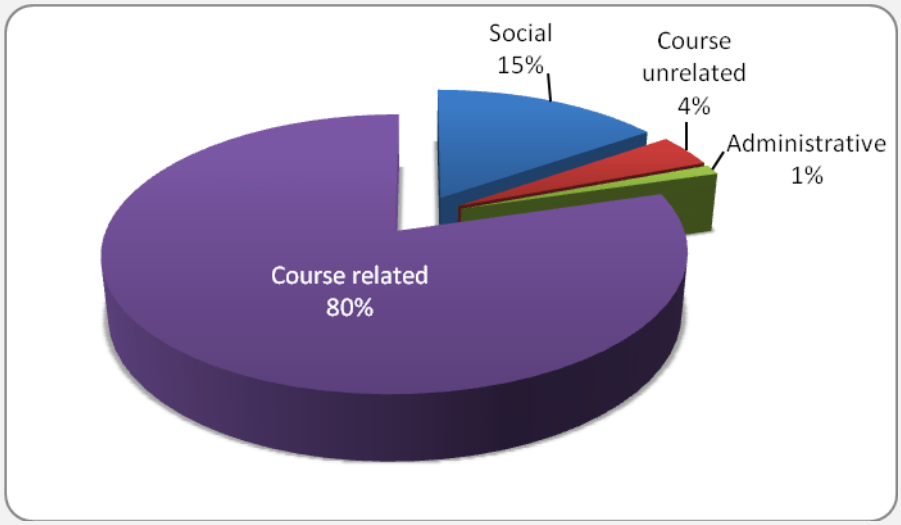


Figure 8.11 Percentages of messages posted in the four categories designed to assess content type; social comments, course unrelated, administrative and course-related.

The response time, measured in days, for each message was also assessed. Messages were then categorised according to the presence of reply into 3 categories. These categories were; messages with reply (n=176/255 messages, 69%), messages without reply (n=10/255 messages, 3.9%), and end of thread-messages (n=69/255 messages, 27.1%) (Table 8.6).

The mean response time to the first category was then calculated and found to be 1 day (SD=1.74, range: 0 to 19 days). Results also indicated that 123/176 (71%) of the messages with reply had a reply in the same day it was posted.

Results also indicated that the majority of the discussion threads were completely resolved (n=59/79 threads, 74.7%) with complete and correct information that totally resolved the question(s) being asked in the thread. Other discussion threads were either; partially resolved (n=14/79 threads, 17.7%) in which information provided partially answered the question(s) being asked in the thread, or unresolved (n=6/79 threads, 7.6%) in which no information was given to solve the question(s) rose in the thread (Figure 8.12).

Types of messages	No. of messages
Messages with reply	176
Messages without reply	10
End - messages	69
Total	**255**

Table 8.6 Messages' level according to the reply.

Resolution of discussion threads

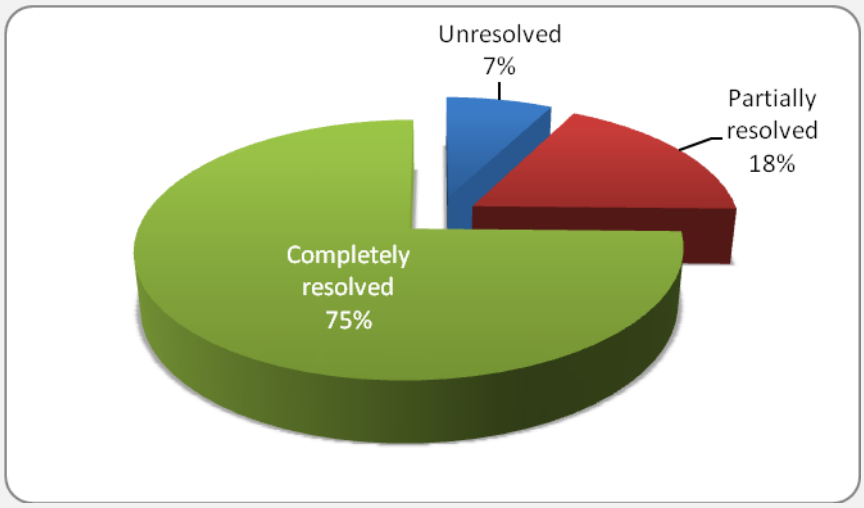


Figure 8.12 Percentages of messages posted at the three levels designed to assess the resolution of discussion threads; unresolved, partially resolved and completely resolved.

The quality of discussion was also compared between the two threads' level for the following variables; knowledge depth, message clarity, content type, response time, and resolution of discussion threads. Pearson Chi-Square revealed no significant difference ($p<0.05$) between the two threads' level for the following variables (Table 8.7);

1) Knowledge depth: the majority of discussions in both threads' level started with messages for understanding concepts and procedural knowledge.

2) Message clarity: the majority of messages in both threads' level showed clear presentation of information.

3) Content type: the majority of messages in both threads' level contained course-related information.

4) Resolution of discussion thread: the majority of discussions in both threads' level were completely resolved.

Furthermore, t-test (Significant value=0.054) showed no significant difference ($p<0.05$) in the mean response time between both threads' level (Table 8.7).

In conclusion, the Prosthetic discussion archive in the period (September –to- December) showed two formats of discussions; question and answer format and discussion forum format. Both formats had the same quality of discussion in terms of; number of posted messages, primary purpose of messages posted by teachers, message clarity, content type, response time, and resolution of discussion thread. Both formats also started with the same knowledge depth. However, both formats, showed different discussion quality in the following two variables; number of threads, and primary purpose of messages posted by students.

Variable		Pearson Chi-Square Asymp. Sig. (2-sided)
Knowledge depth	Knowledge type in "Start" messages	**0.505**
	Processing level in "Start" messages	**0.503**
Message clarity		**0.196**
Content type		**0.306**
Resolution of thread		**0.245**
Response time after eliminating the outlier (n=1 message)		**t-test significant (2-tailed) = 0.054**

Table 8.7 The significance value between the two threads' level (threads with <4 messages, and threads with =>4 messages) for some of the variables designed to assess the quality of discussion.

8.5 Social Learning

The objective of this dimension was to assess the interaction among peers using discussion boards and its impact on the learning process. Social learning was assessed using two variables; students' interaction level, and the percentage of social comments in the posted messages. Only messages posted by students were analysed for such assessment.

Two levels of interactions were designed to assess the messages posted by students. These levels were; independent thinking and interactive thinking. Pearson Chi-Square test (Asymptotic significant value=0.000) indicated that the number of messages showing interactive and collaborative thinking (n=91/135 messages, 67%) among peers was significantly greater than those showing independent thinking (n=44/135 messages, 33%) ($p<0.05$) (Figure 8.13).

Students' interaction level was further assessed at two levels; threads' level, and primary purpose of posted messages. Pearson Chi-Square test (Asymptotic significant value=0.012) revealed a significant relationship ($p<0.05$) between the students' interaction level and the threads' level. Messages with independent thinking were significantly greater in threads with four or more messages. In contrary, messages with interactive thinking were significantly greater in threads with less than four messages (Table 8.8).

Students' interaction level

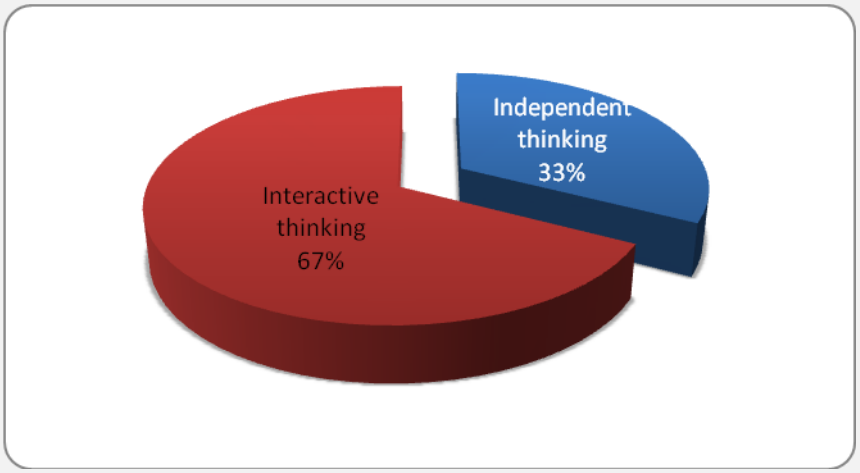


Figure 8.13 Percentages of messages posted at the two levels designed to assess students' interaction; independent thinking, and interactive thinking.

*** Pearson Chi-Square test (Asymptotic significant value=0.000)**

Students' interaction level	No. of messages in threads with <4 messages	No. of messages in thread with =>4 messages	Total
Independent thinking	14	30	**44**
Interactive thinking	50	41	**91**
Total	**64**	**71**	**135**
Pearson Chi-Square Asymp. Sig. (2-sided)	**0.012**		

Table 8.8 Number of messages / students' interaction level at the two categories designed to assess threads' level (threads with <4 messages, and threads with =>4 messages).

Pearson Chi-Square tests (Asymptotic significant value=0.000) also revealed a significant relationship ($p<0.05$) between the primary purpose of posted messages and the students' interaction level. Messages showing interactive thinking were significantly greater when students were asking open questions (n=65/91 messages, 71%) (Table 8.9). For example:

"Hi, could somebody tell me what impression material would you use for the primary impression for edentulous mouth with undercuts preset? Thanks".

On the other hand, messages showing independent thinking were significantly greater when students were asking a question directed to a specific teacher (n=16/44 messages, 36%) (Table 8.9). For example:

"Hi Dr. (...) what is difference between putty and medium and heavy bodied elastomers? Thanks".

Independent thinking was also reported to a lesser extent in messages posted for independent comments (n=14/44 messages, 32%) (Table 8.9).

Primary purpose of posted messages	Students' interaction level		Total
	Independent thinking	Interactive thinking	
Open question	0	65	**65**
Specific question	16	0	**16**
Reply	9	4	**13**
Reply + action	3	8	**11**
Independent comments	14	10	**24**
Non-academic issues	2	4	**6**
Total	**44**	**91**	**135**
Pearson Chi-Square Asymp. Sig. (2-sided)	**0.000**		

Table 8.9 Number of messages / students' interaction level at the six levels designed for the primary purpose of posted messages.

Social comments in messages posted by students in the 3rd period of the year 2008 were few (n=27/135 messages, 20%). Social comments from students were almost the same at the two threads' level (Table 8.10).

Thus, results indicated that student-to-student interaction on the Prosthetic discussion board in the 3rd period of the year 2008 was mainly in the form of open questions. And that social interaction was not a significant factor in promoting discussion.

Threads' level	No. of messages posted by students with social comments	Percentage (%)
Threads with <4 messages	13	48.1
Threads with =>4 messages	14	58.9
Total	**27**	**100**

Table 8.10 Number of messages with social comments at the two threads' level; threads with <4 messages and threads with =>4 messages.

8.6 Cognitive Learning

The objective of this dimension was to assess the level and depth of cognitive activities when using discussion boards. Cognitive learning was assessed in the messages posted by students' with course-related contents (n=102 messages) only. Two variables were used as an indication for such cognitive activities; knowledge type and processing level.

Pearson Chi-Square test (Asymptotic significant value=0.000) revealed a significant association ($p<0.05$) between the knowledge type and the processing level of the students' cognitive activities. Students were mainly trying to understand concepts (n=27/102 messages, 26.5%), followed by applying procedures (n=17/102 messages, 16.7%), and remembering facts (n=11/102 messages, 10.8%). Evaluating meta-cognitive knowledge (n=9/102 messages, 8.8%), and analysing procedural and meta-cognitive knowledge (n=7/102 messages, 6.8%) were reported to a lesser extent (Table 8.11).

Data were further analysed at two levels; threads' level, and primary purpose of posted messages. Pearson Chi-Square test revealed no significant difference ($p<0.05$) in knowledge type (Asymptotic significant value=0.709) (Table 8.12), and processing level (Asymptotic significant value=0.758) (Table 8.13) between the two threads' format.

Knowledge type	Processing level					Total
	Remember	Understand	Apply	Analyse	Evaluate	
Fact	11	6	0	0	0	17
Concept	2	27	1	4	0	34
Procedure	0	3	17	7	1	28
Metacognitive	1	2	4	7	9	23
Total	14	38	22	18	10	102

Table 8.11 Number of messages posted by students for the different cognitive activities.

Knowledge type	No. of messages / threads' level		Total	Pearson Chi-Square Asymp. Sig. (2-sided)
	Threads with <4 messages	Threads with =>4 messages		
Fact	7	10	**17**	**0.709**
Concept	16	18	**34**	
Procedure	14	14	**28**	
Meta-cognitive	8	15	**23**	
Total	**45**	**57**	**102**	

Table 8.12 Number of messages / knowledge type at the two threads' level; threads with <4 messages, and threads with =>4 messages.

Processing level	No. of messages / threads' level		Total	Pearson Chi-Square Asymp. Sig. (2-sided)
	Threads with <4 messages	Threads with =>4 messages		
Remember	5	9	**14**	**0.758**
Understand	20	18	**38**	
Apply	9	13	**22**	
Analyse	7	11	**18**	
Evaluate	4	6	**10**	
Total	**45**	**57**	**102**	

Table 8.13 Number of messages / processing level at the two threads' level; messages with <4 messages, and threads with =>4 messages.

Results also highlighted varied cognitive activities at the different purposes of students' posted messages. When posting open questions (n=64/102 messages, 63%), students were mainly trying to understand concepts (n=22/64 messages, 34%) (Table 8.14). For example:

"Are partial and complete dentures made in RCP? Thanks".

And to a lesser extent, applying (n=11/64 messages, 17%) and analysing procedures (n=6/64 messages, 9%) (Table 8.14). For example:

"Hi, Am I right in thinking that the female component of the dolder bar ..... is flared. Hence it does not fit flush onto the male component of the bar..... Thus when axial forces are transmitted on to the arch, ... there is some degree of rotation. This then dissipates the forces without dangerous overloading of the abutment teeth?

However, when they were posting messages with questions directed to a specific teacher (n=16/102 messages, 16%), they were trying to understand concepts (n=5/16 messages, 31%) and to a lesser extent applying procedures (n=4/16 messages, 25%) (Table 8.14).

In contrary, when students were posting reply messages (n=13/102 messages, 13%), they were basically trying to remember facts (n=6/13 messages, 46%). When posting messages with reply followed by an action (n=9/102 messages, 9%), such as asking another question or referring to an external resource, they were mainly evaluating meta-cognitive knowledge (n=3/9 messages, 33%) (Table 8.14). For example:

"In response to (thread #3108) you explained that Buccal upper and lingual lower cusps relate to supporting cusps, maintaining OVD? This confused me because I thought that Upper palatal cusps and Lower buccal cusps are described as the supporting cusps, ...and that once initial adjustment to these cusps had occured to correct initial ICP interference

that they should be left else loss of OVD occurs and consequently increase in FWS? I would be grateful for any clarification thank you".

They were also trying to a lesser extent to remember facts (n=2/9 messages, 22%) or apply procedures (n=2/9 messages, 22%) (Table 8.14).

Pearson Chi-Square test revealed significant associations ($p<0.05$) between these cognitive activities and most of the primary purposes of students' posted messages. However, this association was not statistically significant (Pearson Chi-Square test (Asymptotic significant value=0.133) when the primary purpose of the posted message was to offer a reply ($p<0.05$) only (Table 8.14).

Primary purpose	Processing level	Knowledge type				Total	Pearson Chi-Square Asymp. Sig. (2-sided)
		Fact	Concept	Procedure	Meta-cognitive		
Open question	Remember	3	1	0	0	**4**	**0.000**
	Understand	4	22	2	2	**30**	
	Apply	0	0	11	4	**15**	
	Analyse	0	3	6	3	**12**	
	Evaluate	0	0	0	3	**3**	
	Total	**7**	**26**	**19**	**12**	**64**	
Specific question	Remember	0	0	0	0	**0**	**0.006**
	Understand	1	5	1	0	**7**	
	Apply	0	0	4	0	**4**	
	Analyse	0	0	0	2	**2**	
	Evaluate	0	0	1	2	**3**	
	Total	**1**	**5**	**6**	**4**	**16**	
Reply	Remember	6	1	0	1	**8**	**0.133**
	Understand	0	0	0	0	**0**	
	Apply	0	1	0	0	**1**	
	Analyse	0	1	1	1	**3**	
	Evaluate	0	0	0	1	**1**	
	Total	**6**	**3**	**1**	**3**	**13**	
Reply + action	Remember	2	0	0	0	**2**	**0.021**
	Understand	1	0	0	0	**1**	
	Apply	0	0	2	0	**2**	
	Analyse	0	0	0	1	**1**	
	Evaluate	0	0	0	3	**3**	
	Total	3	0	2	4	**9**	

Table 8.14 Number of messages posted by students / primary purpose, at the two variables designed to assess cognitive activities (knowledge type and processing level).

*** The highlighted cells indicate the major type of cognitive learning at each level of the "primary purpose of messages".**

8.7 Role of Teachers

The primary purpose of messages posted by teachers (n=120 messages) were assessed at the two threads' level. Pearson Chi-Square test (Asymptotic significant value=0.311) revealed no significant difference in teachers' activities at the two threads' level ($p<0.05$). Teachers, in both threads' level, were mainly replying to students' messages with (n=49/120 messages, 41%) or without proposing another action (n=54/120 messages, 45%) (Table 8.15).

Messages with reply followed by an action were further analysed. Pearson Chi-Square test (Asymptotic significant value=0.014) revealed a significant association ($p<0.05$) between the type of action taken by teachers in their posted messages and the threads' level. The number of messages with reply followed by a question was significantly higher in threads with four or messages (n=18/24 messages, 75%). On the other hand, the number of messages with reply followed by a referral to external resources was significantly higher in threads with less than four messages (n=14/21 messages, 67%) (Table 8.16).

Results, thus, highlighted that messages from teachers with reply followed by a question might play a role in promoting discussion.

Primary purpose of posted messages	Threads' level		Total	Pearson Chi-Square Asymp. Sig. (2-sided)
	Threads<4 messages	Threads =>4 messages		
Open question	0	0	**0**	**0.311**
Specific question	0	0	**0**	
Reply	27	27	**54**	
Reply + action	21	28	**49**	
Independent comment	2	8	**10**	
Non-academic issues	4	3	**7**	
Total	**54**	**66**	**120**	

Table 8.15 Number of messages posted by teachers / primary purpose, at the two threads' level; threads with <4 messages, and threads with =>4 messages.

Types of reply	Threads' level		Total	Pearson Chi-Square Asymp. Sig. (2-sided)
	Threads<4 messages	Threads =>4 messages		
Reply followed by a question	6	18	**24**	**0.014**
Reply followed by a referral to an external resource	14	7	**21**	
Reply followed by both a question and referral to an external resource	1	3	**4**	
Total	**21**	**28**	**49**	

Table 8.16 Number of messages posted by teachers / type of reply, at the two threads' level; threads with <4 messages, and threads with =>4 messages.

8.8 Summary

The discussion board on the Prosthetic e-course was used extensively in the year 2008 by both teachers and students. It was also found to be used during weekdays, weekends and holidays. However, the discussion board was found to be used mainly in the 3rd period of the 2008 academic year, and mostly by 4th year students in a five year undergraduate dental programme.

The quality of discussion was also found to be at a good level in terms of message clarity, content type, response time and resolution of discussion threads. However, it was mainly in the form of question and answer format with students asking questions and teachers replying to those questions. Users rarely referred to external resources in their discussion, and students were mainly trying to understand concepts and procedures and not thinking at a deeper knowledge level.

Students showed a good potential for using the discussion board for collaborative thinking. However, it was mainly in the form of open questions at the start of messages and not as a reply to their peers. Using the discussion boards did not promote deep learning except when teachers were posting further questions and challenging students to think deeper.

Chapter 9

e-COURSE RELEVANCE: QUALITATIVE ANALYSIS

9.1 Introduction

Dental students and academic teachers in the school were interviewed and their attitudes towards online learning in dentistry were assessed using qualitative analysis. Interviews and focus groups were analysed for emerging themes following three main categories; technological, pedagogical, and curriculum design evaluation. Themes and patterns were assigned when more than one quote was reported by respondents. Respondents' demographic backgrounds were also collected and data were analysed. Results are presented accordingly in the following sub-sections.

9.2 Demographic Background

Data reached saturation after interviewing nine academic teachers (3 females and 6 males). Those teacher were from the following departments; Dental Public Health, Orthodontics, Restorative Dentistry, Conservative Dentistry, Prosthetics, Biomaterials, Clinical Practice, Oral Surgery, and Periodontology. Seven teachers are lecturer, one is an Associate Professor, and one is a Professor (Table 9.1).

Results showed varied ranges in the age and teaching experiences of the participated teachers. Four teachers were above 40 years old and had more than 10 years of teaching experience. Three teachers were in the range of 31-35 years old, with a teaching experience ranging between less than 5 years (n=1 teacher) and 5-10 years (n=2 teachers) of teaching

experience. The other two teachers had less than 5 years of teaching experience and were in the range of 26-30 years and 20-25 years old, respectively (Table 9.1).

Results also showed varied ranges in computer literacy among the participated teachers. Most teachers (n=6) reported that they were confident in both computer and internet use. Two teachers reported that they were expert in both computer and internet use and only one teacher reported to be at the beginner level of computer literacy and mainly in advanced computer use. No specific pattern was highlighted between teachers' computer literacy and their related age group. For example, expertise in computer use was reported by two teachers; one was from the youngest age group (20-25 years old) and the other was from the eldest age group (>40 years old) (Table 9.1).

No.	*Code / participant*	*Age group (years)*	*Gender*	*Position*	*Department*	*Computer literacy*	*Teaching experience (years)*
1	T.1	>40	F	Associate Professor	Dental Public Health	Confident	>10
2	T.2	26-30	F	Lecturer	Orthodontics	Beginner	<5
3	T.3	31-35	M	Lecturer	Restorative Dentistry	Confident	<5
4	T.4	>40	M	Lecturer	Conservative Dentistry	Confident	>10
5	T.5	20-25	M	Lecturer	Prosthetics	Expert	<5
6	T.6	31-35	M	Lecturer	Biomaterial	Confident	5-10
7	T.7	>40	M	Lecturer	Clinical Practice	Expert **(e-course developer)**	>10
8	T.8	31-35	F	Lecturer	Oral Surgery	Confident	5-10
9	T.9	>40	M	Professor	Periodontology	Confident	>10

Table 9.1 Demographic data for the participated academic teachers.

Data reached saturation after interviewing forty two students. Those students were from the three undergraduate levels; second year (BDS2), third year (BDDS3), and fourth year (BDS4). Participants were distributed into six focus groups and one face-to-face in-person as follows;

One focus group was conducted with second year students and consisted of six students, 5 females and one male. Five students were in the age group of 20-25 years and one was less than 20 years old. All participants from BDS2 reported that they were confident in computer and internet use (Table 9.2).

Two focus groups were conducted with third year students with a total of 27 students, 19 females and 8 males. The first focus group consisted of 7 students, the second consisted of 11, and the third consisted of 8 students. A one-to-one in-person interview was also conducted with one of the BDS3 male students. Twenty five students were in the age group of 20-25 years and two were in the age group of 26-30 years old. All participants from BDS3 reported that they were confident in computer and internet use except one who reported as being expert (Table 9.2).

Two focus groups were conducted with fourth year students (n=9 students), who were all females. The first group consisted of seven, and the second group consisted of two students only. All students were in the age group of 20-25 years old and were confident in computer and internet use (Table 9.3).

No.	*Code / Participant*	*Age group (years)*	*Gender*	*Computer literacy*	*Undergraduate level*	*Focus groups*	
						No.	Total
1	S.1-2	<20	F	Confident	BDS2	1	1
2	S.2-2	20-25	F	Confident	BDS2		
3	S.3-2	20-25	F	Confident	BDS2		
4	S.4-2	20-25	F	Confident	BDS2		
5	S.5-2	20-25	F	Confident	BDS2		
6	S.6-2	20-25	M	Confident	BDS2		
7	S.1-3	20-25	F	Confident	BDS3	1	3 focus groups + one-to-one inter-view
8	S.2-3	20-25	F	Confident	BDS3		
9	S.3-3	20-25	F	Confident	BDS3		
10	S.4-3	20-25	F	Confident	BDS3		
11	S.5-3	20-25	F	Confident	BDS3		
12	S.6-3	20-25	F	Confident	BDS3		
13	S.7-3	20-25	F	Confident	BDS3		
14	S.8-3	20-25	M	Confident	BDS3	One-to-one inter-view	
15	S.9-3	20-25	M	Confident	BDS3	3	
16	S.10-3	26-30	F	Confident	BDS3		
17	S.11-3	20-25	F	Confident	BDS3		
18	S.12-3	26-30	M	Confident	BDS3		
19	S.13-3	20-25	F	Confident	BDS3		
20	S.14-3	20-25	M	Confident	BDS3		
21	S.15-3	20-25	M	Confident	BDS3		
22	S.16-3	20-25	M	Confident	BDS3		
23	S.17-3	20-25	M	Confident	BDS3		
24	S.18-3	20-25	F	Confident	BDS3		
25	S.19-3	20-25	F	Confident	BDS3		
26	S.20-3	20-25	F	Confident	BDS3	4	
27	S.21-3	20-25	M	Expert	BDS3		
28	S.22-3	20-25	F	Confident	BDS3		
29	S.23-3	20-25	F	Confident	BDS3		
30	S.24-3	20-25	F	Confident	BDS3		
31	S.25-3	20-25	F	Confident	BDS3		
32	S.26-3	20-25	F	Confident	BDS3		
33	S.27-3	20-25	F	Confident	BDS3		

Table 9.2 Demographic data for the participated undergraduate dental students.

No.	*Code / Participant*	*Age group (years)*	*Gender*	*Computer literacy*	*Undergraduate level*	*Focus groups*	
						No.	Total
34	S.1-4	20-25	F	Confident	BDS4	1	2
35	S.2-4	20-25	F	Confident	BDS4		
36	S.3-4	20-25	F	Confident	BDS4		
37	S.4-4	20-25	F	Confident	BDS4		
38	S.5-4	20-25	F	Confident	BDS4		
39	S.6-4	20-25	F	Confident	BDS4		
40	S.7-4	20-25	F	Confident	BDS4		
41	S.8-4	20-25	F	Confident	BDS4	2	
42	S.9-4	20-25	F	Confident	BDS4		

Table 9.3 Demographic data for the participated undergraduate dental students (continued).

9.3 Technological Evaluation

Respondents (teachers and students) were asked to describe their ***use*** and ***satisfaction*** with the e-course in supporting their teaching and learning processes. Four key themes emerged from their responses and results are presented accordingly. These themes are; user satisfaction, utilisation, performance impact and social norms. A summary of the reported technological potential and challenges is also presented in (Figure 9.1).

9.3.1 Users' satisfaction

Respondents' satisfaction with the e-course were found to be clustered around two main categories; satisfaction with the system quality and with the service quality.

