

**FEATURES  
SECTION**

## Current Products and Practice

# Building a learning community on-line: the first step towards a national virtual learning environment in orthodontics

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Virtual learning environments (VLEs) are attractive solutions for the delivery of education on-line. Orthodontic education on-line has the potential to alleviate some of the problems caused by increasing demands on academic staff, the impact of the European work time directives and changes in junior doctors' hours. All act to constrain the effective training of orthodontic postgraduates. The design of a VLE is driven by modern concepts in learning and teaching, the structure, content and assessment methods will help determine the range of behaviours any programme hopes to encourage. This paper aims to provide information on how a modular specialist-training programme in the United Kingdom has been developed and enhanced by a VLE.

*Key words:* Virtual learning, postgraduate education, orthodontic teaching

*Refereed paper*

### Introduction

The postgraduate education of Specialist Registrars (SpRs) in orthodontics places a high demand on Universities and Teaching Hospitals, and competes with other tensions, such as undergraduate training and research. In addition, the number of academics and teaching staff is diminishing and, with the introduction of the new European directives on work time, it means that the academic content in some postgraduate programmes may become compromised. In Bristol, a potential solution to these demands has been the development of a Virtual Learning Environment (VLE) to deliver the academic content of the taught Doctorate of Dental Surgery (DDS) in Orthodontics.

The Specialist Advisory Committee (SAC) requires that training of specialists in orthodontics take 3 years in order to achieve the minimum level recognized for entry to the General Dental Council (GDC) specialist list. SpRs recruited for training in Bristol are registered with the University of Bristol to undertake the DDS in Orthodontics. The University undertakes to deliver an academic course, including a research dissertation as part of their training, in addition to a clinical

component. However, five of the SpRs currently registered for the DDS in Bristol are based at five peripheral units up to 150 miles from the centre. It is here that they undertake their clinical training and they only travel to Bristol for their academic input. The recent changes in junior doctors' hours and the need for compliance with the European Working Time Directive (EWTD)<sup>1</sup> means that travel from these remote units is now considered to be part of trainees' work time. This directive will obviously reduce the length of the academic day and a solution to this travel burden had to be found.

In addition, there is also a well-recognized shortage of academics in Bristol to deliver teaching and this latter group are under further pressure to deliver high quality research. This situation is not unique to the South West Region and a national VLE might enable expansion and enhance training for postgraduate students in the UK. Any increases in teaching efficiency and effectiveness would clearly have benefits for both trainers and trainees. This article is intended to provide information on how the DDS curriculum in Bristol has been developed and enhanced with the use of a VLE.

## What is a virtual learning environment?

A VLE is a series of web pages linked to provide a forum through which learning and teaching can be delivered, at least in part, on-line. They are learning management software systems that combine the functionality of computer-mediated communications and methods of delivering course content on-line. Some have described them as 'academic filing cabinets'. A VLE can be used extensively in further education where entry to sites is normally password protected and their front pages usually contain a range of hyperlinks, including a link to a map of the content and its structure. The core content of a course can be combined with access to information in electronic journals, e-books and the wider Internet. This is set alongside communication tools, such as e-mail, conference systems and access to tutors or peers. A link to a discussion area will allow either synchronous (chat room) or asynchronous (discussion board) interaction between participants on the programme. The platforms can also provide video and audio links to present a rich source of learning material.

A VLE can be used to support a range of learning contexts, ranging from conventional classroom delivery to distance and on-line learning. Therefore, the development of a VLE is an opportunity to reappraise the pedagogic stance of a teaching programme and to make a choice about a didactic or constructivist approach. These terms will be explained later in the article. The design of any VLE will be influenced by what the authors of the programme believe to be important in teaching and learning. This will determine not only the structure and content of the VLE, but the assessment methods embedded within it and the range of behaviours the programme encourages. VLEs can be used to support undergraduate and postgraduate teaching programmes, as well as continuing professional development (CPD).

There are some potential barriers to the use of a VLE with perhaps the most obvious being the variable Information Technology (IT) skills of the teachers. However, most teachers in orthodontics have a minimum level of IT skills (e.g. electronic lecture presentations) and, with little extra training, the skills required to use a commercially available VLE can easily be acquired.