System quality was related to the evaluation of the technology in terms of; ease of use, accessibility, stability, reliability, flexibility, navigation issues, and others. Service quality was related to the evaluation of the services provided by the e-course support team in terms of; availability, effectiveness and efficiency.

The e-course had undergone many developments in 2008 reaching a stage that had proved by most teachers interviewed that it is a lot easier to use and edit. '*I think the way it works now is much better than originally. You can put up your online resources and edit your own pages, it's easy'* **(T.1)**. Accessibility to the e-course was also reported to be an advantage; '*I've had no problems with either putting materials onto the e-course or accessing it myself*' **(T.4)**.

Giving the users (teachers) the control to develop and manage contents on the e-course was reported to be an important issue. Its major benefit was in reducing the time and load required from the e-course developer team in developing contents. '*More people are feeling*

confident to change their pages and have control over it which has reduced the load on the e-course developers*'* **(T.1)**. Flexibility of the e-course to meet a variety of needs was also a reported advantage. *'It is fine technically it is for what I want to do I'm able to do it'* **(T.8)**.

Students reported similar advantages. However, they also highlighted some concerns. The advantages of anytime, anywhere access have been acknowledged by some students. *'If you miss-placed the handouts or something like that it is quite easy accessible. Or if you forgot to take the handout with you and you got like a spare two hours in front of the computer then you can, it's accessible anywhere'* **(S.6-2)**. These advantages were further acknowledged by students living in remote cities, where they could access the e-course from a distance. *'Actually that is another really good thing because I'm from London. So coming up to Birmingham's library is not going to happen really. So if I'm at home I can do it abroad and that is useful because if I've left a note I can access it'* **(S.6-3)**.

Ease of use was another major advantage reported by students. *'Pretty easy to use, straight forward and you can just do it when you want it at your leisure'* **(S.4-3)**. Another comment included; *'If you can't find something you can just click on there and it easy to look it up. So just make everything a little bit easier because it is just so easy to track it back'* **(S.5-4)**.

Personalisation, by having the "My wish list" tool, was also reported as an advantage. *'I think it is really good because you got "my wish list" as well. I liked the explanation if they can't they say they can't do it and it is quite good how they explain why they can't do it'* **(S.6-2)**.

Despite these advantages, some concerns have also been reported by students. Navigation issues were reported to be a major problem by students from all groups; however, it seemed a great problem for second and third year students. This has been attributed to the issue of having similar titles. *'A lot of the titles are really similar and then you go on you don't find*

the one you want' **(S.1-2)**. It has also been attributed to the issue of having too many options. '*Sometimes I find it quite difficult to navigate myself around the e-course. Because if you select, you are like going to an area then you have extra options to go through. And sometimes I just can't find it. And also I do feel like quite a lot of taps going on the left hand side of the e-course and I think that can be sorted out like better'* **(S.4-2)**.

Others reported the problem of having information being removed from the e-course over time. *'The thing that bugs me is that once it is there like a wanted to look at the medical history thing and it was there in second year and then I've looked now it is not on the e-course, it just disappeared* **(S.7-3)**. This problem has been confirmed by another respondent; '*I looked at rubber dam once. I found in London there is a video online, I've been looking and just can't ever find it again. So finding things is definitely an issue'* **(S.6-3)**.

Students also indicated that the e-course is becoming so massive which makes it difficult to relate the available information to their year of study. '*Because obviously Conservative Dentistry is such a big branch of dentistry and we are only going to cover probably a small aspect of it this year. And sometimes you don't know and you keep reading more and more and start getting really into like complicated things, I don't know when to stop because I'm not quite sure'* **(S.1-2)**. This has been a major issue for respondents from second year mainly.

In overcoming some of those navigation issues, some students suggested using the search box available on the e-course. However, it wasn't considered by most as the best solution to the problem. *'I think the searches is probably the most difficult because when you do search it does come up with this big massive list and sometimes you do have to go through a lot of them because they are quite similar but not exactly what you are looking for'* **(S.5-2)**. Other students suggested splitting the e-course contents according to the year of study. *'I think in terms of departments which have got so much information almost to a sense that you can get*

confused because it could be a bit too much and that is always not broken down as well as it could be. I think the separate years' idea is a very good idea' **(S.2-2)**. Such an opinion was agreed by most respondents from second year.

Different attitudes were reported towards the issues of loading contents on the e-course, especially multi-media formats and some images. '*It is mainly with podcasts and videos, the multi-medias they don't load or don't play'* **(S.8-4)**. Another comment included; *'When I was looking at some histology slides, some of them just didn't load up and it would say loading and it will take very long time and at the end it just says all images are unavailable, and also with the Oral Biology'* **(S.4-2)**. Others, however, experienced no technical problems and did not find it as an obstacle to using the e-course; '*I really don't think I've had any technical problems really. The videos seem to work fine, the ones I looked at anyway. They take a bit of time to load but that's with anything I think. Loading the lectures seems to be fine'* **(S.1-2)**.

Nonetheless, broadband speed seemed to be an issue to some students; '*my internet connection is a little bit slower than the usual at University'* **(S.5-3)**. Software compatibility problems, such as multi-media players, were also thought to be part of the loading problems faced by students. '*I didn't have the right player but I figured it out. You just have to use real player'* **(S.8-4)**. Or anti-virus blocks; '*When mine didn't play, it turned that it is my anti-virus software that was blocking some videos from playing. So once that was sorted, so far everything is fine'* **(S.9-4)**. The problem of Macintosh compatibility was also reported; '*I have a Mac computer and not everything is compatible with that'* **(S.7-4)**.

E-mailing issue was also highlighted by students affecting some online activities that depend on posting messages. '*I haven't experienced any technical problems as such, but I know some of my friends have, all like struggling to actually receive the e-mails'* **(S.1-2)**.

Participants were also asked about their satisfaction with the technical support available for using the e-course. Some teachers were happy with the service quality and believe that its efficiency was partly attributed to the structure of the e-course management team. *'What is happening at the moment with the e-course is an especially interest group we have. That is quite a good mixture of people because there is some experienced people and some more younger or more from the keen people who actually know what they are doing in terms of working with computers because that can be one of the barriers'* **(T.1)**. Most importantly was the e-course developer who had a combined IT and clinical teaching experiences. This combination was seen as an advantage by some teachers in making communication around developing contents more easy. *'I think the problem might become if you had an IT team it would be working independent of teaching staff rather than providing what the teaching staff would like in terms of format and content. So I think it has to be under the right ownership as is at the moment of clinical teachers'* **(T.4)**.

The structure of the e-course team was also considered important in maintaining the alignment of the e-course's strategies with the school's strategy. '*In terms of a team to develop it, I think it is really important that it develops in line with what a school's strategy might be for learning and teaching, what a university strategy might be for learning and teaching. So I wouldn't want to see anything developing completely out of line that hasn't got the main goals there'* **(T.1)**.

Lack of time and computer literacy for advanced content development were the main challenges reported by some teachers. '*I think it is all very well saying you can do this, you can do that with the e-course. But I mean it just stands at the moment which we do not have enough support and enough time really to be able to do it'* **(T.2)**. Another comment included; '*I love to do big graphics and clever things but I don't have either time or computer literacy to do that'* **(T.8)**.

Lack of time was also reported by the e-course developer in managing the e-course as it is growing. '*As I said two days a week isn't really enough to keep it going. And at the moment I'm spending rest of my time running on the technical side, keeping the server going, and very little actually creating learning materials'* **(T.7)**.

Different arguments were highlighted around the needs and possibilities of assigning a special e-learning team in the school separate than the School's teaching staff. Some teachers supported such strategies; '*I think it would be helpful to have somebody just purely for it. If the e-course is such a big part of our teaching, then what would be phenomenal is to employ someone purely to keep it going'* **(T.8)**. This has been confirmed by another teacher; '*I think that would be extremely interesting. I think if you had somebody who is an educationalist separate from dentistry which can liaise with people and is open enough to understand the limitations or the complexities of what teaching a dental student has over many other courses. I think that would be an extremely interesting idea'* **(T.3)**.

Others did not agree as one of the reasons cited was the difficulty in communicating around the content. '*You still have to have the time to sit down and go through them and say "This is a clinical case, this is how it works...". And I think in terms of time and labour we wouldn't be able to do it'* **(T.2)**. The second reason was lack of funding. '*That would be nice but if you appoint a couple of technicians that is the equivalent of a clinical lecturer. So what do you do? Do you sort of sack a teacher to enable a bit of extra-virtual teaching to be done? Other people might argue that real teaching is at the moment better than virtual teaching'* **(T.7)**.

Students showed positive attitudes and were highly satisfied with the quality of the service provided by the e-course team. It was reported to be very effective. '*I once had a problem because I'm using Firefox as an internet explorer, then I just e-mailed the problem to the e-*

course coordinator and then they just e-mail you back and tell you the solution and the problem was sorted out' **(S.1-4)**. It was also reported to be highly efficient. '*I think if you do have a technical difficulty I think as soon as you start to put them on the discussion board and then the response you get is very quick, like you get it within the next day'* **(S.6-2)**. Some, however, reported no experience in asking for support. '*If I'm having problem like as I said with the videos just give up or use my friend's computer. I know I can ask the e-course managers, but I just get around with it'* **(S.5-3)**.

9.3.2 Utilisation

It was interestingly noted the huge difference in utilisation of the e-course between its old and new platforms as indicated by teachers. *'Initially there were just a few people who were really interested in it who were contributing. And I think in the last year or two we've got to a completely different phase where we've got what you call a ''critical mass''. So I think now it becomes so much part of what happens here. Even the people who were very resistant are not so resistant. So I think that has really, really changed the emphasis of it'* **(T.1)**.

Interviewed teachers showed interest in using the e-course in one way or another. Some have actually directly contributed to developing contents on the e-course in their specific subject area. '*I have contributed to materials on the e-course'* **(T.4)**. Another comment included; '*I'm one of the main editors of the oral surgery pages. Anything that is on there I've put on or given the e-course team to put on'* **(T.8)**. Others were indirectly supporting content development on the e-course. *'I support the e-course. I think it is excellent and if I'm asked the material I'll provide it. But I'm not actually actively engaged in developing it myself'* **(T.9)**.

All interviewed teachers also shared in the discussion forum component on the e-course. '*We also use it on the discussion board part of it and that's usually around times when students have assessments'* **(T.1)**. Another teacher reported; *'My other involvement on the e-course is on the discussion forum where I'm answering questions for students'* **(T.4)**.

Students also reported frequent use of the e-course as commented by a second year student; '*I try to go to it three times a week and a lot more during exam time'* **(S.1-2)**. Similar comments were reported from third year; '*I use it a lot once every two weeks, mainly for Prosthetic and Cons.'* **(S.5-3)**, as well as from fourth year students; '*I use the e-course a lot. I use it all through the year especially during exam time'* **(S.2-4)**. However, three respondent from fourth year reported that they don't use the e-course as much as their colleagues; *'I don't use as much as other people do, but more around exam time for revisions and things like that. Otherwise, I just tend to use books'* **(S.1-4)**.

The main driving force behind using the e-course reported by almost all interviewed students was for revision and around exam time. *'Not regularly but when it comes close to exam time then I would look to the e-course more. But I wouldn't really use it to maybe study for tutorials or lectures'* **(S.8-4)**. Another comment included; *'I use it during exams mostly because it's good because I think it gives you what basic knowledge you need especially for the smaller departments you can look in books and get more from it but I think as long as you know what the core material is would be a good thing'* **(S.6-4)**.

Another main reason for using it was for preparing before tutorials, lectures and clinical sessions. *'I try to use it most days the night before just to see if there is any lectures on there or any more information regarding the lecture next day'* **(S.2-2)**.

It was also found to be used more towards the clinical years (3^{rd}, 4^{th} and 5^{th}). *'I think it's more for like clinical procedures and say for 3rd, 4th and 5th year really and exams and sort*

of things' **(S.4-4)**. Another comment included; *'I think I used it a lot more during revision time. But that we've started during practical things you can actually look up what you're going to be doing. So at the moment I've been using about two times a week'* **(S.3-2)**.

9.3.3 Performance impact

Respondents were asked whether using the e-course had a positive impact on their teaching and learning performance or not. Some teachers considered that the advantages of using the e-course outweigh its disadvantages, resulting in an overall positive impact on their teaching process. *'The actual advantages for me as a learning and teaching practitioner and I'm sure for students as the learners far outweighs any additional efforts that the e-course brings. It is just a different method of teaching. If I wasn't using the e-course I would be doing something on paper which wouldn't be different anyway. So actually it is not an additional load'* **(T.6)**.

The e-course was also reported to have a great role in reducing administrative work even if it was just used as an information resource base. *'That has stopped us having mountains of paper work and the administrative organisation of how you get students to go to different places it can all be delivered swiftly and fairly simply and doesn't need lots of changing from year to year. So that's saving resources in different places, saving your administration resources if you like'* **(T.1)**.

A similar potential was reported in better designing the curriculum, thus reducing teaching efforts. *'We do MCQ's, at the beginning of each oral surgery tutorial. I would much rather see that completely online and leave the tutorials for discussion around the topic rather than having to do the MCQ's as well'* **(T.8)**.

It was also reported to have a great role in overcoming some of the problems of low staff-to-student ratios especially during the demonstration of laboratory procedures; *'I think videos*

are very useful. We use them in the senior laboratory course to demonstrate methods and procedures in a way that is not amenable to delivering in a lecture. And in small group teaching will not allow all the students to see what was going on' **(T.4)**.

It was also reported to support distance teaching, thus, expanding the possibilities of teaching. *'When our students go out in fourth and fifth year to outreach clinics and they are working there for any matter, there is a potential for some discussion that they might have. We do have discussion about outreach clinics, we tend to have that life discussion with the group of students, which I prefer actually to have a face to face discussion with students, but you could link that on and have more of a discussion'* **(T.1)**.

However, two respondents felt that the e-course did not add much to the efficiency of their teaching. The first teacher reported that the time in their curriculum is sufficient to support all aspects of their teaching process; *'I think we do give them an extra-support because we don't just give them lectures. I think we do have enough time. I'm certainly trying to make enough time for students'* **(T.2)**. And the second teacher reported that teaching can be very professional without the need to use e-learning approaches; '*I think it is a very worrying statement to say that online is to make it more professional. I think it can be very, very professional without ever going near an online resource'* **(T.3)**.

Students reported major impacts from using the e-course on their learning, skills and performance. '*I think the e-course is essential to our learning. I think it is very good. And the way it is formatted is quite good'* **(S.2-2)**. And the teachers' efforts on the e-course were acknowledged by most students. *'I appreciate it is an extra work and it is something else to look after. But it is a great way of learning and reinforcing our teaching. So it is good to keep it and it is worth it. So thank you'* **(S.8-3)**.

Major advantage was reported in the ability to use the e-course at students' own time and pace. *'I'm definitely a morning person, I like to wake at 7 O'clock in the morning and listen to a podcast on denture design and I can do that. Whereas my flat mate, she wants to do that at 2 in the morning because they are still up from the night before, they can do it also'* **(S.6-3)**.

The e-course helped students to be well prepared for the pre-clinical sessions. *'The Cons., they put some information up for the session, so you can work on what you need to do for that session and get prepared'* **(S.6-3)**. As well as for the clinical sessions; *'I use the e-course a lot, I find it really helpful. I think it is very good as well when you're going on clinical practice and you're doing some things and you suddenly forget things for a certain process and you can quickly click on it and just have a quick look'* **(S.2-4)**.

By providing alternative approaches to view laboratory demonstrations, the e-course was also reported to help in overcoming the problem of decreased staff: student ratio in pre-clinical sessions. '*I think videos are most useful for Cons, and again because sometimes it's very hard especially the sessions that we have to gather around to be able to actually watch the teacher teaches us. So if you want to just see it yourself and learn it go on your own pace you can slow it down and speed it up so it's useful in that sense'* **(S.1-2)**. The same was reported for overcoming the problems of limited clinical case or clinical time. *'Obviously you can't see every clinical case when you're on clinic, so it actually shows you pictures and it got quite a bit of details which is quite good'* **(S.2-4)**.

Accordingly, students reported that using the e-course made them feel more confident in their profession. *'But for me I think videos are really good, because if you've seen how to do it, you've seen the technique, and stuff like that it gives you more sort of confident and you feel like you know what you are doing'* **(S.20-3)**. Another comment included; *'I think this*

year we started to prepare because we want to. In front of the patient you really want to look that you know what you are doing' **(S.2-3)**.

The e-course was also reported to help broadening the general knowledge of students. *'There are lots of links everywhere you kind of get an overview about different related topics and things like that. So it's just broadening the general borders for your understanding'* **(S.6-2)**. It was also reported to help building the critical thinking skills of students. *'It teaches me to learn in different ways. And then you come to dentistry and you realise it is not enough being text books and it is not enough being that kind of things. So then you start realising that it could be so many different things and there isn't a set thing'* **(S.7-3)**.

The e-course was reported to have positive impact in adding enjoyment and changing the learning experience of students. *'I do think it's quite useful and makes learning easier and more interesting just because it adds more variation to what you're doing'* **(S.7-4)**. Another comment included; *'I can't imagine doing dentistry without the e-course really. I mean I'm a book person but the benefits I've got from the e-course when I've used it even if it might be before an exam has been tremendous'* **(S.8-4).**

9.3.4 Social norms

Social norm was found to be one of the driving forces behind using the e-course in the school. Social norm is defined in this study as "the excepted pattern of behaviour".

The following quotes from teachers highlights directly or indirectly the effect of social norms in using the e-course; *'I know that students who come and apply to the school for places they often would say that they've seen the e-course. So I think it is modern as well which I think is important it kind of attracts younger people in. So I think that is quite*

benefit' **(T.1)**, and *'I find it very frustrating if you don't put things on the e-course then it is almost like "Oh, Oral surgery hasn't got much there'* **(T.8).**

The effect of social norms was also highlighted by students. *'I haven't actually accessed podcasts on the e-course before. Having heard how useful they could be, I will try like search for them'* **(S.4-2)**. However, teachers' attitudes and emphasis on using the technology were considered as a stronger driving force for students in using the e-course. *'I think mainly we haven't thought the need for it. Just because the emphasis mainly from my lecturer is look on the e-course, look on the lecture section of the extra link and because they've gone and they found them you just think this is kind of what they want you to learn. Where is no-one really emphasised the blogs and even no one told us about them'* **(S.5-2)**. Another comment included; *'I don't really use anything on Google but mainly the e-course. I'm not using Wikipedia because our lecturers and clinicians always say that you can't really trust what is on there. So I just really use the e-course and they've got everything on our e-course anyway'* **(S.20-3)**.

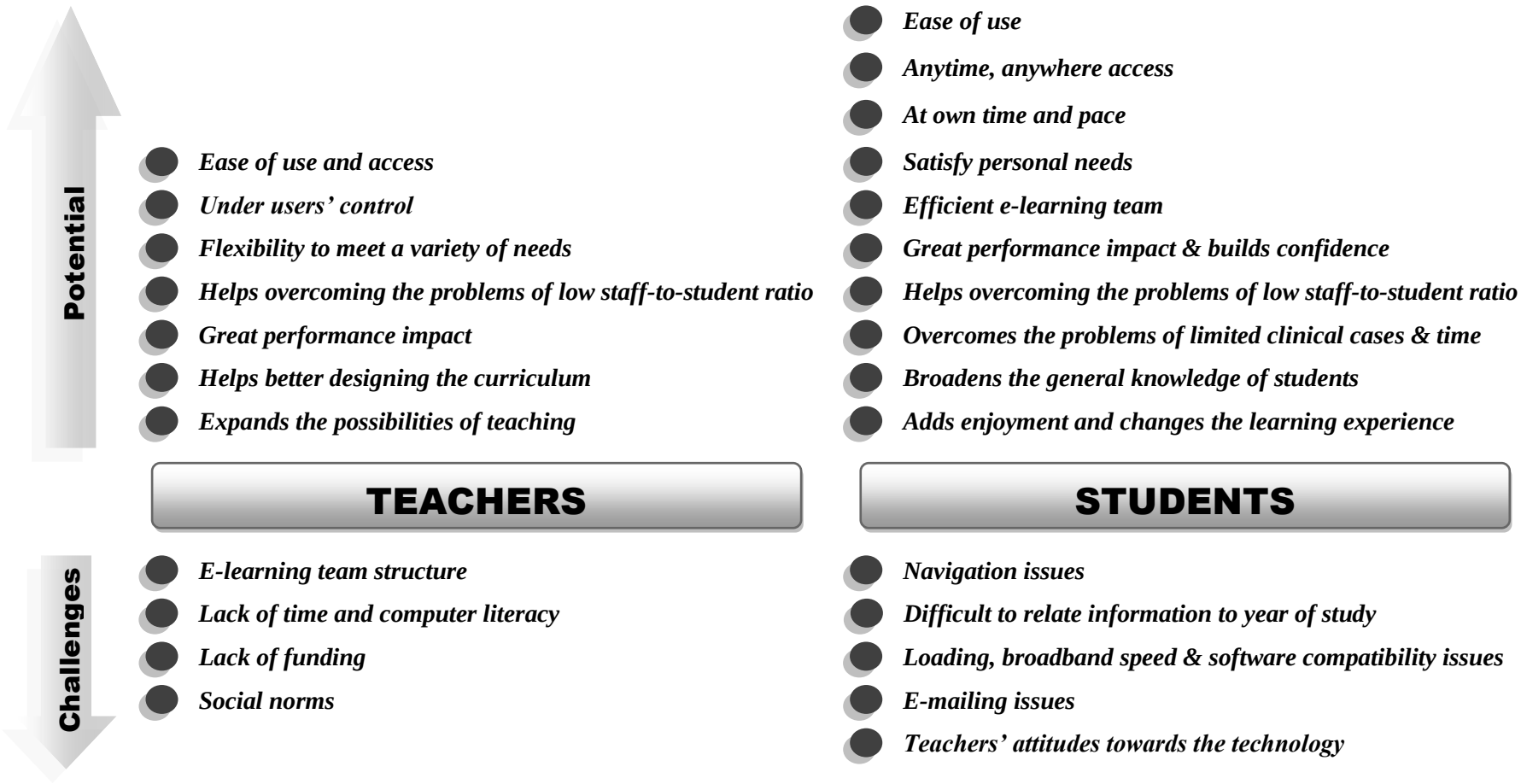


Figure 9.1 Summary of the "Technological" potential and challenges in using the e-course to support teaching and learning.

9.4 Pedagogical Evaluation

Pedagogy is meant to describe the methods of the teaching and learning transactions. The e-course was assessed for its effectiveness in supporting such transactions in the school. Six key themes emerged; communication, collaboration, active learning, feedback, accommodating a diversity of learning styles, and communicating expectations. A summary of the reported pedagogical potential and challenges is also presented in (Figure 9.2).

9.4.1 Communication

The e-course was found to have a role in facilitating the communication process between students and their teachers. Such a potential was reported by teachers mainly through the use of discussion board tools; *'My other involvement on the e-course is on the internet forum where I'm answering questions for students. I think that can be useful for student for clarification of certain points, and direction towards other resources'* **(T.4)**. Another comment included; *'We've got the discussion boards on all of our pages. And I think they are useful tools for the students to clarify certain questions and so on that they may have with the page. And I'm happy to do that and discuss things'* **(T.8)**.

Students varied in their response to the preferable communication tool. Some students highlighted the positive role of the e-course in facilitating the communication process. This was also through the discussion board forums. Main reason cited was that it is an easy and fast way; *'If you've got any query or questions and stuff you can always post up your question and then they get back to you quite quickly'* **(S.27-3)**. Another reason was that it is a preferred method for some learning styles; *'The good thing about these is that it is*

anonymous. So if there is a question you feel you are a bit embarrassed to ask or something like that, you don't feel stupid really' **(S.23-3)**.

However, improper ways of reply from teachers were reported to be an obstacle in using such tools. *'Because it is open and everyone can see it, I think it is very a bit harsh on the person to write the comment and then had the lecturer to put him down. And it is all archived so everybody can still see them'* **(S.12-3)**. Getting no reply from teachers was another reported issue; *'The only thing that I think is not so good is sometimes on some pages you never get an answer. So it sort of defeats the point of using it. If it is not reliable that you are going to get an answer, then there is no point in posting something in the first place'* **(S.17-3)**.

Thus, some students preferred personal contacts with the teachers. This could be via e-mails to ensure getting a reply from teachers. *'I prefer e-mailing the tutor or the clinician myself, because at least I can guarantee an answer'* **(S.2-2)**. Or through face-to-face contact to ensure a proper way of reply***;*** *'I think if I wanted to ask a question, I think it's always more polite to go and ask the lecturer myself and you've get a fully understanding of a discussion if you get to that point where it can get you stuck or you can go and look it in a book because some questions are lazy and some lecturers are rude'* **(S.6-4)**.

9.4.2 Collaboration

Collaborative learning is defined as "a situation in which two or more people learn or attempt to learn something together" (Dillenbourg, 1999). Three tools on the e-course were found to support collaborative work. These tools were; Wikis, Blogs and Discussion Boards and will be discussed in details in the 'Curriculum design' section.

9.4.3 Active learning approaches

Active learning involves putting students in situations that compel them to read, speak, listen, think deeply, and to do or write (Berge, 2002). Respondents reported positive potential for the e-course in supporting and facilitating the implementation of active learning approaches. Many learning activities were available on the e-course to support such objectives including; animations, virtual patients, Mag-scope, mind-mapping, and games. Web 2.0 tools (Wikis, Blogs, and Discussion boards) were also reported to have a role in supporting active learning approaches. Such a potential was highlighted by some teachers; *'Dentistry is a very practical subject and animations and videos lend themselves to dentistry very well'* **(T.7)**. Another comment included; *'I think the clinic is where higher learning comes in because that is a real life situation, I think from that point of view, the teaching clinic blogs works for students at a time. And the most kind of higher level of learning that we get is when students ask us questions on the discussion boards'* **(T.5)**.

The incorporation of problem-based teaching and student-centred learning were also thought to be easier by the supportive tools on the e-course; *'You can bring problem-based learning into it also. So you post a problem and the students then discuss it and put things on and I think in that sense it would be useful. I like that idea I think student-centred teaching is very important and I think it is very much the way to go'* **(T.8)**.

Students also highlighted the significance of having contents on the e-course that promoted active learning; *'I think the prosthetic department they have a really good interactive section because they've got podcasts, they are quite up-to-date and relevant to lectures that are given. And their videos which actually shows for example certain techniques, so I think the prosthetic department have done really well with their part on the e-course'* **(S.9-4)**.

The 'Virtual patients' component on the e-course was also reported to promote deep learning; *'I just discovered the virtual patients I found that are just really good. They give a mouth and you can zoom in then you give your diagnosis then they give the actual diagnosis. I learned quite a lot'* **(S.2-3)**.

Others were interested in mind-mapping; *'I think the oral pathology section, I haven't used them myself, but we were shown in a lecture and the idea of them sounds really good. Just to know that you can have all the concise information there. We can sort of see you know what topic you need to learn'* **(S.8-4)**.

Web 2.0 tools were also reported by students to have a potential in promoting active learning; *'If you are going on a blog, it is quite interesting to see how some students done the treatment and how the treatment progressed or something like that. That is quite useful'* **(S.6-2)**.

However, some concerns and negative experiences were also reported by students. These issues will be discussed in the "Curriculum design" section.

9.4.4 Feedback

Some components of the e-course were reported to be effective in providing feedback and reflection for both; teachers in their teaching process, and students in their learning process. Some teachers reported the benefits of using the "Treatment blogs" component on the e-course. It is an area where pictures and treatment progress of clinical cases presented. Treatment blogs were positively reported in helping staff to get feedback from students about the method of teaching some clinical techniques. '*We have teaching clinic blogs we essentially take the basic information that they've learned and between us; between myself, members of staff and students themselves, discuss if they feel that the techniques that we've*

given them is a good idea, is a bad idea, how they've arrived at doing these techniques, how they can modify these techniques' **(T.5)**.

Others reported that they get feedback about their teaching from the questions posted on the discussion board. *'I've modified my lectures for third years from questions that have been on the discussion boards, so they've changed the way I teach. And it is a method for them to find out what I talk badly, to find out what I was trying to say that they didn't understand when I explained the first time'* **(T.7)**.

Feedback for students was reported in three areas: feedback from teachers, feedback from colleagues, and from self-assessment tests. All types of feedbacks were reported as an advantage of the e-course in supporting the students' learning experience.

Feedback from teachers was mainly through replies to students' messages on the discussion board. *'With the discussion, I think it is great. When you do hear like the clinician stating something they could actually say something in a different way than in lectures and it is just to make sure you understand that a little bit more'* **(S.5-2)**.

Feedback from colleagues was also reported to help build confidence in knowledge level and was also mainly through messages posted in the discussion board. *'I think it is good to know that it is just there that you can use it if you need to get in contact with someone even if it is not a lecturer or something because someone out there like a student might know the answer and they might just help you. It is just good to know that you are not alone whatever you are doing'* **(S.26-3)**.

However, varied response was reported for getting sufficient feedback from such methods. These responses will be discussed in more depth in the 'Curriculum design' section. Feedback from self-assessment tests will also be discussed in details in the latter section.

9.4.5 Accommodating a diversity of learning styles

Major benefit from the e-course was reported in providing different ways of teaching and learning, thus accommodating a diversity of learning styles. Teachers highlighted such a potential in the following quotes; *'I think that it is an extremely useful and important part of learning. And it also appeals to certain students learning styles. So I think it helps to give a broader approach which means that you can address students learning styles which do very hugely. And so I think what is important from sort of a school perspective is that you do try and cater to everybody's different learning styles'* **(T.1)**. Another comment included; *'I'm a strong believer that students have very individual favourite learning styles, some are best with lectures, some are best with books, and some might prefer web-based learning. We are going to get all of them. So I think it is important and it is useful and it is helpful'* **(T.7)**.

Having different formats on the e-course was reported by students to have a great potential in accommodating diverse talent and ways of learning. '*People learn in different ways and having things that is in visual and audio as well as something that is plain written it helps quite a bit'* **(S.21-3)**. Another comment included; *'They say the same thing in loads of different ways so you can choose how you want to learn it'* **(S.7-3)**.

9.4.6 Communicate expectations

The e-course was considered to have a major potential in communicating what is expected from students in their study, such as providing videos for clinical procedures as a guide to follow and to know what is expected from them. *'I think the more we can show the students what they are expected to do, it is not necessarily something to copy but it is something they can compare their own technique to and decide what they need to do, they need to improve on essentially'* **(T.5)**.

Similar views were reported by students; *'I think that they make sure that we have got a basic knowledge of everything and if it is there then there is no excuse for us of not to have it for ways to make you always a competent in clinic. And it just makes it easier for us and for them to know that we should know it and as a way for us to actually known it'* **(S.2-4)**. Another comment included; *'And also with the lectures, the clinicians or the lecturers put things what they want you to learn. So if you look in books they go into so much detail which is not necessary. So the lecturer sort of combines them then you can just look up very specific'* **(S.27-3)**. Thus, it was considered as a good representation of the syllabus; *'Every time I need further reading for lecture I first go to the e-course before I take a textbook because it doesn't have a syllabus as such but it gives you boundaries as to how much details you need to go into for extra-reading. And then it also gives references for books as well. There is a lot more quizzes on there and self-teaching purposes as well'* **(S.1-2)**.

Students also reported the significance of the e-course in familiarising them with the questions format, thus preparing them mentally for their exams. *'I think while we are doing viva especially with the Perio. thing there is no way to be able to go in there and have a look at some of the pictures that they gave us and identify what they were so if we can have the resource for that because it is not all in the books or if there is it is more confusing or thing. I think it definitely help me pass exams, it put things into easier sort of context and I found it really useful'* **(S.2-4)**.

The e-course, with its virtual representation of the school's strategies in teaching and learning was also reported by students to be important in guiding them towards the expected outcomes within the curriculum. *'In terms of clinical teaching I think that each dental school is quite specific about how certain things are done. So with the clinical aspects, you can't really see that in other website to the specificity of what our dental school requires. So I*

think in terms of that it is better to follow the protocol of what our dental school wants' **(S.2-2)**.

9.4.7 Concerns

Despite these advantages, many concerns were also reported by teachers in using the e-course to support the conventional teaching and learning in the school. Lack of time was the most challenging factor facing teachers in using such innovations; *'However, as a member of staff, having the time to monitor that and to set that up, on top of him to do all the clinical work and all the tutorials and teaching it is just not feasibly and it is not practically possible'* **(T.8)**. Another comments included; *'It is an extra-load. Beside the fact the matter is that what the university really want is not bad it is important, is they want grants to be generated for publications to be written, for research to be done. They want teaching to be done but there isn't enough time of the day, not in this building to be spending the time to developing that particular material'* **(T.9)**.

Some teachers also highlighted the importance of having regulations in using such innovations; '*My thing about the e-course is that we need to have more regulations and if we are going to use it as a supplementary to our teaching then we need to know more about which students are using it and when and that kind of thing I think'* **(T.8)**.

Staff development and support was another reported concern; *'I'm not sure the dental school with its under-starting problems is ready to get the next step up which is to truly incorporate e-learning as a teaching tool. That is a huge step and it is got big staff training and staff time problems associated. So I don't think we are ready yet'* (T.**7**). Another comment included; *'We need dedicated staff resource to do that. So it is not that we are not forward for*

electronic learning. I think it is a really important adjunctive way of learning; it is just that we don't have the resource currently' **(T.9)**.

Student development and support was also a considered issue; *'I think there is abundant online support for teaching. The problem is getting certain percentage of the students to really utilise all the information that is there and to recognise that the e-course doesn't have every single answer. It is just a framework then they should develop their own learning from the abandon other sources that are out there'* **(T.4)**. Another comment included; *'I think the concept of online learning I would be hugely positive towards. But the students don't know how to use online resources and how they should use online resource'* **(T.3)**.

Overloading students with information and work when adding online component to the conventional methods was thought by some teachers to be a problem; *'I think that in a controlled fashion they could be very useful. But it can become unwieldy when there is a huge amount of available materials in addition to other sources such as texts outside the e-course'* **(T.4)**. Another comment included; *'My concerns would be firstly that you would be overloading students with work. So would that be instead of a physical tutorial or as well as? And if it is as well as, is it extra-assignment then you got to go to learning and teaching community whether they are allowed for extra-assignments and so on'* **(T.8)**.

Such a concern was also echoed in some students comments; '*I can see that with cons especially because there is so much information sometimes it takes so long to figure out what bits you need to read. Especially around exam time there is such so many pages they're all kind of similar they don't all seem to have kind of good continuous way through. I don't know I felt a bit lost because there was too much information. So I think may be its just cons or just me'* **(S.6-4).** It was also contradicted by other students; *'Personally, I think too much information is better than not. If there is too much you are free if you don't want to read a*

whole article on something you don't have to. At least you know what is expected from you' **(S.6-3)**.

9.4.8 Replacing face-to-face teaching

Respondents were asked about the possibilities of using online learning to replace face-to-face teaching. Negative views were reported by most teachers. *'I'm strongly against it. And the reason for that is that a lot of the information we deliver in lectures relies on the students' being able to rationalise against images that they get on the screen. And so the cognition skills of the students can't be provided through handouts. The handouts are very much providing the skeleton but they need to be in the lecture to understand the context. So we specifically don't put our lectures on and we don't put handouts on the e-course'* **(T.9)**.

The same was also reported by students; *'I'd prefer the extra-details the lecturer adds on, whereas I find the slides on the internet not as good and more boring. I always go to the lecture and if I had a choice between online lecture and the real lecture, I would go to the real one'* **(S.8-3)**. Another comment included; '*Videos are good but I don't think it's a replacement for like certain procedures in real life. I think it's important to see in real life and then backed up by the videos'* **(S.6-2)**.

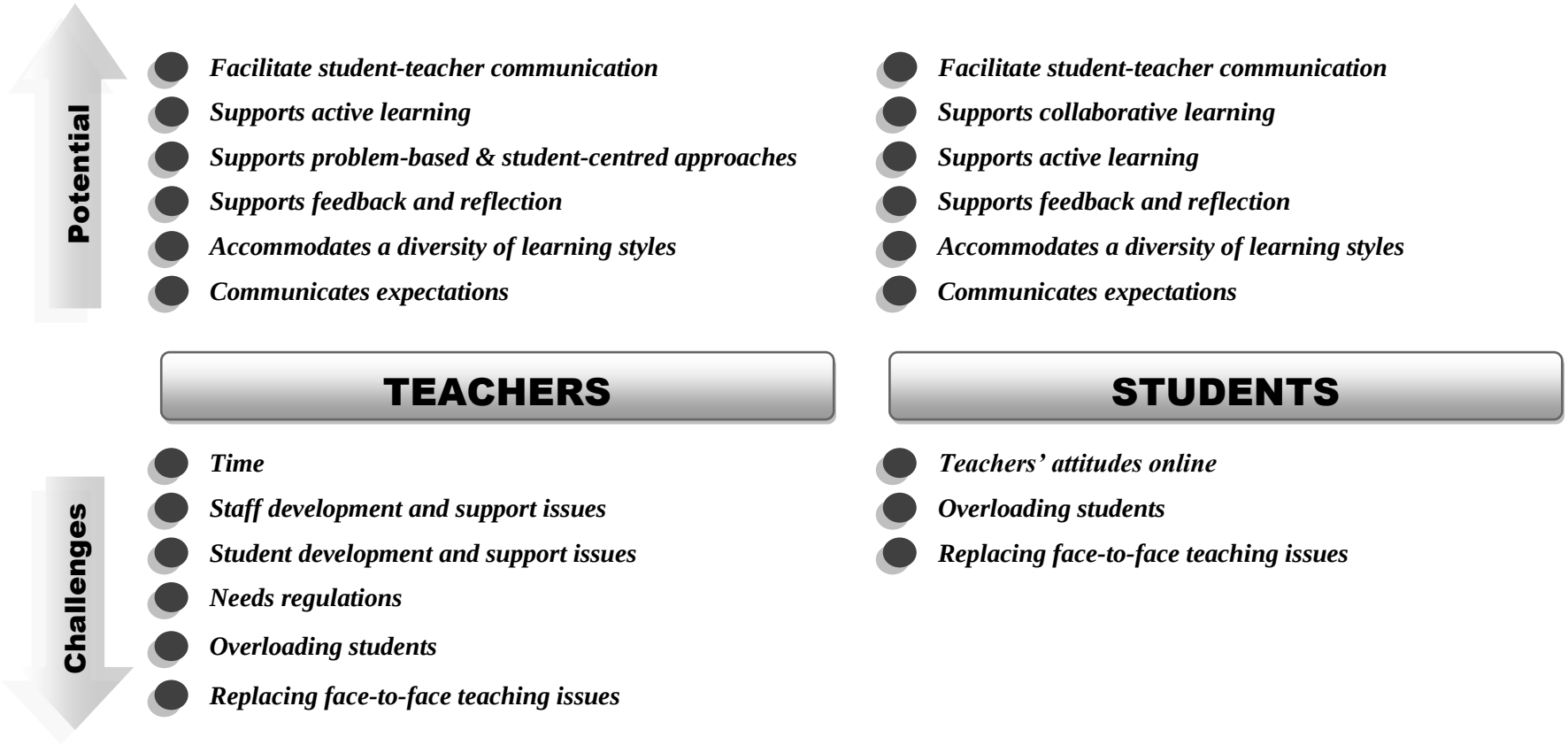


Figure 9.2 Summary of the "Pedagogical" potential and challenges in using the e-course to support teaching and learning.

9.5 Curriculum Design Evaluation

The e-course was assessed for its effectiveness in supporting the curriculum in the school. Five components of the curriculum design were assessed in this study. These components are; learning goals and outcomes, learning resources, learning activities, discussion activities, and assignments and assessments. A summary of the reported potential and challenges in supporting curriculum design is also presented in (Figure 9.3-9.7)

9.5.1 Learning goals and outcomes

Many advantages were reported from using the e-course in supporting the teaching process. It was reported to have a positive impact in supporting the outreach clinical teaching, which is part of the dental public health curriculum. *'The opportunity to start to think at where they might be going, and it gives a place where they then come back to in fourth and fifth year if they are looking to where they are going, who's working there',* and so on **(T.1)**. It was also reported to help in guiding the staff working in the outreach clinics to what they should be teaching and what should be expected from students. *'The staff who works in outreach clinics, is not university staff. They also have password to get onto the e-course. So they can see what our students are being taught on any of the pages, they like to get a bit of confidence by looking what students are actually supposed to do and then it can help them in their teaching when they are remote from the main hospital service'* **(T.1).** So the e-course was found to be a great tool to link between the school and the community in supporting some areas of the curriculum.

It was also thought to have a potential in bringing a multi-disciplinary approach into teaching and learning in the school; *'I think our e-course could be most useful in dentistry not being*

so segregated, as in all the different topics and actually becoming much more of an integrated curriculum' **(T.8)**.

However, some teachers questioned the changes in learning trends that might result from using online learning. *'A high-level learner is someone that will look at one source and then will compare that with other sources. If they have been told it is on the e-course it is something that they wouldn't question it one and two they wouldn't go out and look at other resources. And automatically they stop from becoming higher learners. So that I think is a drawback of the e-course'* **(T.5)**.

Teachers were also suspicious about the quality of teaching that might result from using online technologies; *'Coming back to the e-course from that point of view I feel unfortunately as a lecturer, even though I don't like it, I have jumped to that spoon feeding kind of mentality whereby we have provided an e-course for them which is essentially an online library purely because its information that is being taken from books, taken from extra resources, and put in such a way that the students can easily and at their own time click in, log in and look at the information'* **(T.5)**.

They were also suspicious about the quality of the learning outcomes and learning benefits from using such technologies as a major source of information in the teaching and learning processes in the school; *'My only concern with e-learning is that students learn superficially. So they will ask a question or look into something at a superficial level and they wouldn't go away and really understand it in-depth. And in my experience with modern students that they don't spend the time going into a particular subject or topic in huge detail unless that is a designated task for them to do and they are going to be assessed on the detail of their learning from that format'* **(T.9)**.

The same suspicions were reported when using the e-course for answering students' questions on the discussion boards; *'But also the reason why I'm saying that this is more spoon fed is because we have a discussion board. And the fact that we are answering the students' wishes in a way making it easier for them to learn is not always the best thing. As I said learning is how you get to the answer not the answer itself. With the e-course itself we are providing the answers'* **(T.5)**.

The streamlining of the designed e-course objectives with the curriculum goals in the school was found to be important in organising and managing the courses more efficiently; *'I think sometimes it helps me to think about how we might put things and what information students need. And certainly in terms of some of the resources that we put up is actually streamlined with some of our processes'* **(T.1)**.

Concomitantly, the absence of such alignment was reported to be a problem and might lead to a fragmented delivery approaches. One of the reasons cited for such a problem was the difficulty in updating contents that was developed by teachers who were no longer available in the school. Thus, some of the contents on the e-course were reported not to be synchronised with the courses being taught. *'There has been a difference between what we teach them and what is on the e-course'* **(T.2)**. Another reason cited was that different teachers from the same subject area developed different contents and in different styles. Thus, integrating the whole course together was found to be difficult. *'One thing we find particularly in this school is that even though courses may have aims and outcomes, the delivery of pockets of information from different people they deliberate different styles depending on which member of staff is doing it. And there isn't that much integration in the whole course and I think there is always a chance that they can get very fragmented in this delivery'* **(T.3)**.

Thus, re-designing the curriculum was highlighted by some teachers to be an important step towards successfully implementing online teaching and learning strategies within the school. *'If we want online learning to work, we need to create this space within our curriculum to allow them to do that. But that essentially is going to be re-designing each curriculum. And I think it really needs to happen because I think we are too traditional in this school. I think we should have more problem-based, student-centred learning'* **(T.8)**. However, two factors were reported to be the present barriers to such development; time and man-power. *'It is finding the time to do it. It is just purely impossible. To create an e-course that is fully and really backing up what we are teaching and really good resources to help us explain our subject, we need some extra man power'* **(T.8)**.

Using online approaches within the school strategy was confirmed by students to augment self-directed and life-long learning objectives within the curriculum; *'Having the theory there, lectures and looking at things on your own time, things that are objectives and good quality and are part of this course, I think it is really good'* **(S.8-4)**. Another comment included; *'I focus more on the clinical side because I struggle with that a lot more. So it's probably the clinical side which is more important to me'* **(S.1-2)**.

However, synchronisation and alignment of the e-course with the courses' objectives was reported by students to be of great importance in maximising the benefits of using online learning approaches. *'For most areas it doesn't tie in that well with what is going on in clinics. And I think it is better to put more patients with blogs and goes more discussion about actual clinical cases than just like theoretical scenarios and questions'* **(S.8-3)**. Such an effect was greatly highlighted in the extensive use of the Prosthetics and Conservative Dentistry e-courses; *'Prosthetics, they give us a little test every week in the beginning of every session, and they are lovely people on the e-course, gives a little bits of information leverage what lectures were about or they'll be some videos or just something towards the*

test. So it helps just in your revision. And the Cons., they put some information up for the session, so you can work on what you need to do for that session and get prepared' **(S.6-3)**.

The "Spoon feeding" problem and the fear of not promoting higher-order skills, as previously questioned by teachers, have also been reflected in some students' reports. *'The thing is if you become a little dependent on the e-course like the Cons lab, then one week like they haven't got anything on the e-course and you get used to the e-course it is like you are not really sure which book to look in or where to find the information because obviously you try to go on the internet and try to look for it you get loads of different information'* **(S.7-3)**. Other students considered it as an indirect positive potential in promoting better learning. *'I think we would end up learning more than we would generally because you have to look in such ten books before you get to the purpose and get bored to get the same amount of information when it's all there for you. I know its spoon feeding but it does make your life a lot easier and do take on more'* **(S.3-4)**.

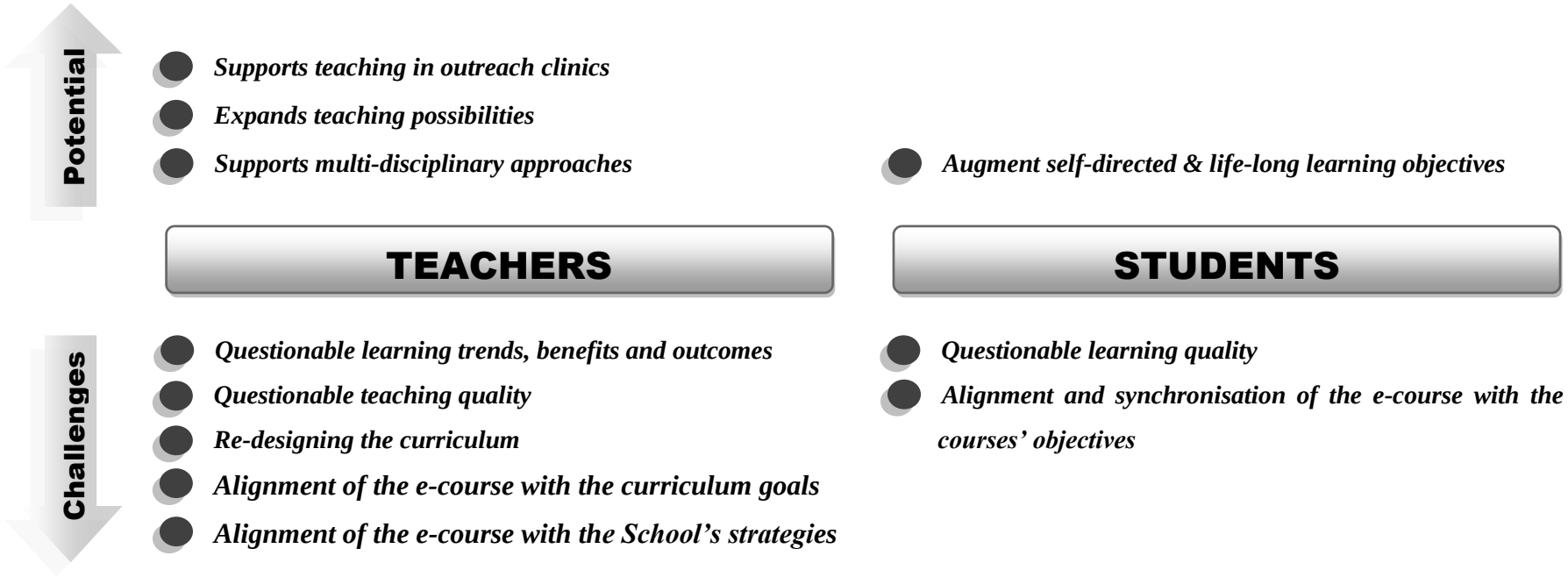


Figure 9.3 Summary of the potential and challenges in using the e-course to support the "Learning goals and outcomes" in the curriculum.

9.5.2 Learning resources

The e-course was reported by both teachers and students to be a great platform for presenting contents in different formats such as; lecture notes and handouts, animations and interactive contents, multi-medias, pictures and images, clinical cases, mind-mapping, glossaries, and many more. Respondents were asked about their satisfaction with such learning materials in supporting their teaching and learning. Varied views, debates and concerns were reported by both teachers and students around such matter.

Having lectures online could help students to be more organised and better follow the lectures. A comment from teachers; *'I initially felt that the lectures' pages that we've put on were more for the students to get a grasp of the structure of the lectures, of how lectures ran from one to another. And I felt that having an order of lectures on there, students can use it as a tick list as one to ensure they've got all the lectures'* **(T.5)**. Another comment from students; *'I think it's really important that we get the handouts like before hands or during the lecture because then we can pay more attention to what they are actually saying rather than worrying about copying everything downward and where the missing things'* **(S.5-2)**.

It was also reported to be effective in assuring that all students received the required information. A comment from teachers; *'The positive things are that you can demonstrate to students that they have received the knowledge they claim not to receive. And you can direct them back to lectures to re-read notes and re-gather handouts'* **(T.4)**. Another comment from students; *'With the exams we just had in past as well we don't get for them all lectures and I think one of the reasons why I did pass was the fact that you could go through the lectures from previous years that we haven't been get if we didn't have enough weeks or some were not able to do that. So you can be able to draw information from different parts and sort of things'* **(S.6-4)**.

Promoting background reading was another potential reported from having online lectures and handouts. Some teachers supported such view; *'The other advantage of having online is that they can actually see the content before the lecture, so the actual more enthusiastic students will perhaps do some background reading before the lecture itself, and if they have the slides that's a little bit easier to do'* **(T.6)**. While others contradicted it; *'But from my limited teaching experience I have to say that, more often than not, the students only think about their next lecture 15-minutes before lecture. And if they are going to take anything off in terms of handouts, they will print it out just before they come and then sit with it I mean not already read or thought about it before the actual lecture'* **(T.3)**.

Such a potential was also reflected in some students comments; *'It's good as in prior to going to the lecture you can kind of do background reading first and you can take a look what the lecture about and then prepare for it accordingly may be'* **(S.1-2)**. Accordingly, it was thought by students to make teaching more interactive; *'There always known that if people turning up to a tutorial and don't know anything then what's the point of them being there? So it would help then to have more productive tutorials and it will help us to have a clue of what is going on basically'* **(S.4-4)**.

Providing resources in a variety of formats was reported to be essential in satisfying students need and learning styles. A comment from teachers; *'Again it's coming back to allowing the students to have a variety of resources and methods in which to learn. Some people might find it easier learning about dental materials if they have it playing in their ears'* **(T.6)**.

It was also reported to be essential in providing better ways of presenting information. A comment from teachers; '*I think some of the points that are quite difficult to get across by typing that would potentially be a place where we could pick up on some of the discussion and have a short podcast to explain some of the quite difficult ideas which maybe hearing*

somebody talk about it would help' **(T.1)**. Another comment from students; *'I think podcasts are really useful, because you have like 4 or 5 people and they are all kind of experts in their fields and they are discussing whatever topic, then it is quite easy to get different opinions and then you can target the points. And that's really helpful for understanding'* **(S.6-2)**.

Having the multi-media formats on the e-course was reported to be important in helping visualising concepts and procedures, thus, supporting the pre-clinical and clinical teaching. A comment from teachers; *'I think that the videos are useful, particularly when teaching dental techniques. I think it is often much easier to visualise a concept than to try and read it from a book. So from that aspect, I think they are great'* **(T.3)**. This was also supported by comments from students; *'I prefer learning from videos because you can see what they are doing and that is what you are going to be doing because you are going to be physically doing it not writing it down'* **(S.24-3)**.

Online resources, because of its 24/7 availability, was reported to add the dimension of just-in-time, just-in-need information to teaching and learning. A comment from teachers; *'I think the videos are very valuable and I would actually like to have a video for every dental procedure available for the students to revise from just before they see their patients, just–in-time revision'* **(T.7)**. Another comment from students; *'I personally find it easier to just look at videos and then that. And even just look it like the night before, because you've already seen it once you haven't really learnt it like you didn't know much more. So the next day, because it's already in your mind it's just like a quick brush up when you see it again not like the first time. And then when you go into do it it's just a lot easier'* **(S.3-2)**.

Students considered the online resources on the e-course to be a very reliable resource for them to use because they are developed and checked by their teachers; *'And because the resources are provided by the lecturers and the clinicians at this school, it is just really good*

for you to know what they expect from you. So you know their information and then it just helps you throughout the course' **(S.4-2)**. This makes it more relevant to students' learning; *'I use the e-course quite a lot because it got a lot of relevant information especially to the clinical stuff that we do, updated quite frequently, and it's quite useful reference or at least a starting point for other bits'* **(S.4-4)**.

Compared to other static resources such as books and articles, students reported that online resources have greater positive potential in many ways. It was found to be more interesting and enjoyable; *'I do think it's quite useful and makes learning easier and more interesting just because it adds more variation to what you're doing. And I think taking the pictures are very useful, which of we can't get into textbook'* **(S.7-4)**.

It was also reported to have information difficult to find in other resources; '*I think it is the only place where you can read about the materials you are using in clinics in more details like tips on how to use it something like that. You don't really get that anywhere else'* **(S.8-3)**.