### *E-learning within Dentistry*

Self-instruction and the use of distance learning through the Internet are able to enhance and augment academic resources. It can individualize the learning environment for students, allowing them to work wherever or

whenever they wish. In dental education it is known that computer-assisted learning (CAL) and electronic learning can be as effective as other methods of teaching, e.g. lectures.<sup>2-4</sup> Within undergraduate training, Lowe *et al.*,<sup>5</sup> concluded that students could learn to use the Index of Treatment Need (IOTN) as well as, if not better, after using a CAL programme than after a lecture. A study by Irvine and Moore<sup>6</sup> suggested that examination results improved when CAL was used to teach the mixed dentition analysis to students, rather than traditional didactic teaching. More recently, a multimedia package has been found to be as effective as standard lectures in teaching the undergraduate orthodontic curriculum.<sup>7</sup> Certainly there is widespread support for CAL within dentistry because of the flexibility and accessibility of the learning resource.<sup>8</sup>

Although evidence exists to support the effectiveness of CAL, it has been shown to be of limited value in some areas of teaching, such as clinical decision-making skills in restorative dentistry.<sup>9</sup> This can be overcome with the use of more flexible electronic learning where discussion facilities are available for small group discussions.<sup>10,11</sup> E-learning must be designed to engage students and to make them want to return.<sup>12</sup> Providing some means for communication on-line in order to exchange ideas and problems is therefore essential. The challenge is to design resources to achieve higher-level objectives such as synthesis and evaluation.

## Teaching within Orthodontics

Within the profession of teaching, Dalgano<sup>13</sup> reported three broad principles that together define the constructivists' view of learning:

- Each learner forms their own representation of knowledge building on their own experience.<sup>14</sup>
- Learning occurs when the learner's exploration uncovers an inconsistency between their current knowledge representation and their experience.<sup>15</sup>
- Learning can also occur within a social context and that interaction between learners and their peers is a necessary part of the learning process.

These theories suggest that the learner has more of a say in their own learning and an active role in the learning process. Interactivity with peers and tutors is also encouraged as seen in the problem-based learning approach.

Sackville and Eysers<sup>16</sup> have argued that pedagogic values should reflect how we choose to use these new technologies. In order to get the best learning opportunities for our students a number of types of interaction

need to be built into the VLE. Interactions are needed between the student and the technology, as well as the student and the content. This ensures the material is being actively read and understood. The learner is then able to interact with a VLE that can present text, clinical photographs, audio, video and animation. They can also be asked questions with an instant answer and explanation from the computer. On top of this, the student's engagement with the program can be recorded and used to help in their assessment. These pedagogic tools offer interactive choices, and provide an opportunity for complex and sophisticated learning to take place, in many cases learning experiences that would not be practical in a clinical setting. Interactions also take place between the student and the tutor through chat rooms, discussion boards or by video conferencing. Collaboration between the learners themselves can occur in group work and interaction with participants on the programme, as well as the wider professional community.

The teaching on many orthodontic programmes, in common with much of the clinical teaching in both medical and dental schools, is usually of a didactic nature alongside a clinical apprenticeship to learn basic skills.<sup>17</sup> Students are used to this type of learning and expect a similar type of teaching in any newly designed on-line programmes.<sup>18</sup> In orthodontics, this would encourage a didactic approach, but this does not utilize current technology to its full potential. The development of VLEs could encourage a shift in the teaching paradigm towards a more learner-managed approach. It has been suggested that constructive alignment, or constructivism, will optimize the opportunities for quality learning.<sup>19</sup> Constructive alignment ensures that teaching methods, choice of content and assessments are aligned to activities assumed in the learning objectives, aiming to produce competent and reflective specialists.

In a systematic review of the literature, dialogue, involvement, support and control were found to be the major features of on-line learning.<sup>18</sup> If attention is focused into these four areas, teachers can support a shift in the approach to education and fully utilize this new technology.<sup>20</sup> Others have suggested asynchronous dialogue as an opportunity for active participation and in-depth reflection.<sup>21</sup> Student involvement includes engagement with the content material and collaborations on-line. Support includes face-to-face contact, feedback on performance and peer support developing the concept of a learning community on-line. Control of the key learning activities in the on-line programme can be in the hands of the teacher or the learner. Current on-line learning falls into four areas:

- teacher determined, task specific;
- teacher determined open-ended or strategic learning activities;
- learner determined task specific;
- learner managed open-ended or strategic learning.

The first area is essentially academic content with teacher support. The learning goals depend, in part, on accurate recall of the text. In this, the teachers are using the VLE to support traditional classroom structures. The teacher specifies the activities, outcomes, deadlines and exchanges. This leaves the learner with little scope for initiative or innovation. This may be appropriate particularly at the beginning of an orthodontic course to provide a 'skeleton' on which to build.