It was also considered to save time; *'It's a lot quicker. Just look something up on the computer, and you can do it anytime of the day you go to the internet. Whereas for the library and books, you need to give it back, you don't normally have enough time to flip the whole book to see what you're going to get, it's just you can look for more specific things'* **(S.3-2)**.

Other potential reported by students was that it gives boundaries to what should be learnt; *'When you do online learning, with the e-course, because it is already laid out for you, it gives sort of boundaries as to what you need to go into as well so it's quite helpful because with books you sometimes have to go for ages before you learn'* **(S.3-2)**. And that all the learning materials is provided in one space; *'It is like a big textbook you can just go to rather*

than fish around and always get information, search for it and it will come up' **(S.17-3)**. Another dimension included; *'It brings together the whole 5 years rather than you have to go and search in your folder that might be collecting dust'* **(S.9-4)**.

The availability of the online resources to everybody was considered a great potential. *'A really good thing that it makes equal for everyone because if there is only eight books in the library and everyone got to look in one book before their lecture not everyone is able to get a copy of that not everyone is able to forward every book but if everyone got access to the e-course and then it does make quite fare and then'* **(S.3-4)**.

Despite these advantages, many debates were also reported. Providing resources, especially lecture notes and handouts, on the e-course was thought to impact lecture attendance. Some teachers considered it as a major concern; *'I feel quite strongly against having lectures and handouts on the e-course, because I think if you put them on the e-course the motivation to actually turn up to a lecture isn't there. And I don't believe the lecture is just standing up and giving loads of information to students. I think there should be something where you are using the opportunity to actually explain something into a more detail'* **(T.2)**. Other teachers contradicted such views; *'It hasn't affected lecture attendance at all which is one of the concerns that we had. I don't have any negatives about doing that'* **(T.1)**.

The same concern was also negotiated among students. Some students assured that having online resources does not affect lecture attendance; *'I don't think I would learn the same because it is not what is on the slide. It is what the lecturer has as well. But I think it fills the gaps and makes everything more understandable'* **(S.8-3)**. However, few students supported such concern; *'I think it does affect attendance a lot because obviously if you don't have the lecture on the e-course like before then you've kind of more intent to go to the lecture,*

whereas when you know you can just get it off the internet, a lot of people just can't be bothered to go' **(S.25-3)**.

Most teachers (5/9) highlighted the need and importance of peer-reviewing the resources provided on the e-course; *'I think the e-course can be made a lot stronger by now starting to peer-review what is on there by other people looking at other people's pages and commenting on them. This is something that has never been done and should be done. Because you will find a huge amount of holes left right in centre'* **(T.3)**. They also highlighted the drawback of having resources that are not peer-reviewed and that they only represented teachers own opinions and not facts. *'One serious drawback that our online library has, the e-course has, compared to an actual library does is that the library is full of books that have been proof read, edited, subject to peer review. Whereas our online learning is not that, it hasn't been taken that far. And information that is on there is also something a matter of opinion from different members of staff rather than a proof fact. And I feel sometimes it is difficult for students to differentiate fact from opinion'* **(T.5)**. Accordingly, educating students on how to use such technologies in their learning process was a challenging factor; *'I found one of the challenges I have sometimes is that again it is a matter of opinion and it is the matter of understanding what the evidence base. But you have your students say "Well, it is not as it says on the e-course". I only mention it because every single student says it to you apparently'* **(T.3)**.

Some teachers expressed concerns in the possibility of defeating the real message behind the provided information when using some of the formats to deliver online contents. Podcasts was one of the mentioned formats; *'I think there is a real danger they become divorced from the real essence of the message you are trying to get across through that type of format. They have a place podcasts, it depends what you are trying to achieve with them but I don't believe in putting lectures on podcasts'* **(T.9)**. Clinical cases were another format for such a

concern; *'My only reticence with it is I think you have to be extremely consistent in the message that you are coming across in your clinical cases and dentistry is not a consistent process. Dentistry you show the same radiograph to three different people you have three different interpretations, they might not be interpretation of diagnosis but interpretations of what you should do. But it is a useful resource, but not to be so heavily reliable'* **(T.3)**.

Teachers also noticed that the efficiency of students is independent from the instructional delivery methods, and that the good students are the same with different instructional format; *'I think those that are keener are more likely to use it. But those are also the students who are more likely to come to the lectures, who are more likely to come to the tutorials, who are more likely to contribute. So I think there is that side of it'* **(T.2)**. This is supported by another comment; *'I think the students that tend to access the online material tends to be the most conscious students anyhow and they are probably the ones that need them least'* **(T.9)**.

The duty of regular updating the contents on the e-course was highlighted by some teachers; *'I think that if they are on for a limited period of time it has no problem doing lectures and handouts on. I think they should come off after a years-period, for example six months something like that so they can be updated, rather than sitting there, no updates and no changes to it'* **(T.3)**. This was echoed in some students comments; *'I think the handouts you get in the lecture are not the same on the e-course'* **(S.3-2)**. However, lack of time was reported by teachers to be a problem; *'They get outdated every year. And with the best in the world, we probably wouldn't get it updated on the e-course every year'* **(T.9)**.

Copyright was mentioned by few teachers and the importance of having policies for such issues was highlighted; *'Some universities made it explicitly clear that the IP belongs to the creator but the copyright belongs to the school for example. Birmingham University is a bit*

vague about it. Birmingham University is disparately behind other universities as far as e-learning is concerned. We don't have any e-learning policy' **(T.7)**.

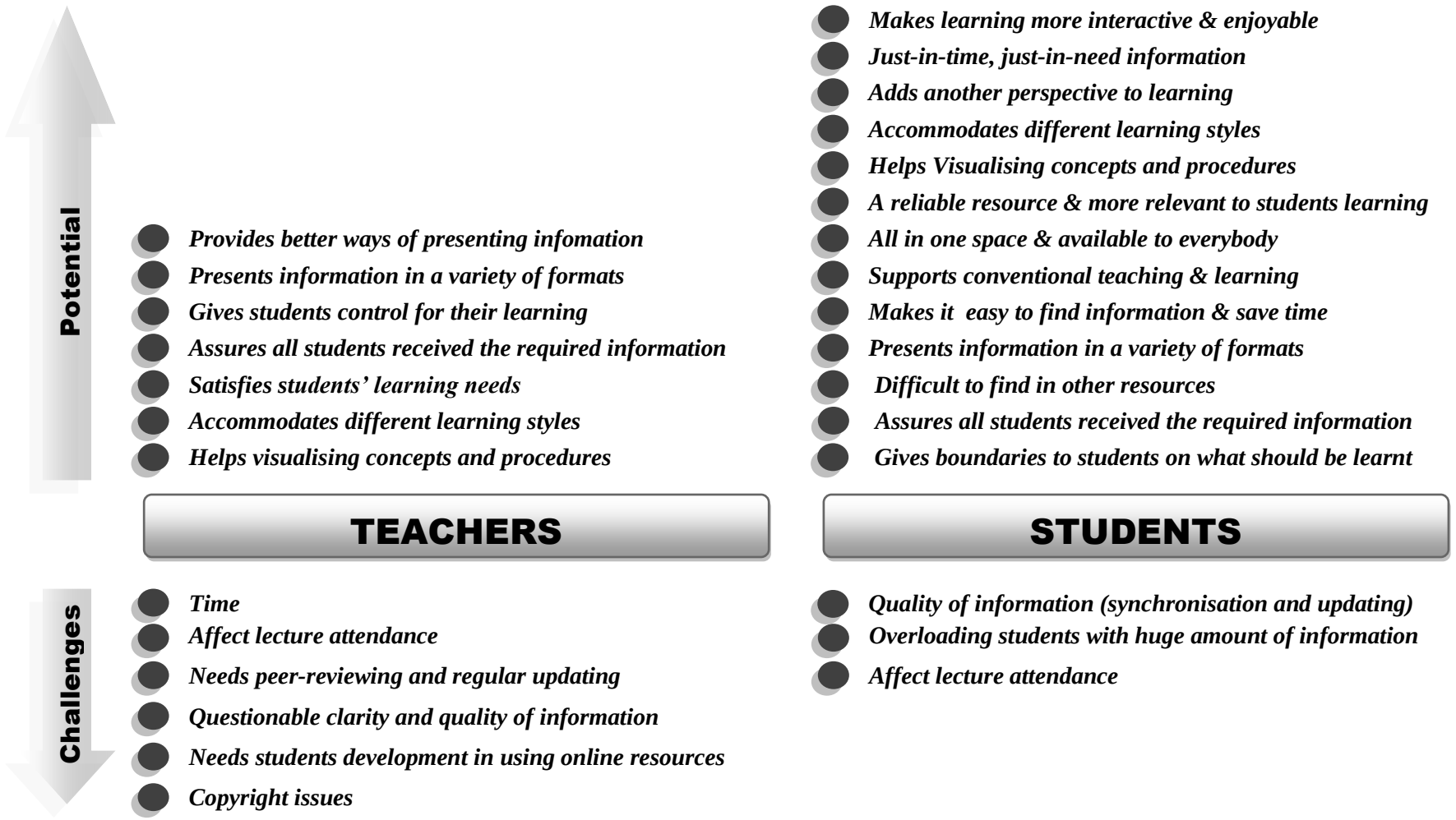


Figure 9.4 Summary of the potential and challenges in using the e-course to support the "Learning resources" in the curriculum.

9.5.3 Learning activities

Learning activities on the e-course were presented mainly in the form of developing Wiki pages and Treatment blogs. Other activities available on the e-course were; self-assessments and discussion topics and will be discussed in other sub-sections.

The concept of constructing online learning activities and having students to share in developing contents to be published on the e-course was not much accepted by most teachers. Difficulties of assessing such activities was one of the reported concerns; *'You have a complete responsibility to make sure that information is correct and is often harder to sift through other people's information to determine what context is being put in and whether the message is clear, concise and correct than is to actually construct it yourself and put it as an available information'* **(T.3)**. This in turn calls for extra-time and efforts from teachers; *'I think it is a good idea. But again it is a resource; it is having the time to go through everything that has been putting on and so on'* **(T.8)**

Plagiarism was another reported issue; *'I think it is very difficult then to monitor who's doing what. I think and I maybe a quite old fashion, but I think that assignments everybody should put the same amount in'* **(T.2)**.

Teachers also questioned the benefits of using online learning activities if they were not assessed; *'They will not necessarily answer the question. If there is no need for them to answer the question, if it is not based on assessment, maybe you get 1% of the students responding to a higher level of resource base thing'* **(T.5)**. Thus, their total benefits might not worth the time and efforts, as reported by another teacher; *'I think it is quite interesting to have an oral surgery blog and put up such a new finding in research and that kind of*

thing. I think that would be quite useful. But whether students will check it I don't know' **(T.8)**.

They were also concerned about the outcomes that might result from peer-learning; *'The quality of the Wiki pages depends on the quality of the input. And if the input is from students and is not being edited by anything else, then obviously the problems if other students go and pick up this erroneous'* **(T.4)**. The same was reported for using Blogs; *'I haven't used them. I'm not certain how they can learn from each other. It is also based on the assumption that the students have sufficient knowledge and sufficient interpretation on a situation, to make an intelligent comment at any particular time'* **(T.3)**.

Peer-reviewing was again a reported concern by teachers; *'As a concept it worries me. Because if students to put them on, it has to be very carefully monitored by staff to insure that the information that has put on is correct. And being published on the web I don't think, I think again it has to be peer-reviewed'* **(T.8)**.

Using such innovations seemed to be new for teachers and requires staff development. *'The Wiki was a web 2.0 feature which I believe requires a bit of staff direction to get the students to use it. Its long term value I'm not sure about it. We've never decided are these going to be assignment pages where students can have a look at other students' assignments, or are they going to be Wiki pages like in Wikipedia. It is a lack of clarity at the start'* **(T.7)**.

Learning activities had two different opinions and was a debate among students. Positive views reported by students were that it provided information at the level of the undergraduate students; *'I've used them extensively for my prosthetics revision with specialty teaching. And I found them really helpful even more probably than what the teachers said. With the things that the teachers put on it is very much it could be out of a text book. So even though it is right and it is all there you might not understand it necessarily. But with things*

like Wiki pages and the things that students help out with I think it helps really to break things down and explain in it in a way that is better' **(S.8-4)**.

It was also reported to help students measure the level of their knowledge, thus, builds confidence; *'Definitely I would say having the student-shared part of the e-course is really valuable. And it is an advantage and it is really helpful. And it does give confidence. It helps you to measure up your level of knowledge to your peers'* **(S.8-4)**. And to promote peer-learning such as when blogging students' clinical cases; *'I think if you got a patient where everyone can learn from and they are quite varied. It is really good in terms that you can see how quickly or high slowly a person is progressing with that case and you can relate it to your own one. You can see the difficulties that they come across and how they deal with it. So it is very informative'* **(S.9-4)**.

Trusting information on such activities was a major concern. Accordingly, some students treated such activities with cautions. *'I don't think I'll trust it to be fair. And I don't know what the extent of checks has gone for it like referencing and that I think it is very important. And I feel like I could write something on the computer on there and whether it would be right or wrong we wouldn't know. I'd rather have something from the clinician than from the students really'* **(S.2-2)**. Other students, however, did not consider it a major problem; *'I think I would trust it to be honest. Obviously any information you take with some thoughts. Then when the students do write it they are not writing it from nothing, they are looking into textbooks then they write it on. So I think obviously you don't use it as a sole resource but it is a very useful addition to the e-course'* **(S.6-2)**.

Teachers' attitudes towards such approaches seemed to be a key factor; '*I think the stuff that is led by staff and teachers is more like you can trust it. They are more useful for us. But if they more validate what students put on and they really tell us to use that as well. But*

because we are still not sure whether it is used or taken whole heart and whether it is correct or not, so we are like unsure of it' **(S.16-3)**.

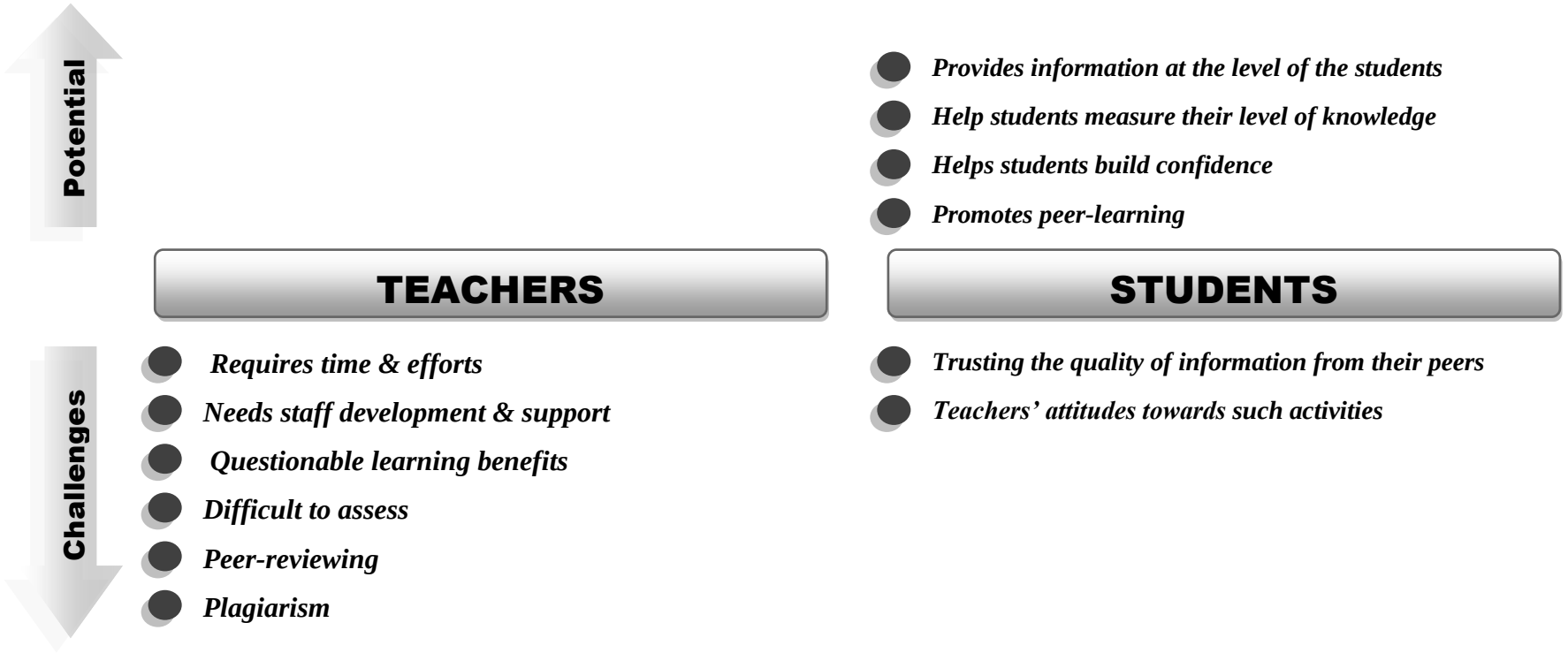


Figure 9.5 Summary of the potential and challenges in using the e-course to support the "Learning activities" in the curriculum.

9.5.4 Discussion activities

The discussion board is a relatively new feature added to the e-course in 2008. It was used in two formats; open discussion, or frequently asked question (FAQ) format; and topic specific discussion or as an assigned discussion activity format. At the time of the current study, the assigned discussion activity format was still at a trial stage and was not assessed in the current study.

Teachers reported some positive potential from using open discussion format to support their teaching process. Apart from being a good and fast way of communications with students, it was also reported to help in organising teachers' time; *'Teachers that I've spoken to and for myself as well means that I can answer these questions when I wish, and not when the students wish. So that helps organise my time and the students know that for me and other teachers not to keep bothering in the office with learning and teaching questions but to ask by the discussion board because we prefer to answer that way'* **(T.7)**.

It was also considered an important way supporting students learning needs; *'The students obviously find them useful because they do ask questions on the discussion boards and I try to provide them with the answers that they need'* **(T.2)**.

Major concerns from teachers, however, were clustered around the learning quality and benefits resulting from using online discussion tools. Some teachers reported its potential in promoting higher level thinking; *'And the only kind of higher level of learning that we get is when students ask us questions on the discussion boards. And the kind of question that they are putting on they are already providing the answers for them. And which already shows the thinking all they require is the thinking about it and they are gaining our opinions for example or gaining our take and thing like that. Which is again that is higher education that*

is higher learning isn't it?' **(T.5)**. As well as collaborative thinking; *'When things are posted on the discussion board by one student and I answer, we often get another student reading it and contributing to it. So in a virtual sort of way I guess that's what you have but it is not formalised into a network if you like'* **(T.9)**.

The majority of teachers, however, highlighted its drawback in building dependence and laziness in students' learning behaviours; *'It is often appeared to be used rather laziness by the students when they don't appear to be bothered to look for information which is either already there on the e-course or within readily available texts or lecture notes. They'd rather just ask for someone to give them the answer which is not in the spirit of self-directed learning'* **(T.4)**.

Due to the anonymous nature of posted messages on the discussion boards, some teachers reported some netiquette issues. '*I do think that with the discussion boards students do think sometimes they have the attitude that it should be answered there and then. They don't seem to appreciate that a member of staff has to sit down and actually have the time to answer questions. We are not available 24 hours, 7 days a week'* **(T.2)**. Thus, for properly using such technologies, teachers highlighted the importance of having netiquettes rules and regulations on the e-course. *'It is really wrong that it is anonymous. It needs much more regulations and you know the discussion boards are really great and I really think they are important. But you must have to know which students are asking their question because if the same student is asking the same questions again and again and again, then the student is obviously week and needs a bit more support. That is my biggest fear about using the e-course in general'* **(T.8)**.

As reported for all other components on the e-course, having such activities within the curriculum required a lot of time and effort from teachers; *'It does create a lot of work for*

the teacher. And I'm on the discussion board lists of several specialties. And I can see at certain times of the year it goes mad. It is a good thing but I think the actual work that it generates maybe slightly outweighs its usefulness perhaps' **(T.6)**.

Students also reported some positive and negative attitudes towards using the online discussion tools in their learning process. Apart from being a good and fast way of communicating with teachers, it was reported to promote collaborative thinking; *'I think in terms of the discussion board where you can ask the clinicians questions. I think that is good, because if you got question everyone can see the answer. Someone might add into that and some other ideas might come off it'* **(S.2-2)**. It was also reported to be an interactive way of learning; *'It is very interactive it is not a way of you trying to get an easy way to not look into a book. Or if you don't understand something then you can ask about it, but it is not directly of getting answers'* **(S.9-4)**.

Its potential in supporting students in building confidence in their level of knowledge and experience was also highlighted; *'I'm a really good friend with the discussion board, you kind of see what other people are going on and then make sure you are doing the same thing. So it is really good'* **(S.6-2)**. And also in broadening the scope of their knowledge; *'I think it is great. There are always questions that someone's ask that you never actually thoughts about and they just give you a different way of looking at things. When you do hear like the clinician stating something they could actually say something in a different way than in lectures and it is just to make sure you understand that a little bit more'* **(S.5-2)**.

Because the information on the discussion boards are traceable, they were acknowledged as an additional source of information; '*I find the discussion board quite useful especially the questions because you can actually look at them throughout the years. And some of the*

questions that have been asked are questions that you've wanted to ask so it is like another source of information for you' **(S.4-2)**.

Negative experiences from students were reported from having negative attitudes from teachers in replying to their messages as has been discussed in the 'Pedagogical' section. Other students were not satisfied with the layout and quality of information delivered through the discussion boards. Thus, it was reported to be difficult to search for information; *'And also I think the archives it is all like one archive. So if you are thinking that someone might have asked that before you have to sit through loads of information. Whereas, if the answer for each question is already popped up on each page then it might be useful to use'* **(S.17-3)**.

It was also reported to be difficult to follow and understand the written information; *'Most of the time I find it doesn't really make sense to me because I don't understand what the students are asking half of the time, and like I can't relate to it because it is not my patient. I don't know usually I read what the lecturers have written but that is usually a bit more specific to the patient in question. And I don't really quite follow what they are going on all about most of the time'* **(S.20-3)**. Thus, was thought to be effective for personal use only; *'I agree it is more for personal use because if I was to look up something I wouldn't use that, I wouldn't think to go to the discussion board just because there is so much waffle in there. It is not really summarised on what you want to learn. So it is not useful in that sense like learning wise, it is more personal like if you got a problem then just put it up there'* **(S.25-3)**.

The improper use of the discussion boards in discussing things was also a reported negative issue; *'I don't think people really discuss, I think people just ask questions. And especially in prosthetics people just ask questions and just demand it that they got an answer. And some of them would ask simple questions you could have just opened the book'* **(S.6-4)**.

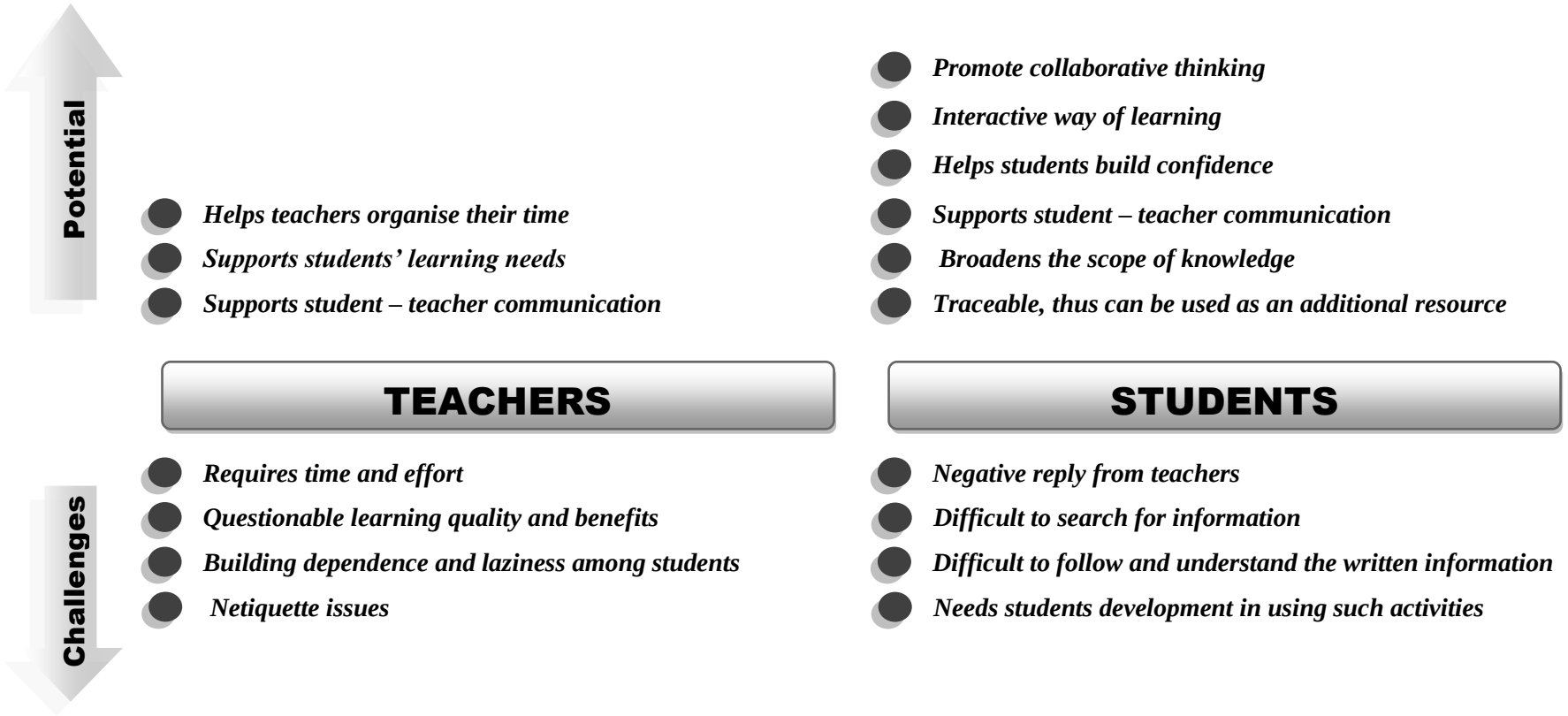


Figure 9.6 Summary of the potential and challenges in using the e-course to support the "Discussion activities" in the curriculum.

9.5.5 Assignments and assessments

The e-course has been assessed as an approach for supporting the delivery and management of assignments and assessments in the dental curriculum. Teachers reported that the e-course has limited capabilities in supporting such components. Self-test and formative types of assessments were the only types thought to be well supported by using online tools; *'Short answer questions are something that has been on there for quite a while and is found to be very useful by the students'* **(T.5)**. Another comment included; *'The MCQ's was something that I've put on couple a years before. And they were designed just as a revision guide for students in key topics that we felt they were important. But I do think as a revision tool for the students, something interactive, and something that isn't just them reading some text on a page. It is more useful to them'* **(T.8)**.

Students also highly rated the significance of self-tests on the e-course; *'I try to go to it three times a week and a lot more during exam time because there is a lot more quizzes on there and self-teaching purposes as well'* **(S.1-2)**. Another student reported; *'I think in first year if I remember may be some practice questions. These are always good. Every year there is a brilliant. Even if there is hundreds of that it is so good. That is probably the only other thing that I do in first year'* **(S.5-3)**.

Major benefits reported by students from such formats were that it presented information from a different angle; *'I think the questions are quite good. I think it is quite good because there is different ways and forms of asking the question. Like you can just have an MCQ or you can have like a picture or diagram so you get familiar with the topic and understand it from different angles'* **(S.6-2)**. It also helped students test their knowledge; *'I like using the self-assessment questions especially after you've done the revision review, they can plug up points that maybe you need to go over or maybe you not strong in. But as you're going along*

it is a good way of finding out what you do know and the smiley faces is really helpful' **(S.5-2)**.

The feedbacks included in the online self-test were reported to have a great impact on learning; *'I think they are really good. What is good is that if you do get it wrong or right they have a piece of information after it just to explain it a bit more. So if you get it wrong then you know why and they always explain that'* **(S.3-2)**.

The advantage of being able to repeat them multiple times was also acknowledged by students; *'You can do them repeatedly after certain amount of time. So you can score and check if your score was better than the first time. It is not sort of robust once you've submitted your answer then that's it. You can have another go which I like about it'* **(S.8-4)**.

They were also found to be a good format to follow for exams in some areas; *'That's in Prosthetics, some of the pictures were quite similar that actually came up in the exam and they've given you the model answer for them so you could then think of other topics or other pictures that might come up. And because they actually given you the model answer so it was obvious how much details you needed or like what you needed to write or it actually helped your learning and it actually helped you answering'* **(S.6-4)**.

The online assignments and summative assessments received negative attitudes from students, mostly from fourth year. Plagiarism was one of the main reported concerns; *'We already used it for clinical governance. There are loads of things you have to go through and questions you have to answer that are already on there so we have to do this year. I don't know who's to say who did it and who's to say we can do it together'* **(S.4-4)**. Internet problems were another reported concern; *'If your internet break in the middle of it just like technical things, things that always go off and on and if that happen and you are half through a test there is a time limit it's just have many problems that can be with it. I don't*

know having to do a test at home just as house made having come in and out and then they don't know what you are doing it is just I don't know' **(S.6-4)**.

On the other hand, third year students reported positive experience with using online tools for assignments; *'I just remembered actually when we were doing this biomaterial thing. There was a real learning in there. They made it so that you have to read through the pages to get the answer to the project question. I think that worked really it did for me anyway. There wasn't everything put there on the lecture, you had to read all pages. I think they can use it as part of the teaching like that'* **(S.8-3)**. The difference in attitudes could be attributed to the difference in the instructional design of the contents.

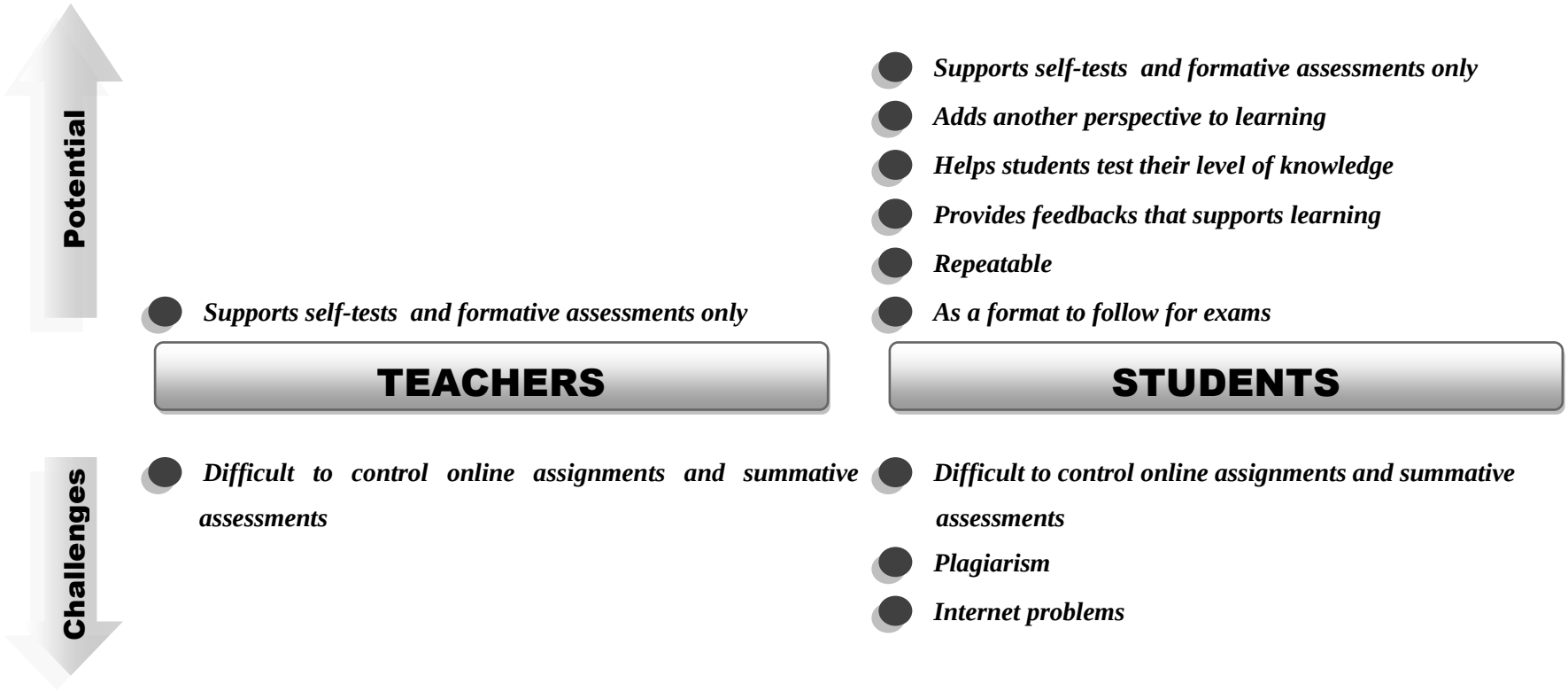


Figure 9.7 Summary of the potential and challenges in using the e-course to support the "Assessments and Assignments" in the curriculum.

9.6 Summary

The relevance of the e-course to students and teachers' teaching and learning was assessed. The following potential and challenges were reported;

9.6.1 Students

Students were highly satisfied with the e-course in supporting most aspects of their learning process. The advantages of anytime, anywhere, and at own time and pace access was reported to help students gain control over their learning process.

The varieties of resources and the different ways of presenting information was acknowledged for many reasons; adding another perspective to learning, accommodating different learning styles, and making learning more enjoyable and interactive. It was also reported to augment conventional clinical and didactic teaching in a variety of ways. All this and other reported advantages were thought to have a great impact on students' cognitive and physical learning skills.

Learning and discussion activities on the e-course were also reported to promote collaborative thinking and provide an interactive way of learning. Major advantages were reported in helping students build confidence and broadening their scope of knowledge. Self-tests and feedbacks on the e-course were highly rated by students in helping them to test their level of knowledge and build confidence in their learning behaviour.

Overall, students rated the e-course as a significant adjunct to conventional learning methods. It was reported to have a great impact in supporting and promoting self-directed and life-long learning behaviours.

Despite these advantages, some concerns and challenges facing students when using such innovations were also reported. Some of these concerns were related to technical issues such as; navigation, e-mailing and loading issues. Other concerns were related to teaching and learning issues such as; the alignments of the e-course's contents with the courses' objectives, overloading students with information and work, and the need for student development in using some of the resources. Peer-learning and plagiarism were also considered a challenge by students. Nonetheless, teachers' attitudes towards the technology were considered the key driving force behind students use and satisfaction with such innovations.

9.6.2 Teachers

The e-course with its wide variety of resources and interactive tools was thought to help teachers overcome some of the teaching challenges such as; low-staff to student ratio and teaching in outreach clinics. It was also thought to expand the possibilities of teaching in a variety of ways such as; supporting problem-based, student-centred and multi-disciplinary approaches. Answering students' needs on the discussion boards was reported to help teachers organise their time and gain feedback for their teaching. Teachers also highlighted the significance of such innovations in supporting students' needs and accommodating different learning styles.

However, teachers reported many challenges and concerns that seemed to outweigh the advantages of using such innovations. Major challenges were;

1. Lack of time.
2. Extra- effort needed for developing contents and assessing online activities.
3. The structure of the e-course management team.

4. Staff development and support in using the technology.
5. Student development and support in using the technology.
6. The issues of overloading students.
7. Questionable learning trends, benefits and outcomes.
8. Difficult to control and assess online activities.
9. Questionable clarity and quality of information.
10. Questionable teaching quality when using such innovations.
11. The need for re-designing the curriculum.
12. Alignment of the e-course's objectives with the School's strategies.
13. The concern of affecting lecture attendance.
14. Needs peer-reviewing and regular updating.
15. The need for regulations.
16. Copyright issues.
17. Netiquette issues.
18. The ability of these technologies in replacing face-to-face teaching is questionable.

In conclusion, e-learning seem to have a role in augmenting conventional teaching and learning in dentistry. However, many challenges are still facing teachers and students in using the technology.

SECTION SIX

DISCUSSION

Chapter 10

FINDINGS OF THE STUDY

Chapter 11

E-LEARNING IN DENTISTRY: BRIDGING THE GAP

Chapter 10

FINDINGS OF THE STUDY

10.1 Introduction

The last 20 years have seen significant changes in how learning takes place. One of these changes has been the increasing use of Internet based technologies. Such technologies allow people to connect, communicate, and socialise in a manner that is unprecedented and very different to what had gone before. Educational strategies, including dental education, need to cope with the speed and dynamics of such changes. In addition, there are numerous reports on the shortage of dental academics (Silke, 2004; Rushton and Horner, 2008). This decreasing number of academics, who are often stretched with both teaching and research duties, is being asked to reform curricula and implement changes to reflect a contemporary dental course.

One of the solutions that are often championed as a possible strategy for coping with such pressures is the use of e-learning approaches. Many dental schools were keen to incorporate e-learning within their educational strategy and there have been several successful results reported in the literature (Mattheos *et al.*, 2001; Engilman *et al.*, 2007; Zary *et al.*, 2009). However, there is still a lack of good evidence to support e-learning in the development of a dental curriculum with many reported challenges and concerns from teachers, students, administrators and e-learning developers (Chambers, 2009; Haden *et al.*, 2009; Shah and Cunningham, 2009; Ward *et al.*, 2009; Zary *et al.*, 2009; Handal *et al.*, 2010). Thus, more research in this area is still required.

Within this dilemma, the University of Birmingham, School of Dentistry, introduced an online learning system in 2002, which is called the "e-course". The main objective of this online learning environment was to support students' learning needs (Gupta *et al.*, 2004). The e-course has undergone a continuous development to serve different educational needs. It progressed from Web 1.0 capabilities, when it was first launched, to a fully compliant Web 2.0 system in 2007. The school has received many popular accolades as a result of the e-course including the Times Higher Award sponsored by the Joint Integrated Systems Committee which is one of the highest "Higher Education" honours that is awarded (JISC, 2007). Therefore, the e-course is a suitable case study which can be used to explore some of the potential advantages and challenges that face dental education when such online courses are integrated within the curriculum.

For the purposes of the present study, the e-course was assessed in four separate stages;

- **Stage 1:** a pilot study was conducted to evaluate an online orthodontic e-course that has been developed by the author of the study. The aims of this stage were twofold; 1) to give the author the experience of developing e-learning contents using the e-course, this was seen to better help the author in approaching the research and reflecting on the findings; 2) to assess students' needs and attitudes towards the e-course as a preliminary guide to the study design.

- **Stage 2:** the different tools, components, and content delivery formats on the e-course were evaluated in order to explore its overall functionality and to assess how it is used and which parts were the most popular for access by teachers and students.

- **Stage 3:** the discussion board archive on the Prosthetic e-course was analysed as a case example. This was seen as an area where the e-course is effective in supporting higher-level teaching and learning approaches.

- **Stage 4:** students and academic teachers were interviewed to record their motives, knowledge and attitudes towards the e-course. They were asked to identify the potential, challenges and barriers in using such innovations in dental education.

Findings from the study will be discussed in the following sub-sections.

10.2 Efficiency and Use

The e-course has many tools and functions that make it a convenient online learning environment for both academics and learners. It supports learning communities by providing different tools and formats for presenting information, and this in turn helps to accommodate a variety of learning and teaching styles. It supports content communities that allow users to post and share content using wikis and blogs. It also supports communities of clinical practice by using blogs, wikis and discussion forums. In these areas, there are spaces for discussing clinical cases and other learning subjects that are linked to the course. The discussion forums have a strong pedagogical approach as they are used to support collaborative and reflective learning. The self-assessment components on the e-course incorporate feedback features that are useful in supporting self-directed learning. This wide variety of information delivery formats and pedagogical support is in addition to the anytime, anywhere, and at own pace features of online learning environments. This demonstrates a potential in supporting independent, student-centred and life-long learning behaviours (See chapter 7, section 7.2 and 7.3).

The e-course is also a space where learners can track their teachers' expectations and needs. It is also a space where teachers can track their learners' expectations and needs. Thus, the e-course, with its wide variety of tools and flexible structure has the potential in changing the models of teaching as well as shaping the learning environment within the school. Whilst

there are many advantages to the use of the e-course, it was not used particularly well to track the progress of students learning (See chapter 7, section 7.2 and 7.3).

The open design of the e-course allows the content to be equally accessible to all members in the school which in turn may have an added impact on students' learning. Such a design allows students to get an overview of the dental course in one space. This in turn, can indirectly drive students to think broadly across disciplines and critically analyse a topic from different aspects of the course. It also has the potential in bringing together multi-speciality contributions to a discussion topic. Students are responding well to such an approach by requesting more information. However this positive approach to the e-course from students is, often received negatively by some academic teachers as they feel that this will add more workload as they track students' learning through a variety of channels and learning resources. The open design can also be challenging for teachers as they may not have the skills to publish their contents online. Also it may not fit with all teaching styles, and thus, can be a barrier to use by some teachers (See chapter 7, section 7.2 and 7.3).

The e-course, with its open system format, is not just a virtual space made available by technology. It provides a community for learners that shape their whole learning experience. It is also capable of enabling a variety of pedagogies, and thus, reflecting on the teaching strategies present in the school. Despite its many potential, such a design did have some drawbacks. This highlights the potential role inherent in the design of the e-learning environment; as open or closed systems. Thus in designing an e-learning system, dental schools need to prioritise their teaching and learning needs, design a roadmap for their strategies, and then choose the appropriate e-learning design that fits with this strategy. Although this may appear as a straight forward decision, using and integrating e-learning is a

very complex process that requires careful planning and must include the relevant stakeholders.

Whether just having the technology is sufficient to encourage users to use the e-course is also investigated in this study. By the end of 2008, there were 2085 pages of content developed for e-course use. Most (85%) of these pages are designed for the undergraduate dental students, with (70%) of the content developed to support the clinical courses (BDS clinical e-courses). The remainder of content is for use by the Biomaterials course and other postgraduate use. The e-course has been developed as an open space for voluntary contribution and has been used as such in most areas. Thus, such an extensive use by different teaching specialties as well as by students, as highlighted by current findings, may indicate that the technology is easy to use and therefore does not prevent users from contributing to the e-course. It may also highlight the high level of motivation and positive attitudes of teachers in the school towards using such e-learning approaches. This positive attitude may be derived from internal motivation towards the technology or as a response to students' needs to such innovative approaches to support their learning (See chapter 7, section 7.4).

An in-depth analysis reveals that the level and purpose of use of the e-course did not seem to utilise the full potential of the technology. Results show that half (51%) of the pages on the e-course were designed using passive information delivery formats. The most common passive formats were; lecture notes (37%), and PowerPoint lectures (29%). The multi-media formats (videos and podcasts) constituted less than (9%) of the available content. Self-assessment tests made up around (23%) of the content, and which are greatly appreciated by the students. Almost all of these self-assessment tests (95%) were designed with immediate feedback. The interactive collaborative content is mainly in the form of Wiki pages developed by students

and these constituted only (4%) of the developed content. This shows that the easiest and preferable format for teachers to deliver to the e-course is the use of previous lecture notes and handouts. The teacher is content to develop the material primarily for the traditional delivery system; i.e. a lecture or a tutorial, and then make it available after the event on the e-course. On the other hand, the more interactive pages require more time involvement and consequently are not developed in the same quantities (See chapter 7, section 7.4).

The e-course has also been used more extensively by some clinical specialities than others. For instance the Prosthetic Department contributed the most material with (13%) of the online content. This was followed by the Conservative Department (8%) and the Paediatric Dentistry Department (8%). Such results show how a few enthusiastic individuals promote the e-learning approach and are therefore more available to the delivery of the online content. It may be argued that other teachers are comfortable with their present form of delivery format and do not wish to engage with the e-course. This appears to be more of a problem for the teacher as it will hinder proper integration of the e-course within the curriculum (See chapter 7, section 7.4).

The discussion boards on the e-course also show a similar trend. Their extensive usage is only seen in few departments. In 2008, only five (out of 22) of the clinical departments used it extensively. The highest number of posted threads is reported on the Prosthetic discussion archive (108 threads), closely followed by the Conservative Department (99 threads) and the Dental Public Health Department (86 threads). Even though, nearly all departments uses it as a short question and answer format with an average length of discussion ranging from 2 to 3 messages only. Discussion board is one of the Web 2.0 tools that have recently been added to the e-course. This can partly explain the limited use of such tools on the e-course. Teachers also questioned the quality of teaching and learning using such approaches, thus, more

evidence and successful models are needed in such areas of education. Students' development and maturation, as well as teachers' development in the pedagogical benefits and potentials for discussion boards is evident in this study. Even though, the extensive use of such tools and approaches by some departments and the positive potentials reported by students and teachers still highlight their significance in supporting teaching and learning (See chapter 7, section 7.3 and chapter 9, section 9.5).

In conclusion, findings so far highlight many potential avenues by which the e-course can support teaching and learning in the school. It has powerful capabilities allowing teachers and learners to design active and interactive tools. It is also flexible to meet a variety of teaching and learning approaches. However, a closer investigation indicates that the e-course is mainly used by a small group of enthusiastic teachers and mainly in a passive format. It is mainly used as a content management system and an information repository space. Teachers as yet do not seem to utilise its maximum potential.

This indicates that e-learning in the school is still seen as an adjunct and not a positive link with the curriculum. It is supported by a few teachers who effectively use the e-course in their own area. The majority of the staff still uses traditional methods of teaching whilst the students are actively requesting and using the e-course pages. It can thus be suggested that, for successfully augmenting the conventional teaching and learning in the school using e-learning approaches, there should be a well planned and designed e-learning strategy that can support teachers to get the maximum benefits of the designed e-learning approach.

10.3 Effectiveness of the e-course in supporting a Higher Level of Teaching and Learning Approaches

The extensive use (108 threads) of the Prosthetic discussion board by students in 2008 not only highlights their popularity but also their significance and pedagogical strength. It is found to be an environment where students feel comfortable in using this form of interaction. It is used by the undergraduate dental students from different years during weekdays, weekends, and holidays. Expanding the boundaries of time and location of teaching and learning can be utilised as a potential to help overcome some of the shortage in academic teachers in dental schools. However, it can be argued that using e-learning approaches requires more time and efforts from teachers because it lacks time limits. Thus, these issues should be carefully planned if such an approach is used as part of the teaching and learning strategies in the school.

Varied levels of social and cognitive presence took place when students used the online discussion board. The pattern of student and teacher interaction showed a substantial alteration in roles with the learner adopting a centric approach (Sahu, 2008). However, the current use of the Prosthetic discussion board indicates that it is mainly utilised as a fast and easy way for students to communicate with their teachers, especially during exam times. Higher levels of critical analysis and collaborative learning were not always present. It was found that promoting and developing such skills was highly dependent on both the role and presence of the teacher in the online environment (Mazzolini and Maddison, 2007). Findings from this study show that the learning benefits for the students are not inherent in the technology, but depend upon collaborative activities between themselves and with their teachers (Garrison *et al.*, 2001) (See chapter 8).

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10.4 Perceived Potential, Challenges and Concerns

Whether e-learning technology can support dental education was partly answered from this research study. E-learning technology has the potential to support dental education. However, its integration into the dental curriculum still faces some challenges. These issues were explored in the current study from the end-users (teachers and students) perspectives and at different levels.

A pilot study was first conducted to assess students' needs and attitudes towards e-learning. An orthodontic e-course was designed to support the didactic and clinical components of the undergraduate orthodontic curriculum. Four modules of the undergraduate orthodontic course were chosen for initial assessment and were converted to online formats. The contents were developed using passive (text, handouts, and PowerPoint presentations) as well as active (animations) formats. Self-assessments were also designed with clinical cases to help students build their clinical skills, especially in diagnosis and treatment planning.

Students are highly satisfied with the content provided by the online orthodontic e-course. The variety of methods used to present information such as; the photo gallery, images, animations and glossary are considered important formats for visualising concepts, thus helping students to better understand the orthodontic subject matter. The clinical cases, in the form of self-assessment with feedbacks, are also considered important in building the clinical skills of students and satisfying some of their learning needs. Such online components can be utilised to overcome the shortage of clinical exposure in the undergraduate orthodontic

teaching programme. It also has a great potential in promoting self-directed and life-long learning behaviours.

Findings from the pilot study highlight the positive potential which online learning technologies can support and augment the conventional teaching and learning. It also emphasises the students' need of such approaches to support their learning. However, the alignment of the orthodontic e-course with the curriculum objectives is found to be the key factor in the reported successes of the pilot study (See chapter 4).

The attitudes of students and academic teachers from different specialities were then assessed to explore further potential, challenges, and concerns in using e-learning technologies in dental education. This assessment was made using both one to one interviews and focus groups. Participants were asked to evaluate the e-course at three levels; technological, pedagogical, and curriculum design. Their attitudes were also assessed to explore gaps and relationships between the learners, teachers and the curriculum towards e-learning technologies.

When participants were asked to assess the technological efficiency of the e-course, its design and infra-structure is found to be one of the key factors behind its success. Ease of use and access together with giving the control to the users are the major features in breaking the "fear of technology" barrier. The flexibility of the e-course to meet a variety of needs and to accommodate different learning and teaching styles are also important features. This has been reflected in the big difference in the use of the e-course between the old (Web 1.0 format) and the new (Web 2.0) flexible format as reported by the teachers. Giving control of the e-course to the teachers allows them to build and continuously update the content within their course quickly and reduces the load on the e-course management and support team. Giving the control to the learners allows them to control their own learning needs and progression, as

well as share in developing content for the e-course. Thus, this research shows that e-learning technologies will be more successful when they are made user-friendly and allows the control to pass to the users (See chapter 9, section 9.3).

Participants of the study are highly satisfied with the quality of the e-course support system in the school. They greatly acknowledge the efforts of the e-course developer and support team in properly designing it to fit to the needs of the school. However, this has raised a big concern among teachers about what the structure of the e-course team should be. The current team is a group of teachers and clinicians in the school, who are also taking the responsibility to manage the e-course. Their dental background has made them more prepared pedagogically to support the e-learning strategy within the school. On the other end, they are also very busy teachers with a heavy load of teaching and research responsibilities. Teachers do need support from the team to allow continuous development and updates to take place. At the same time, they are concerned of overloading the e-course team with extra work. This is a dilemma that faces the school. The structure of the e-learning support team has an important role in the succession of e-learning implementation strategies. Therefore, it needs to be well planned and supported if e-learning is to remain a major part of the schools' strategy (See chapter 9, section 9.3).

When participants were asked to assess the pedagogical potential of the e-course, a number of desirable outcomes were identified. The multiple communication tools on the e-course, especially the discussion boards, facilitate student-teacher contact out of class time. Such communication technologies that increase access to teachers can usefully augment face-to-face contact in a variety of ways. The continuous support and feedback from teachers can play a major role in supporting student motivation and involvement in their learning activity. It can also strengthen teachers' interactions with all students, especially with shy and retiring

students who are reluctant to ask questions to the teacher directly. Thus, the presence of such technologies enhances the speed of communication as well as broadens the base of learners actively involved in the learning process. The increased opportunities for interaction with fellow students can also enhance and promote collaborative learning. However, findings indicated that teachers' attitudes and response online greatly affected participation and engagement of students (Webster and Hackley, 1997; Piccoli *et al.*, 2001). The development of such skills among teachers is crucial to the success of the e-learning instructional goals (See chapter 9, section 9.4).

The e-course is also found to support an active learning approach. Activities designed by teachers for such objectives are highly valued by students and promote deep learning. Web 2.0 tools such as; wikis, blogs and discussion boards are another area where students can actively engage and reflect on their learning. However, the findings of this study highlighted challenges when using Web2.0 tools in teaching and learning. Some students highly acknowledge them and report that there are many learning benefits when both active and passive contributions are present on the e-course. One major benefit reported by students is that they value learning from their peers. This helps students build confidence in their learning skills. On the other hand, others do not feel as confident using such approach and do not consider it a great way of learning. The main reason cited was that it was not under the control of their teachers. Some teachers are also wary about the "learning from peers" approach and do not favour giving the students the authority to share and publish contents. They claim that such contents are not reliable and need to be well reviewed by teachers. Thus, the use of technology to support active learning, where students can share in the learning experience needs much support and development for both teachers and students. It will also require a shift in culture on the approaches that are used in teaching and learning . (See chapter 9, section 9.4)

Feedback is a major supportive approach in teaching and learning and is highly valued by both teachers and students (Zary *et al.*, 2009). The ways in which the e-course can provide feedback are many. The self-assessment tests allow for feedback and promote self-directed learning (Handal *et al.*, 2010). Students enjoy receiving feedback from their teachers as well as their peers. However, the effectiveness of the latter approach is found to be highly affected by the teachers' attitudes and behaviours online. An unresponsive teacher will promote a negative attitude to the use of the interactive tool (See chapter 9, section 9.4).

E-learning technologies can improve time on task for students and faculty members that can lead to effective learning and teaching (Chickering and Ehrmann, 1996). Information on the e-course is found to support just-in-time, just-in-need learning. This can help students to organise their learning time and direct it as needed. The discussion board, with its asynchronous feature, is also reported to help teachers organise their time and respond to students' needs according to their time convenience (See chapter 9, section 9.4).

Many students reported that they feel stimulated and more organised by knowing what is expected from their learning (Chickering and Ehrmann, 1996). The e-course provides an ideal communication channel between students and teachers by which they can review expectations. This can help students to focus on what is required in their learning which in turn will lead to promoting self-directed learning (See chapter 9, section 9.4).

Findings from this study highlight the different possibilities by which the technology can assist teaching. The e-course is used to support the outreach clinical teaching, which is one method of delivering dental education. Students may be away from base and not have direct access to a particular specialist teacher. It is also acknowledged by some teachers for its capability to support inquiry-based and multi-disciplinary teaching approaches. Expanding

the possibilities of teaching can have a great impact on designing better curriculum (See chapter 9, section 9.4).

Despite these and other many advantages of e-learning, time and work load have always been seen as the main barriers to teachers fully utilising the technology in the teaching and learning process. Therefore, teachers require support and development in their pedagogical skills to properly incorporate new strategies in their curriculum design. The curriculum should have the following components which will assist in the content provision for e-learning. The course should have; learning goals and outcomes, learning resources, learning activities, and assessment and assignments (Collins and Berge, 2006).

Online learning resources on the e-course have many benefits compared to other conventional resources such as books, journals and lecture handouts. They make it possible to present information in a format that helps visualises concepts and procedures, which is difficult to find in other resources. The variety of formats in presenting information also helps to accommodate different learning styles and needs. Online learning resources on the e-course are developed by academic teachers to support their subject. Therefore, they are considered reliable resources and more related to students' learning needs. Students can use such resources according to their time, need and pace. All this supports a self-directed, independent, student-centred learning approach. It can also help overcome the challenges of low staff-to-student ratio, reduced clinical contact time and other curriculum constraints (See chapter 9, section 9.5).

Despite the great benefits and needs of online resources reported by students, some teachers do not share their views. Their main worries are that the electronic version requires regular updating and peer-reviewing, which again is time and efforts expensive for teachers. In some cases it may raise the possibility of confusing the message. The Birmingham curriculum has

many lectures in the course and teachers are concerned that this will have an effect on lecture attendance. Further analysis of such attitudes, however, indicates that there is a relationship between teachers' knowledge and their motives towards the technology. Enthusiastic teachers are less concerned and reported more positive attitudes. Nonetheless, almost all the teachers who participated questioned the possibility of "spoon feeding" and superficial learning that might result from using e-learning approaches. This again calls for the need for pedagogical development and support for both teachers and students and the continuous assessment of teaching and learning benefits, if e-learning to be an integral part of the school's strategy (See chapter 9, section 9.5).

The e-course supports self-assessments and self-evaluation learning, which has been acknowledged by all participants (teachers and students) as a good factor. On the other hand, using the e-course to support learning activities, such as assignments and summative assessments provided much debate from both teachers and students. Plagiarism is the main challenge. Teachers also reported the challenge of time and work load to design, assess and peer-review such contents. This once again highlights the need for teacher and learner support in this area (See chapter 9, section 9.5).

Against this backdrop, four main foci have been identified in the present study to play equal and important roles in the success of e-learning approaches in the school. These foci are; teachers, learners, the curriculum, and the e-learning support team. The question will then be "Are we ready for e-learning transfer in the school?"

10.5 Are We Ready For E-learning Transfer?

Re-designing the dental curriculum to reflect learning outcomes is reported to be a major challenge for teachers. It mandates more emphasis and structuring around developing critical

thinking, inquiry-based, student-centred, and multi-disciplinary approaches. E-learning approaches, as shown in the current study, have much potential in supporting such curriculum reform. At the same level, the change in curriculum design is found to be crucial to the success of the e-learning strategies. Such a change needs great effort by, and much support to, the other role players; teachers, learners and e-learning support team.

Learners play a major role in the success of e-learning strategies. Their knowledge, motives and skills towards the technology is found to be important. All students participated in this study are confident in computer and Internet use (See chapter 9, section 9.2). They highly rated the need and importance of the technology in supporting their learning process. The impact of the e-course on the students' cognitive and physical performances is identified in three major areas. The presentation and interactivity features of online systems add enjoyment and give control to the students, thus, changing their learning attitudes. The exploration and virtual practice on clinical cases on the e-course help the students to be better prepared and more confident to carry out certain real life clinical tasks. The wide range of information in an open system format helps the students to develop their critical thinking skills and broaden their general knowledge, thus, changing their learning experience. Self-assessments, teachers and peers all provide feedback and assist students in controlling their learning, thus, developing their self-directed, self-evaluation and independent learning skills. The e-course is thus, considered as a knowledge management system where students explore and share knowledge and experiences with their teachers as well as their peers (See chapter 9, section 9.5).

Despite the high level of students' knowledge and motives towards the e-course, their drive to use it is found to be highly governed by their teachers' attitudes and motives (Hendricson *et al.*, 2006b). For example, the Prosthetic and Conservative departments contributed greatly

to the e-course. They are also rated highly by students for their teachers' attitudes and motives and the alignment of their e-courses with the teaching objectives. Accordingly, their e-courses are used extensively by students.

Students enjoy using the technology in supporting their learning needs. However, they are also aware of the issue that they may become overloaded with amount of information and learning activities. Misalignment of the educational goals within the school is the major reported factor for such drawback in using the technology in their learning (See chapter 9, section 9.5).

E-learning approaches do support and encourage self-directed and life-long learning skills. However, current findings indicate that, technology presence is not enough to assure the development of such skills among learners. Further support and development is needed and should be designed as part of the curriculum as well as the school's strategy.

Teachers seem to have a significant role at all levels of e-learning integration within the curriculum. Their knowledge, motives and skills towards the technology is a key factor to success (Hendricson *et al.*, 2006b). In the current study, almost all teachers participated are confident in computer and Internet use. Participants' age group did not show any specific pattern with either; their computer literacy, or their knowledge and attitudes towards the e-course. Six (out of nine) teachers are actively involved on the e-course and share in developing content and managing courses on the e-course. The other three did not contribute much and mainly use the discussion board part of the e-course. Reasons cited for such a limited contribution from the latter group included; one teacher did not have the time to contribute more effectively, the other teacher did not perceive much usefulness of the e-course in enhancing teaching methods, and the third teacher is not fully confident in developing content for the e-course (See chapter 9, section 9.2).

In general, teachers' knowledge about the technology is satisfactory. They highlighted the potential for the e-course in expanding teaching possibilities and rewarding students' needs. Their knowledge and interest in improving their teaching and learning practices and the need for curriculum change are also clearly stated, particularly emphasising the need to improve students' engagement and satisfying their learning needs. However, half of the participated teachers do not show equal interest in using the technology to achieve the desired teaching and learning outcomes. Further analysis of their attitudes explores the following major challenges. The need for evidence of learning benefits from such approaches, insufficient e-pedagogical skills, and inadequate level of perceived usefulness in the need to use e-learning approaches. Therefore, some teachers do not wish to fully shift their present teaching to e-learning strategies. This can be appreciated as e-learning is only a method of delivering teaching and learning materials. Such teachers may be successful in delivering course content by another approach. The teachers also reported lack of awareness of netiquette and copyright issues. Once again, work load, time constraints and the lack of appreciation in developing e-learning courses are found to be the hidden factors behind such concerns (See chapter 9).

Interestingly however, as the e-course being made available to all members of the school, its use by enthusiastic teachers and students is found to have an indirect influence in encouraging others to use it and overcoming some of the barriers and concerns. This point out to the important role that leader can play to enhance the teaching and learning experience in dental education.

Current analysis explored some relationships between teachers and students in their attitudes towards the technology. It also highlighted some tensions and gaps between these attitudes. These relationships and gaps can be categorised under four main areas; knowledge, skills,

motivation and environmental or work support. They can further be defined under two core pillars; pedagogical and technological pillars (Figure 10.1).

Technologically, both students and teachers have equal level of knowledge and skills in using the technology in terms of; accessing, editing, uploading and downloading contents. They are also both satisfied with the quality of the system in terms of ease of use and flexibility. However, there are differences in perceived usefulness from using the technology to enhance teaching and learning. Students perceive great usefulness in augmenting their learning with e-learning approaches. Enjoyment, engagement, and just-in-time learning with the advantage of broadening the scope of active learners are the greatest influences on learning. Teachers, on the other hand, do not perceive much usefulness from using the technology on their final professional performance. They feel that it is an additional effort which is time consuming and is expected to be done on top of what they are already assigned to do in their working day. Accordingly, their motives towards using the technology are not equivalent to the students' motives and interest.

Difference in work support is also highlighted. Students have more support in terms of time and efforts in using most parts of the e-course. However, such support will be more efficient if the e-learning strategies become aligned with the curriculum and schools' strategies. Work support for teachers, especially in terms of time and load, is the major obstacle to engaging and supporting the implementation of e-learning strategies.

Pedagogically, students and teachers have similar knowledge and skills in implementing e-learning strategies. E-learning developments mandate new e-teaching and e-learning approaches. Therefore, both users need more development in their e-pedagogical skills. Their motives also show similar responses. Students are highly motivated and reported enjoying learning from teacher-led contents. However, they do not show equal motivation and

perceived usefulness towards e-learning activities and collaborative learning that are student-centred in design (Handal *et al.*, 2010). Teachers also do not perceive much usefulness from collaborative learning, as the efforts to design and control it outweighs their potential for the busy dental teacher. Teachers also reported some concerns in providing teacher-led contents for the same general reasons cited before. Current findings strongly recommend pedagogical development and support for both teachers and students, if e-learning to be an integral component of the school strategy.

The need for support from the e-learning management team is also strongly emphasised and highlighted by the findings of the current study. They are considered the link between the teachers, learners, curriculum and the technology. Their role is important in supporting students and teachers in developing their technological as well as pedagogical skills. They also have a great role in continuously updating the e-learning system to cope with the speed of technological advancement. Their final role is to continuously feedback students, teachers, and school's policy makers with evidence-based findings on the potential and challenges in e-learning implementations in dental education.

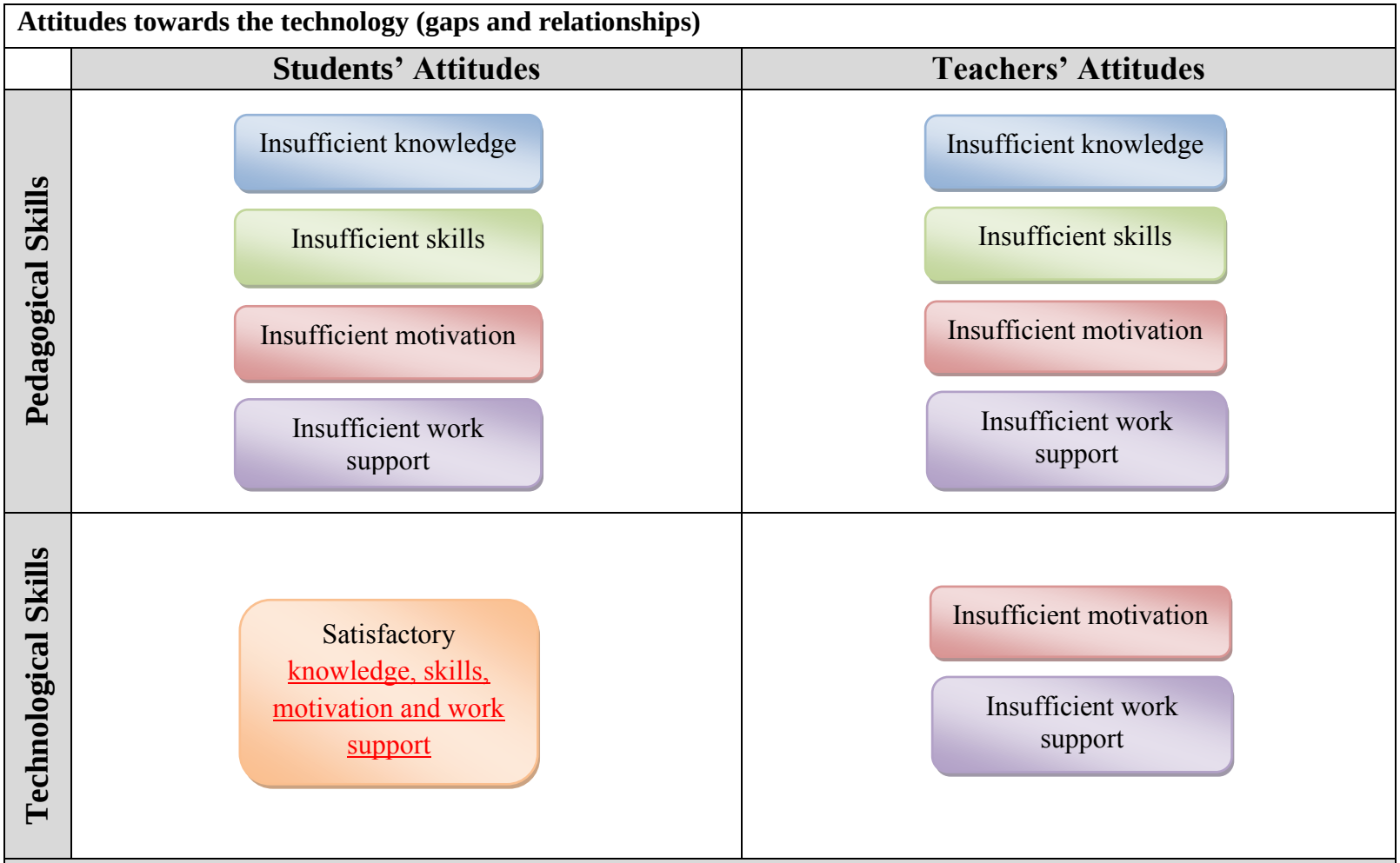

Figure 10.1 Gaps and relationships between both teacher and students in their attitudes towards the e-course.

10.6 Summary of the Findings

Findings of this study show that online learning fosters and promotes a different type of learning. It encourages self-reflection and self-evaluation. It can drive collaboration and group problem solving. E-learning can help students learn in ways they find most effective and allows a broadening of the horizon for learning. It can broaden the base of active participants in the learning process. Current findings also contend that technology integration within the curriculum design expands the teaching and learning possibilities. They also show promising solutions to some of the problems facing dental education (Figure 10.2). Thus, e-learning is able to shape and change the teaching and learning models.

Dental students and teachers are aware of such potential. However, their motives and support to curriculum change needs much institutional support. Institutions should plan and design e-learning strategies that allow successful integration within its strategies, if e-learning to be fully adopted in the school.

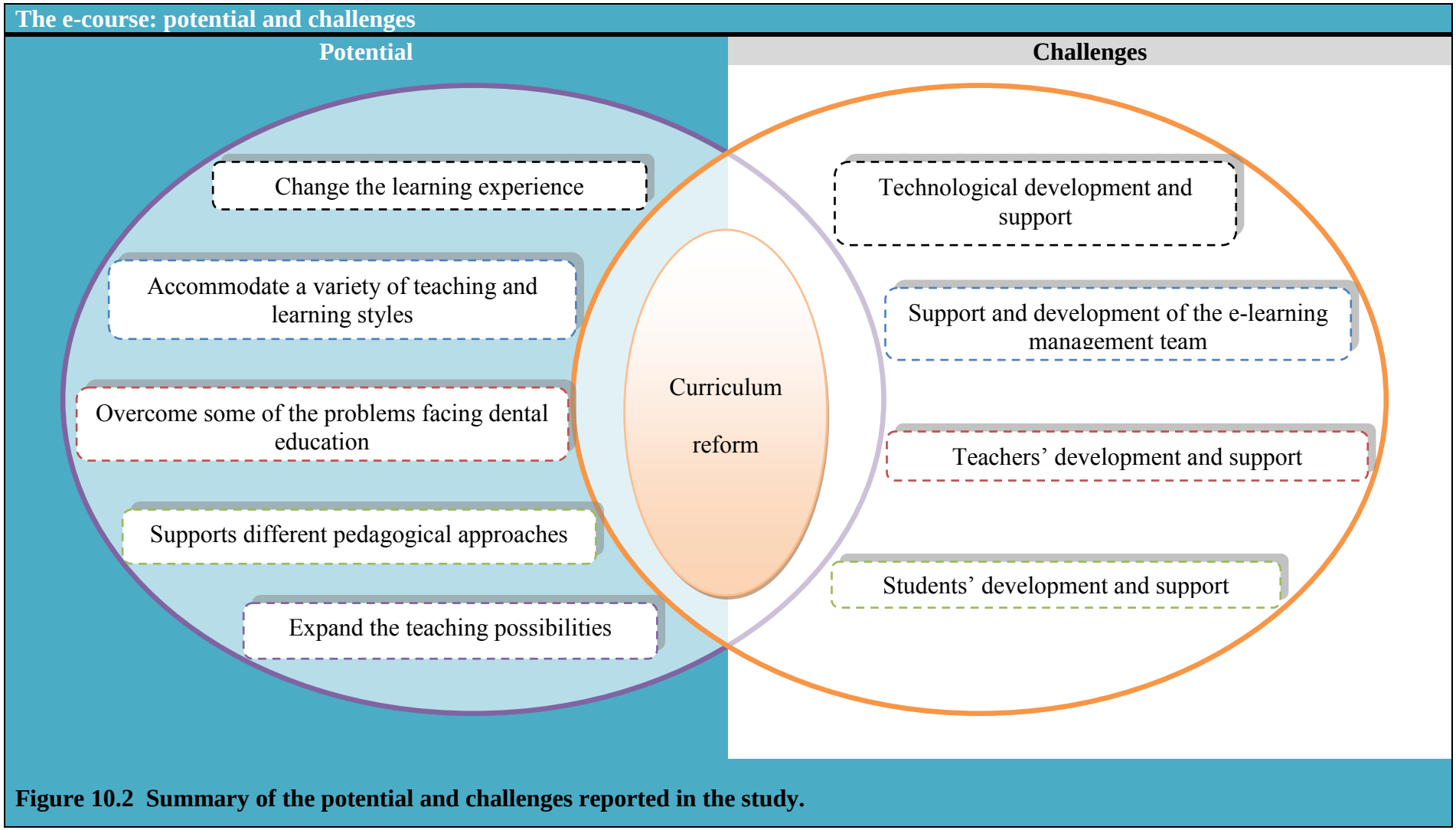

Figure 10.2 Summary of the potential and challenges reported in the study.

10.7 E-learning Frame Guide

Contemporary teaching approaches in dental education should attempt at re-directing the dynamics of learning to focus more on developing critical thinking and reflective learning skills amongst students. This in turn requires that the learning environment should be designed in a way that learning is situated within the context of the curriculum (Berge, 2002). Online learning strategies should then be merged within the main teaching strategies. This will require support for the teachers to help them in re-designing the curriculum so that these technologies are used effectively and that they themselves are able to participate and interact online. It also requires support and development for the learners to help them build the needed skills to learn effectively in such a challenging media.

Investments in professional development for teachers and students will, thus, be necessary if e-learning to be implemented in the school. Within the current study implementation of new approaches will be more successful and more sustainable if organisational behaviour change is managed effectively; i.e. from institutional policy makers level to teaching and learning levels (Casey *et al.*, 2006) in a cycle manner (Figure 10.3).

Frame guide for successful management of e-learning

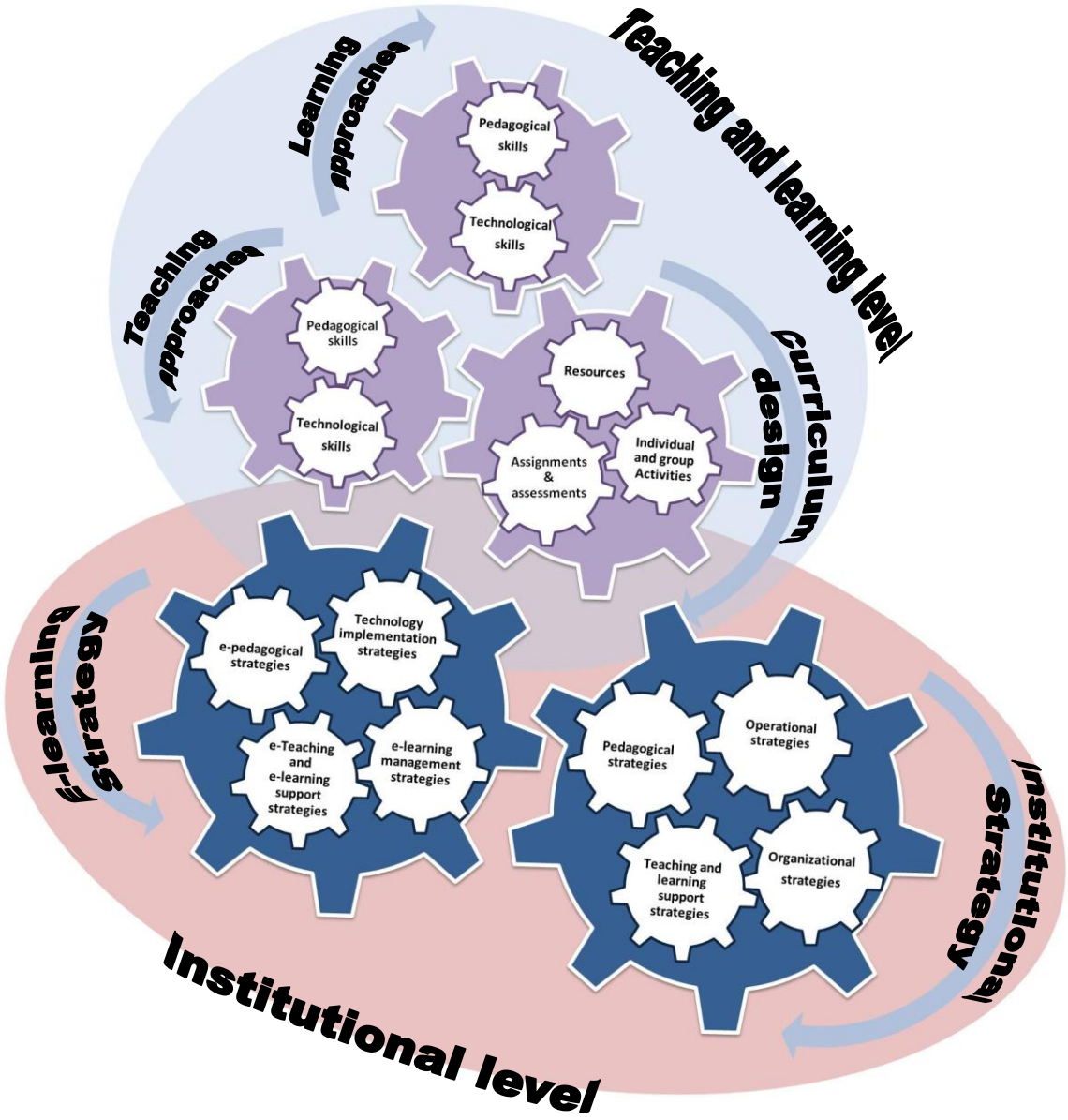

Figure 10.3 A frame guide to successful management of e-learning strategies.

Chapter 11

E-LEARNING IN DENTISTRY: BRIDGING THE GAP

11.1 Introduction

The study has found a wide range of issues from both students and teachers. Therefore we wish to place this study in context with the present literature on e-learning in dentistry. We also hope to bridge the gap of bringing e-learning into dental education so that it is used more effectively and may be used to enhance present teaching and learning practices.

11.2 E-learning in Dentistry: Current Trends and Future Direction

Dental education is under tremendous pressure to compete in the present era as discussed in chapter 3 in this study. There are external pressures on education in general such as globalisation, business market, social influences, technological impact, and economic pressure (Abbey, 2002; Andrews and Demps, 2003; Hendricson *et al.*, 2006a; Rushton and Horner, 2008). There are also some internal pressures on dental education such as shortage in academic teachers (Rushton and Horner, 2008), rapid advances in science and technology (Valachovic, 2005; Haden *et al.*, 2006; Pyle *et al.*, 2006; Swift, 2008), increased demands to prioritise research and the need for evidence-based practices (Hendricson *et al.*, 2006a). There are other pressures including changes in learning mindsets with the increased use of Internet technology, and decreased resources (Margerison and Morley, 2007). Such pressures create difficulties for dental teachers and students (Certosimo, 2010).

The last 10 years, have shown revisions and modifications in dental education which will help general dental practitioners to be prepared for the oral health needs of the twenty-first

century (Haden *et al.*, 2006). Problem-based learning, competency-based learning, community-based learning, multi-disciplinary, e-learning, and many other teaching philosophies, were proposed as approaches to successful curricular reform (Albanese, 2000; Garvey *et al.*, 2000; Abbey, 2002; Mofidi *et al.*, 2003; Rosenberg *et al.*, 2003; Eaton *et al.*, 2006; Rushton and Horner, 2008). Whilst many were successful, none of these resulted in sweeping changes to the dental curriculum (Haden *et al.*, 2010).

E-learning stimulates much debate on how effective it is and whether it can be the solution for dental education problems. The results from this study support previous studies in a variety of positive findings such as; accommodating a variety of teaching and learning styles, promoting communities of learners practices and changing the learning experience, supporting different pedagogical approaches and expanding the teaching possibilities, and others (Gluch *et al.*, 1999; Buchanan, 2001; Kneebone and ApSimon, 2001; Abbey, 2002; Quinn *et al.*, 2003; Jasinevicius *et al.*, 2004; LeBlanc *et al.*, 2004; Schittek Janda *et al.*, 2004; Welk *et al.*, 2006; Steinberg *et al.*, 2007; Zary *et al.*, 2009; Handal *et al.*, 2010). Nonetheless, the integration of e-learning into the curriculum, as reported in this study, has still not reached its maximum potential.

This research addressed the main issues that concern dental teachers and students when implementing e-learning technologies in their teaching and learning. Current results were found to follow the same pattern of findings that are highlighted in the literature. As reported in the literature, teachers suffer from time constraints, work overload and the conflict posed by research demands. Teachers remain reluctant to share their contents and are cautious about the educational benefits and potential impact on lecture or seminar attendance (Gupta *et al.*, 2004). Intellectual property right is also seen as an important issue (Spallek *et al.*, 2000; Andrews and Demps, 2003). Teachers also show limited motivation to explore new e-learning avenues. They are concerned that the students may not have the maturity in

understanding new pedagogical approaches. They are also apprehensive about changing the educational structure and shifting the balance of power from academics to students (Boulos and Wheeler, 2007; Ward *et al.*, 2009).

The reported findings from the students in this study also did not show much change to what has been reported in the dental literature. The learning benefits of using technology are as follows;

- Helps visualises concepts and difficult procedures (Mulligan and Wood, 1993; Wallen *et al.*, 1997; Aragon and Zibrowski, 2008).
- Provides interactivity and engagement with content (Plasschaert *et al.*, 1997; Ludlow and Platin, 2000; Mattheos *et al.*, 2001; Teasdale and Shaikh, 2006; Welk *et al.*, 2006; Linjawi *et al.*, 2009).
- Helps overcoming the problems of low staff-student ratio in pre-clinical and clinical settings (Gluch *et al.*, 1999; Buchanan, 2001; Kneebone and ApSimon, 2001; Abbey, 2002; Quinn *et al.*, 2003; Buchanan, 2004; Jasinevicius *et al.*, 2004; LeBlanc *et al.*, 2004; Schittek Janda *et al.*, 2004; Welk *et al.*, 2006; Steinberg *et al.*, 2007; Zary *et al.*, 2009).
- Helps overcoming the problem of minimal clinical time in some areas of the curriculum (Gluch *et al.*, 1999; Buchanan, 2001; Kneebone and ApSimon, 2001; Abbey, 2002; Quinn *et al.*, 2003; Buchanan, 2004; Jasinevicius *et al.*, 2004; LeBlanc *et al.*, 2004; Schittek Janda *et al.*, 2004; Welk *et al.*, 2006; Steinberg *et al.*, 2007; Zary *et al.*, 2009).
- Provides an approach for supportive feedback from both teachers and peers (Welk *et al.*, 2006).

Learners are always satisfied with teacher-led content, while remain reluctant to engage with the educational benefits of peer-learning. Many learners want the convenience offered by a

blended learning environment such as the mix of lectures and seminars supported by e-learning. However at the same time, the learner does not want to relinquish the social and human interaction that is supported by face-to-face classroom environments. Their enthusiasm towards using new technologies are always governed by their teachers' attitudes and motivation towards such innovations (Zemsky and Massy, 2004; Handal *et al.*, 2010).

Findings indicate that teachers and learners have sufficient knowledge and skills in using the technology and consider themselves computer literate. However, they lack significant knowledge and skills for e-pedagogical approaches and as such may not be considered e-learning literate. This merits further research.

Supporting previous findings, dental teachers need significant development and support to build the knowledge and skills required for using new pedagogical approaches that parallel changes in dental education (Dharamsi *et al.*, 2000; Bertolami, 2001; Hendricson and Cohen, 2001; Palloff and Pratt, 2002; Andrews and Demps, 2003; Kassebaum *et al.*, 2004; Hendricson *et al.*, 2007). Equally important, learners also need support and development to build the learning skills that are required to cope with e-learning pedagogies (Hendricson *et al.*, 2006b; Hillenburg *et al.*, 2006; Ward *et al.*, 2009; Handal *et al.*, 2010).

It is also found that technology does not, by itself, improve education (Leidner and Jarvenpaa, 1995; Jonassen, 2000; Piccoli *et al.*, 2001; Garrison and Anderson, 2003; Tonfoni, 2003; Kovacic, 2006). E-learning development is not just about the technology, it is also about supporting the learner's journey. Present research highlights the fact that e-learning has dual concepts; educational philosophies and technological impact. Paradigms such as "just-in-time" and "at own pace" learning, student-centred and collaborative approaches have emerged and are supported by the technological advancements. However,

their impact is governed by successful integration of pedagogical philosophies within the curriculum.

New technologies needs thoughtful introduction into a conventional curriculum. E-learning managers and schools' policy makers will face continuous challenges in designing e-learning systems. There will be a continuous tension between innovations and the ability to produce cost effective solutions (Graham, 2004). Findings of this study also revealed tensions between teachers, learners, the technology and the curriculum. This ranged from acceptance to reluctance to be involved with e-learning. Thus, the interplay between learners and teachers and the professional needs in such an environment need careful planning and management.

As we move into the future, we continue to identify successful models of e-learning at the institutional, programme, course, and activity levels that can be adapted to work in context. This will involve understanding and capitalising on the unique advantages available in both face-to-face and technology-mediated or blended learning environments (Collins and Berge, 2006).

Research in the field of educational technologies is complex and involves stakeholders from a wide range of backgrounds and interest. Thus, it is important to define the audience of interest when conducting research in this field (Oliver, 1997). It is also a strength if the research involves researchers from different backgrounds when developing a road map on the future of e-learning (Conole *et al.*, 2004; Cartelli, 2006).

E-learning developments may not be the only promising solution to dental education changes. However, technology will always impact on learning strategies (Amirault and Visser, 2009; Handal *et al.*, 2010). The 21st century learning calls for 21st century solutions. Technology at its best can make a huge difference in communication, collaboration, and

education. By eliminating the barriers of time, distance and socio-economic status, e-learning will be the great equaliser in the new century.

While it is difficult to predict what the future holds, we can be pretty certain that the trend towards e-learning will increase. Achieving a state of high learning agility (i.e. the ability to adapt to changes) at the organisational level is a formidable challenge (Clark and Gottfredson, 2008). Strong leadership is needed at all levels to bridge the gap between the dental school environment and the real world (Certosimo, 2010).

11.3 Validity and Limitations of the Study

The aim of this study was to explore the potential and challenges for e-learning in dental education. Data was collected from the e-learning system (e-course), the teachers and the students in the University of Birmingham, School of Dentistry. The e-course has been available for use by all members of the University of Birmingham, School of Dentistry, since 2002. However, the e-course is unique in its features as a virtual learning environment. The current study provided a full description of the system so that readers are able to transfer applicable knowledge and observations to other virtual environments.

The qualitative approach in this study produced a rich source of information about the attitudes to the e-course from both teachers and students. Whilst this may be relevant to the School, the use of multiple outcome measures used in the study (quantitative, qualitative, and content analysis) produce results that are applicable to other educational institutions.

SECTION SEVEN

CONCLUSION

Chapter 12

CONCLUSION and RECOMMENDATIONS

Chapter 13

FUTURE WORK

Chapter 12

CONCLUSION and RECOMMENDATIONS

12.1 Introduction

This research adds to the growing body of literature that recognises the need for new and innovative approaches to dental education, particularly in using e-learning approaches. It is designed to inform e-learning developers and stakeholders who want to gain a greater understanding about the adaptive challenges facing dental teachers and students in implementing online learning strategies. The case study was based on the "e-course", which is the e-learning platform at the University of Birmingham, School of Dentistry.

Findings from this research can be summarised under the following five key issues; technological, pedagogical, curriculum design, and teaching and learning issues.

12.1.1 Technological issues

Potential: e-learning technologies support collaborative as well as individualised learning. It also adds the advantages of anytime, anywhere, at own pace, just-in-time, and just-in-need learning; which are crucial features to learning in this information-intensive and rapidly changing environment.

Challenges: many features are found to have a great impact on using the technology. These features are; ease of use, ease of access, flexibility to meet a variety of educational needs, and user-friendly designs. Software compatibility, bandwidth speed, loading and e-mailing issues, and netiquette and copyright issues are also challenging the sustainability of the technology. E-learning design; open vs. closed, have different impact on the teaching and

learning processes and need careful planning. The structure of the e-learning management team; whether being dental clinicians or a separate e-learning team with a full technological background, raised much debate and concerns among teachers. This issue seems to have a great impact on the support that can be given to teachers in using the technology and thus, its success.

Recommendations: the structure of the e-learning support team has an important role in the succession of e-learning implementation strategies. They play a dual role between; technological design, development and maintenance, and supporting the users with the needed skills and development. Therefore, the structure of such a team needs to be well planned and supported if e-learning is to remain a major part of the schools' strategy.

12.1.2 Pedagogical issues

Potential: e-learning is a new teaching and learning environment made possible by the technology. It facilitates as well as generates a variety of educational philosophies. It enhances as well as expands the possibilities of teaching and learning. E-learning has shown great potential in supporting dental education to overcome some of the challenges. Thus, e-learning can be a suitable educational approach to support dental education in this competitive era.

Challenges: e-learning developments mandate new e-teaching and e-learning approaches. Online activities need careful planning, especially in terms of time limits, so that it does not override the working hours of teachers. Student-centred approaches also mandate new ways of teaching and learning. Students' maturity and teachers' mindsets to use such approaches is a reported challenge.

Recommendations: both students and teachers need great support and development in their e-pedagogical skills.

12.1.3 Curriculum design issues

Potential: e-learning technologies supports curriculum designs in a variety of ways. Presenting information in a variety of formats can help to accommodate a variety of learning styles. It can also support the design of learning activities, assessments and assignments. Thus, e-learning technologies can support the curriculum design to meet a variety of teaching and learning approaches.

Challenges: plagiarism and the need for continuous updating and peer-reviewing of the developed e-learning contents are major challenges facing teachers in using such approaches. Teachers are also questioning the learning benefits and trends from using e-learning approaches. Properly aligning the e-learning content with the curriculum objectives is a reported challenge and also a key to success to e-learning approaches.

Recommendations: curriculum ownership by all the relevant stakeholders within dental schools must be encouraged. Institutions should put great efforts and supports to all the relevant stakeholders to reform the dental curriculum to reflect the needed learning outcomes.

12.1.4 Teaching issues

Potential: teachers perceived much value in using e-learning approaches to expand the possibilities of teaching as well satisfying students' learning needs.

Challenges: teachers reported many challenges and concerns in using e-learning approaches that outweighs their potential. Time and work load constraints, the need for evidence of learning benefits from such approaches, insufficient e-pedagogical skills, and inadequate level of perceived usefulness in the need to use e-learning approaches have always been seen as the main barriers to teachers fully utilising the technology in the teaching and learning process.

Recommendations: teacher and staff development strategies should be implemented in the dental schools to help teachers build the required skills for curriculum reforms. Teaching as a form of scholarship should also be given the same weight and significance as research and patient care in academic institutions.

12.1.5 Learning issues

Potential: e-learning technologies support critical thinking, collaborative, reflective, self-directed, and life-long learning behaviours. It also adds enjoyment and interactivity and change the learning experience of the learners. E-learning approaches can also help the learners be more confident and better prepared to carry out real life tasks. It also has the advantage of broadening the scope of active learners and accommodating a variety of learning styles.

Challenges: teachers' behaviour online and teachers' motives and attitude towards using the technology are the driving force for learners to use the technology. Learners also lack sufficient e-pedagogical skills for learning in a student-centred environment, which requires learners to take control over their learning. This shift in responsibility can overload students if the teaching and learning approaches are not aligned and properly integrated within the curriculum objectives.

Recommendations: student support and development programmes should be implemented in the dental schools to help students build the required skills for new learning approaches.

12.2 Conclusion

Dental education is facing the challenge between technological advancement and educational innovations. E-learning has shown great potential in bridging the gap between these two polar ends. However, the students' and teachers' responses, as reported in this study, suggest that dental schools are experiencing implementation difficulties similar to those encountered with other approaches such as; problem-based learning. Much tension between students' need and teachers' work overload and support in using the technology are recognised. Gaps between demands of curriculum and institutional support for change are also recognised.

Employing a strategy that can help transform the educational process in dental schools is a complex process. Based on findings of this study, institutional ability to change is a product of six factors and their interrelationships; environmental needs, learners' mindset, leadership and teachers' behaviour and mindset, learning technology efficiency and design, e-learning developers and managers, and institutional support. Each factor is a vital force, yet each can prove an intractable barrier to adaptive change and should be considered equally. Despite this complexity, the way forwards calls for strong leaderships and evidence-based innovative models for e-learning approaches to bridge the gap between the dental school environment and the real world.

Chapter 13

FUTURE WORK

This study highlighted the impact of e-learning on the dental educational processes in several areas. These may provide avenues for further work and investigation.

- E-learning environment design may be investigated further
    - To investigate how different designs are perceived by dental students. Such as the use of interaction with other schools or institutions.
    - To assess the amount of technological and pedagogical support needed for elearning for both students and teachers to be able to use such designs efficiently. Do students and teachers need to be IT experts to work in e-learning?
    - To determine the impact that e-learning environments have on the institution.

- E-learning has the potential to support both teacher-led as well as student-led content productions.
    - Further work is needed to investigate the attitudes and understanding of dental students and teachers to supplying content to e-learning environments.
    - To determine whether the increased use of multi-media content (videos and podcasts) provides new pedagogical opportunities.

- E-learning has shown to promote, as well as create, new educational philosophies such as; social networking, community of inquiry, community of practice, communities of learners and contents, and adaptive individualized learning approaches.

- Further work is needed to explore the attitudes and understanding of dental teachers and students when embracing such philosophies.
- To assess how effective e-learning can support the dental curriculum.
- Further work is also needed to explore the potential, challenges and concerns that dental student and teachers may have when using the technology to support e-learning within a dental educational environment.

- E-learning is able to support different pedagogical approaches such as; student-centred, self-directed, inquiry-based, multi-disciplinary, collaborative, and reflective learning approaches.
  - Further work is needed to explore the readiness and understanding of dental teachers and students to engage with the different pedagogical approaches.
  - To investigate which are best practices when implementing e-learning into the dental curriculum?

- Further work is necessary to determine the long term sustainability of e-learning and how it can adapt to the technological and educational changes in future years.

- Further work on the barriers and solutions to face e-learning in dental education are needed so that it is used effectively. This may involve creating partnerships where material is shared between institutions at both a national and international level.

SECTION EIGHT

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SECTION NINE

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APPENDIX I

A PRELIMINARY ASSESSMENT OF AN UNDERGRADUATE ORTHODONTIC e-COURSE

Introduction

The aim of this questionnaire is to qualitatively assess an orthodontic e-course that is being developed for undergraduate dental students.

Please browse through all aspects of the module entitled 'Skeletal Factors' (module 2) and then answer the questions below by placing a tick in the appropriate box.

The information you provide will be a valuable tool for the further development of the e-course.

- -

Demographic information

Age:

Gender: ○ Male ○ Female

Year of study:

Course design						
The aim of this part is to test the overall design of the programme.						
		1	**2**	**3**	**4**	**5**
		Very easy	Easy	Undecided	Difficult	Very difficult
1	Was the programme easy to use?	○	○	○	○	○
2	Was it easy to access course materials related to module 2?	○	○	○	○	○
3	Did you find the information easy to understand?	○	○	○	○	○
4	Was it easy to search for information?	○	○	○	○	○
		Very clear	Clear	Undecided	Unclear	Very unclear
5	Were the contents laid out in a clear fashion?	○	○	○	○	○
6	Was navigation through screens clear?	○	○	○	○	○
		Very motivating	Motivating	Undecided	Unmotivating	Very unmotivating
7	Did the module motivate you to acquire further knowledge?	○	○	○	○	○
		Very related	Related	Undecided	Unrelated	Very unrelated
8	Did the module motivate you to acquire further knowledge?	○	○	○	○	○
		Very invovled	Involved	Undecided	Uninvolved	Very involved
9	Did you feel that you were actively involved in the learning process?	○	○	○	○	○
		Very helpful	Helpful	Undecided	Unhelpful	Very unhelpful
10	Was the programme helpful in testing your knowledge?	○	○	○	○	○
11	Did you find the feedback on your test helpful?	○	○	○	○	○
12	Do you have any other comments?					

Course delivery						
This part is for testing the effeciency of the different methods used for delivering information.						
		1	**2**	**3**	**4**	**5**
		Very helpful	Helpful	Undecided	Unhelpful	Very unhelpful
13	Was the photo gallery helpful?	○	○	○	○	○
14	Was the glossary helpful?	○	○	○	○	○
		Very clear	Clear	Undecided	Unclear	Very unclear
15	Was the glossary clear?	○	○	○	○	○
16	Were the images clear?	○	○	○	○	○
		Very informative	Informative	Undecided	Uninformative	Very uninformative
17	Were the images informative?	○	○	○	○	○
		Very relevant	Relevant	Undecided	Unrelevant	Very unrelelvant
18	Were the animated images relevant to the content?	○	○	○	○	○
19	Do you have any other comments?					

Course outcome						
This part is for testing the effectiveness of this course as a learning tool.						
In genreal, did you find this course:						
		1	**2**	**3**	**4**	**5**
		Very informative	Informative	Undecided	Uninformative	Very uninformative
20	Informative	○	○	○	○	○
		Very well	Well	Undecided	Poor	Very poor
21	Well presented	○	○	○	○	○
		Very easy	Easy	Undecided	Difficult	Very difficult
22	Easy to learn	○	○	○	○	○
		Very enjoyable	Enjoyable	Undecided	Boring	Very boring
23	Enjoyable	○	○	○	○	○
		A lot more	More	Undecided	Less	A lot less
24	More interesting than reading books	○	○	○	○	○
		Very significant	**Significant**	**Undecided**	**Unsignificant**	**Very unsignificant**
25	Could potentially be a significant learning resource	○	○	○	○	○
		Very helpful	Helpful	Undecided	Unhelpful	Very unhelpful
26	Helped you to understand some orthodontic principles	○	○	○	○	○
27	Do you have any other comments?					

Others	
28	In your opinion, this material is best suited as:
	○ an optional supplement to traditional lectures (revision, make up for absences, etc.)
	○ an integrated component of the undergraduate orthodontic course
	○ useful to replace some of the traditional lectures
	○ other (explain)
29	What do you consider to be the best things about the programme?
30	Do you have any suggestions for improving the on-line course. (Please leave comments below)
31	Do you have any other comments?
	Thank you

APPENDIX II

DETAILED RUBRIC FOR ANALYSING DISCUSSION BOARDS

Detailed rubric for the variables used to analyse the prosthetic discussion board.		
Variables	***Rating***	***Criteria***
Author (Kay, 2006)	**1** Teacher **2** Student	The authority of the person posting the message
Authors' level (designed for this study)	**1** Teacher **2** 1st year undergraduate dental student (BDS1) **3** 2nd year undergraduate dental student (BDS2) **4** 3rd year undergraduate dental student (BDS3) **5** 4th year undergraduate dental student (BDS4) **6** 5th year undergraduate dental student (BDS5)	The level of the person posting the message
No. of words (Kay, 2006)	Number	Total number of words in a massage (by word count)
Academic period (designed for this study)	**1** 1st period	For messages posted from January to March in the year 2008
	2 2nd period	For messages posted from April to July in the year 2008
	3 3rd period	For messages posted from September to December in the year 2008
	4 Holiday	For messages posted in August 2008
Posting time (learning location) (designed for this study)	**1** Weekend / holidays	If message was posted in the weekend or holiday time
	2 Weekdays	If message was posted during the week

Variables	*Rating*	*Criteria*
Threads' level (designed for this study)	**1** Threads < 4 messages	Threads containing less than four posted messages
	2 Threads => 4 messages	Threads containing four or more posted messages
Messages' level (designed for this study)	**1** Start-message	Designed for the first message posted in a thread
	2 In-between messages	Designed for all messages posted in a thread excluding its first and last message
	3 End-message	Designed for the last message posted in a thread
Primary purpose (Kay, 2006)	**1** Open question	Open question or information directed to all students and teachers (no names are included)
	2 Specific question	Specific question or information directed to a specific student or teacher
	3 Reply only	Reply to a question, including "Yes" and "That's right"
	4 Reply followed by an action	Reply to a question, including; "Yes" and "That's right", followed by another action (question, propose readings, asking for further clarification or checking with the supervisor)
	5 Independent comment	Independent comment, question or answer including; "Thank you", "asking for clarification or requesting for handouts, lectures, articles"….etc.
	6 Non-academic	A comment, question or answer to a non-academic condition. This includes administrative issues, clinical arrangements, dates and marking issues, and technical support issues

Variables	*Rating*	*Criteria*
External resources (Kay, 2006)	**1** None/unknown	No clear resources or evidence are noted
	2 Teacher / course information	Reference is made to a teacher or course information in a message
	3 Another message	Reference is made to information in another posted message
	4 Web	Reference is made to a website
	5 Book	Reference is made to a book
	6 Article	Reference is made to an article
	7 e-course	Reference is made to the e-course or a page in the e-course
	8 Past exams	Reference is made to past exam papers
	9 More than one resource	More than one resource is mentioned in a message
	10 Coursework	Reference is made to an essay, coursework or homework
Message clarity (Kay, 2006)	**1** Unclear	Message is unclear or confusing – it is typically followed by a message asking for clarification
	2 Somewhat clear	Message is somewhat clear, but there are still confusing or vague points that need clarification
	3 Clear	The message is clear and appears to be understood by the participants in the discussion thread
Content type (Kay, 2006)	**1** Social comment	No knowledge is provided (e.g social comment – "thank you" – asking for clarification - requesting articles, handouts or lectures)
	2 Course unrelated	Knowledge is provided that is unrelated to the course (e.g technical support)
	3 Administrative	Administrative knowledge (e.g due dates, the requirements for final project, or clinical arrangement)
	4 Course related	Knowledge is provided that supports the course curriculum, including "Yes" and "That's right"

Variables	*Rating*	*Criteria*
Response time (Kay, 2006)	In days	Difference between the date a message is posted and the date the following message is posted
	0 Same day response	A message is followed by another message in a thread on the same day
	-1 End	The last message in a thread
	-2 No reply	A message which is not followed by another message or reply (e.g one message in a thread)
Resolution of discussion thread (Kay, 2006)	**1** Unresolved	Information was not given to solve the question(s) raised in the thread
	2 Partially resolved	Information is offered that partially answers the question (s) being asked in the thread
	3 Resolved	Complete and correct information is provided to resolve the questions being asked in the thread
Student interaction level (Wozniak and Silveira, 2004)	**1** Independent thinking	Students present their own thoughts in the posted message. Including "Thank you"
	2 Interactive thinking	Students reflect on other's thoughts and answer others questions or propose an action to others (e.g open questions and seeking advice from anyone)
	3 N/A	For staff messages

Variables	*Rating*	*Criteria*
Knowledge type (Kay, 2006)	**1** Non-academic	For non-academic / technical support /clinical arrangements/ administrative issues / request of handouts, articles and lectures
	2 Fact	Student offers an isolated fact
	3 Concept	Student presents two or more connected facts (e.g connecting facts with conjunctive adverbs like because, consequently, etc.)
	4 Procedure	Student provides information on how to achieve a specific task
	5 Meta-cognitive	Students is reflecting about a strategy to solve a problem task or emotional state while learning
	6 N/A	For staff messages
Processing level (Kay, 2006)	**1** Clarification	Student is asking what a question or comment means—often referring to a specific element or fact in a problem. Including "Thank you", technical support, clinical arrangements, administrative issues, and requesting articles, handouts and lectures
	2 Remember	Evidence that student is recalling or trying to recall a fact, concept or procedure
	3 Understand	The student understands or is trying to understand a concept or a procedure
	4 Apply	A student is applying or trying knowledge which typically involves the use of a procedure
	5 Analyse	A student is actively making connections between two or more concepts
	6 Evaluate	Student provides comments about effectiveness of a procedure or approach to solving a problem
	7 N/A	For staff messages

APPENDIX III

INTERVIEWS TOPIC GUIDE

Technological Evaluation

- ***System quality***

  - What kind of technical problems are you facing when using the e-course?
  - How do these problems affect its usage?

- ***Service quality***

  - What kind of support do you get from the e-course team?
  - Are you satisfied with the service provided?
  - What kind of extra-support do you wish to have on the e-course?

- ***Information quality***

  - Is the information on the e-course clear, understandable, meets your needs and presented in a useful format (as texts, videos, animations and audio)?

- ***Work compatibility***

  - Do you feel that the e-course is compatible with the way you like to teach / learn?

- ***Utilisation***

  - How often do you use the e-course and for what purposes?

- ***Performance impact***

  - Is the e-course an important and valuable aid in your teaching / learning process?

  - How does the e-course impact on your professional performance?

Pedagogical Evaluation

- Is on-line learning in alignment with the pedagogical strategies in the school?

- What are the potential and challenges in using the e-course in teaching and learning in the school?

Curriculum Design Evaluation

- How does the e-course impact on teachers / learners in achieving the desired learning outcomes within the curriculum?

- How does the e-course fit with or support the different components of the curriculum?

Recommendations

- Would you recommend the e-course to your colleagues?

- Do you have any concerns from using the e-course?

- Do have any other suggestions?

APPENDIX IV

THE INSTRUCTIONAL DESIGN OF THE e-COURSE

Information delivery format	*Passive Information Delivery Methods*										*Active Contents*				*Self-assessment +/- Feedback*			*Inter-active tools*			*General Pages*								
Subject	**PowerPoint lectures**	**Lecture notes**	**Videos**	**Podcasts**	**Glossary**	**Multiple format**	**CAL Resources**	**Recommended reading**	**On-line instructions**	**Case Study**	**Animations**	**Mind map**	**Mag-scope**	**Games**	**Without feedback**	**With feedback**	**With feedback + other format**	**Wikis**	**Blogs**	**Discussion board**	**Welcome**	**Course outcome**	**lecture list**	**Timetables**	**FAQ**	**Contacts**	**IT support**	**Others**	**Total**
GENERAL																				**Assessed separately**									
Home						1													1		1	1					7	6	17
Wiki-ecourse																		1									20	1	22
Editing Help									1																			1	2
Treatment Diaries										3												1							4
Non-BDS																													
Advanced Biomaterial	13	1				17		1	37	1											1	72	19	1		1		1	165
GDP Masters	1																				1	1							3
Postgraduate Courses																						1							1
Staff Updates		8				1			1																				10

Information delivery format	*Passive Information Delivery Methods*										*Active Contents*				*Self-assessment +/- Feedback*			*Inter-active Tools*			*General Pages*								
Subject	**PowerPoint lectures**	**Lecture notes**	**Videos**	**Podcasts**	**Glossary**	**Multiple format**	**CAL Resources**	**Recommended reading**	**On-line instructions**	**Case Study**	**Animations**	**Mind map**	**Mag-scope**	**Games**	**Without feedback**	**With feedback**	**With feedback + other format**	**Wikis**	**Blogs**	**Discussion board**	**Welcome**	**Course outcome**	**lecture list**	**Timetables**	**FAQ**	**Contacts**	**IT support**	**Others**	**Total**
BDS Pre-clinical																				Assessed separately									
Biomedical Science	3					2									1							2							8
Cardiovascular Respiratory Module	2					2										2					1								7
Craniofacial Biology	23					1																	1						25
Dental public health	45	4		1		5		1	19												1	11	9			1		2	99
Digestive Renal Endocrine	15	6				1										5	13					6							46
Ethics	2	46				1		8		4												13	1						75
Introduction to Clinical Dentistry	1					1															1								3
ICT	1	14				1										1					1	2	5						25
Learning Dentistry																					1								1
Neuro-Musculo- Skeletal	1					1										3						1	1						7
Oral Biology	27	5				1		1	3		3		5			1	33				1	7					1	1	89
Para-clinical Skills																					1								1
Practical Dental Skills																					1								1

Information delivery format	*Passive Information Delivery Methods*										*Active Contents*				*Self-assessment +/- Feedback*			*Inter-active Tools*			*General Pages*								
Subjects	**PowerPoint lectures**	**Lecture notes**	**Videos**	**Podcasts**	**Glossary**	**Multiple format**	**CAL Resources Recommended reading**	**On-line instructions**	**Case Study**	**Animations**	**Mind map**	**Mag-scope**	**Games**	**Without feedback**	**With feedback**	**With feedback + other format**	**Wikis**	**Blogs**	**Discussion board**	**Welcome**	**Course outcome**	**lecture list**	**Timetables**	**FAQ**	**Contacts**	**IT support**	**Others**	**Total**
BDS Clinical																			Assessed separately									
BASHD	61	4				13								1						1	2	1			1		1	85
Clinical Governance		38				1									2						2							43
Clinical Practice	7	1	1	7		2																						18
Conservative Dentistry	28	56				7		1			2				12	5	40				12	4			1		1	169
Cons Lab Course	2	24	8					1	18								1			1	16		3					74
Dental Biomaterial	5	6			14	2				1			1	1						1	5	2		1	1		24	64
Dental Pathology & Immunology	2					1						3	3		1					1								11
Dental public health																												0
Electives	1	1				1		1													4		1	1				10
Endodontics	2	39	18	4		4		2			10				3	22	8	1			13	1			1		1	129
Forensic Dentistry		2				1											4			1	1							9
Occlusion		11				1										1	3											16
Oral Medicine	2							1									6	3		1								13

Information delivery format	*Passive Information Delivery Methods*										*Active Contents*				*Self-assessment +/- Feedback*			*Inter-active Tools*			*General Pages*								
Subject	**PowerPoint lectures**	**Lecture notes**	**Videos**	**Podcasts**	**Glossary**	**Multiple format**	**CAL Resources**	**Recommended reading**	**On-line instructions**	**Case Study**	**Animations**	**Mind map**	**Mag-scope**	**Games**	**Without feedback**	**With feedback**	**With feedback + other format**	**Wikis**	**Blogs**	**Discussion board**	**Welcome**	**Course outcome**	**lecture list**	**Timetables**	**FAQ**	**Contacts**	**IT support**	**Others**	**Total**
BDS Clinical (continue)																				**Assessed separately**									
Oral Pathology						2						6	9			1						1						1	20
Oral Surgery	25	9				3		2							1	16	28					5	4			1		1	95
Orthodontics	4	15		2	1	2		1									21				1	2	1						50
Paediatric Dentistry	21	3				2				15						5	67	42				1	1			1			158
PDS Outreach									8												1	4							13
Periodontology	6	1		1		10		1							3		46				1		1			1		2	73
Prosthetics	1	48	29	15		5		2	1	12						8	73	41			2	17	1			1		9	265
Radiography / Radiology		3														1	30				2								36
Sedation						1																						4	5

Information delivery format	*Passive Information Delivery Methods*										*Active Contents*				*Self-assessment +/- Feedback*			*Inter-active Tools*			*General Pages*								
Subject	**PowerPoint lectures**	**Lecture notes**	**Videos**	**Podcasts**	**Glossary**	**Multiple format**	**CAL Resources**	**Recommended reading**	**On-line instructions**	**Case Study**	**Animations**	**Mind map**	**Mag-scope**	**Games**	**Without feedback**	**With feedback**	**With feedback + other format**	**Wikis**	**Blogs**	**Discussion board**	**Welcome**	**Course outcome**	**lecture list**	**Timetables**	**FAQ**	**Contacts**	**IT support**	**Others**	**Total**
Self Study																				**Assessed separately**									
Virtual Patients													1															3	4
Online Vivas		1								2						3	6					4							16
Exam Papers						1																1							2
OSCE			4			1																							5
Education									1																				1
Sandbox																										1			1
Extras																													
The Business of Dentistry		5				1																							6
Dental Physics		8																			1								9
EBD: Dental Recalls		26															3					2							31
Games														2															2
School History	2	1																											3
General Pages		3		1												1					6		3			9			23
CAL for download							15																						15
Total pages / instructional format	**303**	**389**	**60**	**31**	**15**	**96**	**15**	**23**	**89**	**38**	**15**	**9**	**19**	**3**	**22**	**77**	**382**	**88**	**1**		**31**	**210**	**55**	**5**	**2**	**10**	**38**	**59**	**2085**

APPENDIX V

PUBLISHED PAPERS

Students' attitudes towards an on-line orthodontic learning resource

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Online Discussion Boards in Dental Education: Potential and Challenges

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Online Discussion Boards in Dental Education: Potential and Challenges

Abstract

Background: It is claimed that online discussion boards enhance critical analysis and reflection, and promote the social construction of knowledge.

Aims: To assess the effectiveness of online discussion board as a pedagogical tool in augmenting face-to-face teaching in dental education.

Method: Data were collected from a discussion archive offered through the E-course website of the School of Dentistry, University of Birmingham, UK in 2008. A multi-component metric was created and included; participation, social learning, cognitive processing, role of instructors, and quality of discussion. Messages were coded for 14 variables to evaluate these dimensions. Data were analyzed using content analysis method and a complete message as the unit of analysis.

Results: There were no significant difference in participation between students and instructors ($p<0.05$). Social interaction with peers appeared only through students posting messages with open questions (27/135 messages). Discussion board was mainly used by students to understand concepts (27/102 messages) and apply procedural knowledge (17/102 messages). Instructors were mainly replying to students' messages with (49/120 messages) or without (54/120 messages) proposing another action.

Conclusions: Online discussion boards were found to be successful pedagogical tools in dental education. Further development of instructor-led discussion approach is needed to insure higher level and collaborative thinking.

Introduction and Aim

General Dental Practitioners are facing many professional challenges to meet the oral health needs of the public throughout the twenty-first century (1). In response, the American Dental Education Association's Commission on Change and Innovation in Dental Education (ADEA CCI) proposed changes that should be made to the dental educational strategies, based on best practices in the literature. The teaching of critical thinking skills is considered to be an important educational principle that helps dental students in developing life-long learning (2).

The incorporation of online elements in education has been reported to bring many added benefits to traditional face-to-face teaching (3). Researchers have recommended the use of online discussion boards for its pedagogical strength. It supports online virtual communities, which engage groups of students allowing them to collaborate and learn from each other in a social learning network. Such innovations remove time constraints, and are claimed to enhance in-depth critical analysis and reflection (4).Despite their potential, developing critical thinking skills in these virtual text-based environments remains a major challenge for educators. It requires the construction of an inquiry-based environment that encourages students to challenge assumptions as well as reflect on their own experiences (5).

The potential of online discussion boards to support learning in the health professional fields has been recognised as a successful educational strategy. The main successes have been in reported in supporting collaborative learning in distance education (9). However, evaluation of such technology and learning methods in a blended approach in dental education is sparse and requires more research.

Several elements and tools have been proposed in the literature for evaluating the design and components of online discussion boards. Garrison *et al.*, in their Community of Inquiry

Framework, identified three prerequisites for the successful performance of such communities. These elements are social, cognitive and teacher presence (6). Kay (7) identified a further 12 dimensions which were considered to be important when designing online communities and developed a comprehensive multi-component metrics. These dimensions are; social learning, cognitive processing, quality of discussion, initial question, role of educator, navigation issues, challenges for students, types of users, attitudes towards discussion, response time, learning outside of school, and learning performance.

Different methodologies were also used to assess and translate the structure and successful functioning of online discussion boards. Content analysis was found to be a potentially rewarding methodology as it can provide important insights into why a session on the discussion forum is successful. However, the process of analysing discussions on such boards can prove to be a time consuming (8).

The purpose of this study was to explore the dynamics of using online discussion boards and investigate methods of maximising its success in dental education.

Material and Method

Sample

The E-course website of the School of Dentistry, University of Birmingham, UK was developed using the software Bespoke (Bespoke Microsoft Interdev 6. Microsoft Certified Partner, UK). Examples may be found online at www.dentistry.bham.ac.uk/ecourse. Its main objective was to augment and support the traditional teaching in the school. Discussion boards were incorporated as part of the e-course website and were accessible for all members of the school. Each year the discussion boards are archived for future reference. The records for the Prosthetics course for the year 2008 were taken as the sample for this study.

Procedure

Participation in the online discussion board on Prosthetics is voluntary. It is used by both undergraduate dental students and teachers and does not attract any grading. Three teachers moderated the board and all are confident in IT skills and had been operating the educational and dental components of the forum for three years. The online discussion board provided group interaction where students can share ideas and experiences, with the view to promote high-level, in-depth interaction among students. It also facilitated the communication and feedback processes between the students and their teachers. Students were advised to title their messages with their year of study. Posting names was left to the students' preferences. Thus, messages from students were grouped according to their year of study. Due to the anonymous nature of posting messages it was not possible to measure the proportion of the full student cohort who used the discussion board.

Following the assessment metric tool (7) and the Community of Inquiry framework (6), a multi-component metric, comprising of 5 dimensions, was created for this study. These dimensions were; participation, quality of discussion, social learning, cognitive learning, and teacher presence.

The overall participation in the online discussion board on Prosthetics in 2008 was assessed using the following six variables;

1) Total number of threads and messages,
2) Number of posted threads and messages per term,
3) Mean length of discussion threads,
4) Mean number of words per message,
5) Types of users
6) Posting time (learning location).

The actual quality of discussion in individual threads was measured as follows; message clarity, content type, author of initial question, external resources used, response time and resolution of discussion threads.

The aim of the social learning dimension was to assess the interaction with peers (student–to-student interaction and reflection). The criteria for this dimension included messages from students in threads which included four or more messages. Two variables were used to assess social learning in these threads; primary purpose of posted messages and interaction level.

Cognitive learning was assessed as a measure of the level of interaction with the content. The criteria for this dimension included messages from students with course-related information only. Three variables were used to assess this dimension; knowledge type, processing level and the primary purpose of posted messages.

Teacher presence was assessed as a measure of the role of teachers in promoting higher level discussion. The primary purpose of messages posted by teachers was used as a key variable to assess their presence. The latter was compared between two types of threads; a) threads with four or more messages and b) threads with less than four messages.

In order to make the coding scheme as transparent as possible, a detailed rubric for the key variables used in this study, is provided in Table 1.

Data collection and analysis

The messages posted on the Prosthetic's discussion archive in 2008 were coded for the various variables using content analysis method. The content analysis technique can be defined as "a research methodology that builds on procedures to make valid inferences from text" (6). A complete message was used as the unit of analysis in this study.

Intra-examiner reliability was then measured for the variables coded using Kappa statistics. These variables are; message clarity, content type, external resources used, resolution of discussion threads, primary purpose of posted messages, students' interaction level, knowledge type and processing level. Data were then analysed using SPSS for descriptive and inferential statistics with significant levels set at $p<0.05$.

Results

Intra-examiner reliability test:

After repeated measures, the final Kappa statistical value ranged from (0.9 to 1) for the coded variables, thus, indicating high agreement levels.

Participation

Both teachers and undergraduate dental students posted a total of 108 threads consisting of 330 messages with no significant participation difference ($p<0.05$). However, when the latter group was further analysed, Kruskal-Wallis test (Asymptotic significant value=0.000) revealed that there is a significant difference ($p<0.05$) between the number of posted messages by students from different years of the undergraduate course. The majority of messages (n=146/176) were posted by 4th year undergraduate dental students in a five year undergraduate program (Figure 1). The discussion board on Prosthetics was used both during weekdays (190/330 messages, 58%) and weekends or holidays (140/330 messages, 42%). A majority of messages 255/330 messages, 77%; 79/108 threads, 73%) were posted during the period September to December of the academic year 2008. The mean length of a discussion thread consisted of 3 messages (SD=2.3, range: 1 to 15 messages). The mean number of words per message was 54 words (SD=56.9, range: 1 to 464 words).

Quality of discussion

Posted messages were mostly clear (315/330 messages, 96%), with course-related information (261/330 messages, 79%). All threads (100%) were student initiated and discussion issues were

mostly completely resolved (84/108 threads, 78%). A mojority of messages (n=266/330, 81%) had no reference to any external resources (Figure 2).

The mean response time was calculated after eliminating three types of messages; the end-message, messages with no reply, and messages with outliers in response time (e.g. response time greater than 20 days, n=2 messages). The mean response time was then found to be 1 day (SD=2.4, range 0 to19 days).

The discussion board in the period September to December of the year 2008 was characterised by having the greatest number of threads and messages compared to all other terms of the year. The Prosthetic discussion archive for that period was, thus, chosen for further analysis to study the effectiveness of discussion boards on the learning process. Three dimensions were then assessed; social learning, cognitive learning, and teacher presence. A majority of messages were posted by 4th year undergraduate students (Figure 1). Thus, the data were analysed at two general authors' level only; teachers and students and the results are presented in the following sections.

Social learning

The number of threads containing four or more messages was (23/79 threads, 29%), and the number of messages posted by students in those threads was (71/135 messages, 53%). Almost half (41/71 messages, 58%) of those messages showed interactive thinking with peers. A majority of this interaction was in the form of open questions (27/41, 66% messages), for example:

"Hi, could somebody tell me what impression material would you use for the primary impression for edentulous mouth with undercuts preset? Thanks".

Other types of interaction were in the form of reply to other student (3/41 messages, 7%), reply to other student followed by an action (7/41 messages, 17%), sharing independent comments

(2/41 messages, 5%), and discussing non-academic issues with peers (2/41 messages, 5%) as shown in Table 2.

Cognitive learning

A majority of students' messages (102/135 messages, 76%) presented course-related information. Pearson Chi-Square test (Asymptotic significant value=0.000) revealed that there is a significant association ($p<0.05$) between the knowledge type and the processing level of the content in these messages. Students were mainly trying to understand concepts (27/102 messages, 27%), followed by applying procedures (17/102 messages, 17%), remembering facts (11/102 messages, 11%), evaluating meta-cognitive knowledge (9/102 messages, 9%), and analysing procedural and meta-cognitive knowledge (7/102 messages, 7%) (Table 3).

Data were further analysed according to the primary purpose of posted messages. Pearson Chi-Square test revealed that the significant association ($p<0.05$) between knowledge type and processing level varied depending on the primary purpose of posted messages. When students were posting open questions (64/102 messages, 63%) they were mainly trying to understand concepts (22/64 messages, 34%), for example;

"Are partial and complete dentures made in RCP? Thanks".

To a lesser extent, students were trying to apply (11/64 messages, 17%) and analyse procedures (6/64 messages, 9%), for example:

"Hi, Am I right in thinking that the female component of the dolder bar ..... is flared. Hence it does not fit flush onto the male component of the bar..... Thus when axial forces are transmitted on to the arch, ... there is some degree of rotation. This then dissipates the forces without dangerous overloading of the abutment teeth?

When students were posting questions directed towards a specific teacher (16/102 messages, 16%), they were trying to understand concepts (5/16 messages, 31%) and to a lesser extent applying procedures (4/16 messages, 25%). In contrary, when students were posting a reply messages (13/102 messages, 13%), they were basically trying to remember facts (6/13 messages, 46%). However, when they were posting messages with reply followed by an action (9/102 messages, 9%), such as asking another question or referring to an external resource, they were mainly evaluating meta-cognitive knowledge (3/9 messages, 33%). For example:

"In response to (thread #3108) you explained that Buccal upper and lingual lower cusps relate to supporting cusps, maintaining OVD? This confused me because I thought that Upper palatal cusps and Lower buccal cusps are described as the supporting cusps, ...and that once initial adjustment to these cusps had occured to correct initial ICP interference that they should be left else loss of OVD occurs and consequently increase in FWS? I would be grateful for any clarification thank you".

To lesser extent, students were trying to remember facts (2/9 messages, 22%) or applying procedures (2/9 messages, 22%).

Teacher presence

Teachers were mainly replying to students' messages with (49/120 messages, 41%) or without proposing another action (54/120 messages, 45%). However, when the former group was further analysed, Pearson Chi-Square test (Asymptotic significant value=0.014) revealed that there is a significant association ($p<0.05$) between the type of action taken by teachers in their posted messages and the length of discussion threads. The number of messages with reply followed by a question was significantly higher in threads with four or messages (18/24 messages, 75%). The

number of messages with reply followed by a referral to external resources was significantly higher in threads with less than four messages (14/21 messages, 67%). Thus, messages from teachers with reply followed by a question seems to play a role in promoting discussion (Table 4).

Discussion

The changing pace of Internet learning technology is creating new interactions for learners (10). This study shows that technology is now able to support online environments, which in turn enhances teaching and learning in dental education. The extensive use of the discussion board by students in the current study not only highlights their popularity but also their significance and pedagogical strength. It is also found to be an environment where students feel comfortable in using this form of interaction. However, our findings shows that the learning benefits for the students are not inherent in the technology, but depend upon collaborative activities between themselves and with their teachers (6)

At the end of the period of study, i.e. December 2008, an end of speciality examination took place, which was part paper based and part oral. The presence of this examination explains the high use of the discussion board in the 4-month period before the end of the observation period. It was the 4^{th} year students who were being examined which explains the high use of the discussion board by this group. The discussion board is open so junior years are able to view the responses of their senior colleagues. Such learning activity was not monitored in this study but may be an area for further research into the interaction between year groups.

Varied degrees of social and cognitive presence were found to take place when students used the online discussion board. The pattern of student and teacher interaction showed a substantial alteration in roles with the learner adopting a centric approach (11). However, higher levels of critical analysis and collaborative learning were not always present. It was found that promoting and developing such skills was highly dependent on both the role and presence of the teacher in the online environment (12).

The Results highlight two main challenges to the successful incorporation of online discussion boards in dental education. These are curriculum design and teacher development. Contemporary teaching approaches in dental education should attempt at re-directing the dynamics of learning to focus more on developing critical thinking and reflective learning skills amongst students. This in turn requires that the learning environment should be designed in a way that learning is situated within the context of the curriculum, and there should be planned pre-learning activities (13). Online learning strategies should then be merged within the main teaching strategies. This will require support for the teachers to help them in re-designing the curriculum so that these technologies are used effectively and that they themselves are able to participate and interact online.

The current study assessed an in-depth one discussion archive in one dental speciality. It provided a preliminary insight into the dynamics of such approaches and explored the challenges facing successful incorporation of such technology in teaching and learning in dentistry. They are useful and students do find them popular. However they only function well if the teachers also interact in the discussion board. Further studies are needed to assess the use of discussion boards across different specialities before generalising the results. Further work including focus group interviews with both teachers and students, is needed which will allow the assessment of attitudes towards the use of such technologies.

Conclusion

Online discussion boards may offer a new pedagogical process which will promote teaching and learning in dentistry. The current preliminary results indicate that the educational philosophy underlying the design of an online asynchronous program is crucial to the way in which it could

support and augment teaching and learning. Further support in training teachers to effectively incorporate online elements in their curriculum to achieve their final goal of effective teaching and learning is necessary. The findings of this study are considered an initial step towards providing evidence-based research that highlights specific pedagogies in designing effective online components within the dental curriculum.

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Table 1. Detailed rubric for the variables used to analyze discussion board messages

Variables	Rating	Criteria
Author	**1** Instructor **2** Student	The authority of the person posting the message
Author level (designed for this study)	**1** Instructor **2** 1st year undergraduate dental student (BDS1) **3** 2nd year undergraduate dental student (BDS2) **4** 3rd year undergraduate dental student (BDS3) **5** 4th year undergraduate dental student (BDS4) **6** 5th year undergraduate dental student (BDS5)	The level of the person posting the message
Response time (7)	In days	Difference between the date a message is posted and the date the following message is posted
	0 Same day response	A message is followed by another message in a thread on the same day
	-1 End	The last message in a thread
	-2 No reply	A message which is not followed by another message or reply (e.g one message in a thread)
Posting time (learning location) (designed for this study)	**1** Weekend / holidays	If message was posted in the weekend or holiday time.
	2 Weekdays	If message was posted during the week.
Number of words (7)	Number	Total number of words in a massage (by word count)
Message clarity (7)	**1** Unclear	Message is unclear or confusing – it is typically followed by a message asking for clarification
	2 Somewhat clear	Message is somewhat clear, but there are still confusing

		or vague points that need clarification
	3 Clear	The message is clear and appears to be understood by the participants in the discussion thread
Primary purpose (7)	**1** Open question	Open question or information directed to all students and instructors (no names are included)
	2 Specific question	Specific question or information directed to a specific student or teacher
	3 Reply only	Reply to a question, including "Yes" and "That's right"
	4 Reply followed by an action	Reply to a question, including "Yes" and "That's right", followed by another action (question, propose readings, asking for further clarification or checking with the supervisor)
	5 Independent comment	Independent comment, question or answer including "Thank you", "Asking for clarification" or requesting for handouts, lectures, articles….etc.
	6 Non-academic	A comment, question or answer to a non-academic condition. This includes administrative issues, clinical arrangements, dates and marking issues, and technical support issues
External resources (7)	**1** None/unknown	No clear resources are noted or evident
	2 Teacher / course	Reference is made to a

	information	teacher or course information in a message
	3 Another message	Reference is made to information in another posted message
	4 Web	Reference is made to a website
	5 Book	Reference is made to a book
	6 Article	Reference is made to an article
	7 E-course	Reference is made to the e-course or a page in the e-course
	8 Past exams	Reference is made to past exam papers
	9 More than one resource	More than one resource is mentioned in a message
	10 Coursework	Reference is made to an essay, coursework or homework
Student interaction level (14)	**1** Independent thinking	Students present their own thoughts in the posted message. Including "Thank you"
	2 Interactive thinking	Students reflect on other's thoughts and answer others questions or propose an action to others (e.g open questions and seeking advice from anyone)
	3 N/A	For staff messages
Content type (7)	**1** Social comment	No knowledge is provided (e.g social comment – "thank you" – asking for clarification - requesting articles, handouts or lectures)
	2 Course unrelated	Knowledge is provided that

		is unrelated to the course (e.g technical support)
	3 Administrative	Administrative knowledge (e.g due dates, the requirements for final project, or clinical arrangement)
	4 Course related	Knowledge is provided that supports the course curriculum, including "Yes" and "That's right"
Knowledge type (7)	**1** Non-academic	For non-academic / technical support / clinical arrangements/ administrative issues / request of handouts, articles and lectures
	2 Fact	Student offers an isolated fact
	3 Concept	Student presents two or more connected facts (e.g connecting facts with conjunctive adverbs like because, consequently, therefore, otherwise)
	4 Procedure	Student provides information on how to achieve a specific task
	5 Meta-cognitive	Students is reflecting about a strategy to solve a problem task or emotional state while learning
	6 N/A	For staff messages
Processing level (7)	**1** Clarification	Student is asking what a question or comment means—often referring to a specific element or fact in a problem. Including "Thank you", technical support, clinical arrangements,

		administrative issues, and requesting articles, handouts and lectures.
	2 Remember	Evidence that student is recalling or trying to recall a fact, concept or procedure
	3 Understand	The student understands or is trying to understand a concept or a procedure
	4 Apply	A student is applying or trying knowledge which typically involves the use of a procedure
	5 Analyze	A student is actively making connections between two or more concepts
	6 Evaluate	Student provides comments about effectiveness of a procedure or approach to solving a problem
	7 N/A	For staff messages
Resolution of discussion thread (7)	**1** Unresolved	Information was not given to solve the question(s) raised in the thread
	2 Partially resolved	Information is offered that partially answers the question (s) being asked in the thread
	3 Resolved	Complete and correct information is provided to resolve the questions being asked in the thread

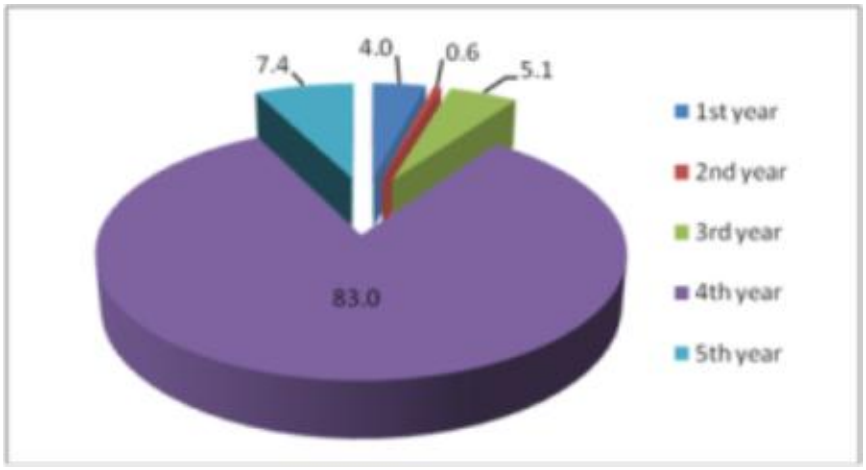

Figure 1. Percentages of messages posted by students from different undergraduate level; BDS1 (1st year), BDS2 (2nd year), BDS3 (3rd year), BDS4 (4th year), and BDS5 (5th year).

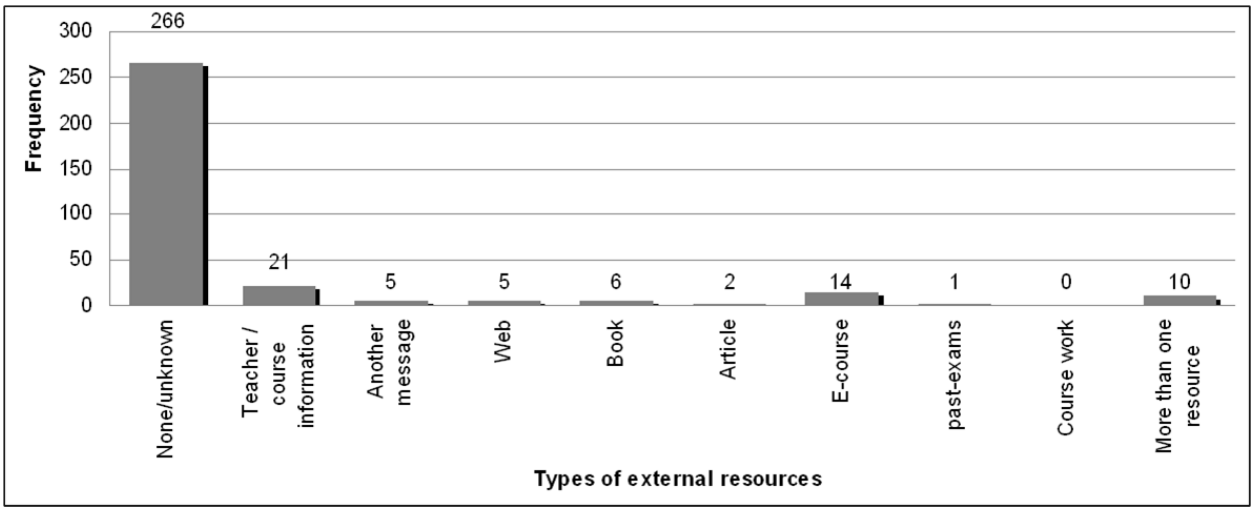

Figure 2. Frequencies of messages posted according to different types of external resources used.

Primary purpose of posted messages	Students' interaction level				Total
	Independent thinking		Interactive thinking		
	Thread with <4 messages	Thread with =>4 messages	Thread with <4 messages	Thread with =>4 messages	
Open question	0	0	38	27	65
Specific question	6	10	0	0	16
Reply	0	9	1	3	13
Reply followed by action	0	3	1	7	11
Independent comment	6	8	8	2	24
Non-academic issue	2	0	2	2	6
Total	14	30	50	41	135

Table 2. Number of messages / students' interaction level at the six levels designed for the primary purpose of posted messages.

Knowledge type	Processing level					Total
	Remember	Understand	Apply	Analyze	Evaluate	
Fact	11	6	0	0	0	17
Concept	2	27	1	4	0	34
Procedure	0	3	17	7	1	28
Metacognitive	1	2	4	7	9	23
Total	14	38	22	18	10	102

Table 3. Number of messages posted by students for the different cognitive activities.

Primary purpose	Threads' length		Total
	Threads<4 messages	Threads =>4 messages	
Reply followed by a question	6	18	24
Reply followed by a referral to an external resource	14	7	21
Reply followed by both a question and referral to an external resource	1	3	4
Total	21	28	49

Table 4. Number of messages posted by teachers / type of reply, at the two threads' level; threads with <4 messages, and threads with =>4 messages.