The other areas are also applicable to orthodontic teaching. Teacher determined open-ended learning is where the teacher sets the overall objectives, but the learner is able to explore beyond these. Learner determined task specific offers the learner discretion as to how they engage with the content to perform a specific task.

Life-long learning may be facilitated by learner-managed open-ended activities, where the learner is in control of the learning outcomes through a personal development plan for continuing professional development. Here, the teacher/colleague is in the background offering advice on procedure and resources as a facilitator for learning. Our current teachers/consultants in orthodontics may find themselves unprepared for this role.

Within a VLE, constructivism is probably the current dominant learning approach, and this emphasizes the social construction of knowledge, the context of learning and collaboration as part of the learning process. From a constructivist perspective, learning is an active process in which learners construct new ideas or concepts based on their current and past knowledge. Courses following this approach will encourage discussion of issues related to the subject, but the educator will refrain from providing a correct answer. Teachers engage in a process of scaffolding in which they encourage students to discover ideas for themselves.<sup>22</sup> Resource-based learning places emphasis on the retrieval and evaluation of material from the World Wide Web. This is most appropriate for active learning, engagement with the technology and the subject, perhaps for life-long learning.

Problem-based learning provides a tangible purpose to the learning process. It develops problem-solving skills and students have to take responsibility for their own learning. In an orthodontic training programme, this

can facilitate deep learning and understanding, but can also be frustrating especially if clinical examples are chosen. The clinical experience is often didactic teacher/clinician led where the student is expected to 'Do what they are told', since they lack clinical experience. On-line seminars can present similar material and a number of alternative approaches can be discussed, with the pros and cons leading to the conclusion that perhaps a number of different plans could work.

Narrative-based teaching can use clinical experience in a positive way to make the subject 'come alive'. Many of us can still hear the voice of our first consultant/teacher with some pearl of wisdom that has stayed with us. Situated learning encourages the use of clinical opportunities for teaching with information technology support within the clinical area. Perhaps the greatest opportunity in e-learning is the synergism between pedagogy and information technology. Pedagogy describes the traditional instructional approach based on teacher-directed learning theory. Andragogy describes the approach based on self-directed learning theory. The etymological of the latter is from Greek, *aner*, meaning adult, and *agogus*, meaning guide or leader.<sup>23</sup>

## Development of the DDS in Orthodontics

In order to design a curriculum based on the constructivist perspective, the aims of the education programme, its learning outcomes, teaching/learning approaches, assessment techniques and course evaluation must all complement each other. Outcome-based education focuses on the end product and is developed from an analysis of the professionalism of an orthodontist. Learning outcomes, therefore, determine what is taught, such as knowledge, skills and attitudes in order to fulfil this role. It is not restrictive, as there are many methods by which to achieve these outcomes. Governing bodies such as the GDC insist that newly qualified specialists must demonstrate from the outset the highest quality in clinical care. Therefore, it would seem sensible to ensure that a curriculum is developed from defined learning outcomes that reflect the requirements of specialist training.

Following on from the curriculum working party of the SAC in Orthodontics and Paediatric dentistry, a document entitled *Learning Outcomes for the Specialist Registrar*<sup>24</sup> has been produced by the SAC. This is based on the three essential elements of a competent and reflective practitioner as outlined by Harden *et al.*<sup>25</sup> These elements are:

- what the orthodontist is able to do (technical intelligence);
- how the orthodontist approaches clinical practice (intellectual, emotional, analytical and creative intelligences);
- the orthodontist as a professional (personal intelligence).

Within these elements there are 11 domains including treatment planning, treatment procedures, basic clinical science, communication skills and personal development. Each domain is then further subdivided into learning outcomes, which define what the learner is accountable for.

In Bristol the curriculum has been developed to reflect these learning outcomes. This approach allows continued development and reform of the programme as changes occur within the profession and in the delivery of health care.<sup>18</sup>

The main advantage in developing a curriculum such as this is that it allows for more active learning on the part of the student. Using the information gained in order to solve problems leads to knowledge that is retained long-term and removes the need for short-term memorization of facts to pass exams.<sup>18</sup> The curriculum has moved towards the constructivist approach by incorporating self-directed learning, problem-based learning and reflection. In addition, one-to-one clinical supervision within their clinical units is encouraged to develop certain learning outcomes. There will need to be a change in assessment to reflect this deep learning strategy.

At the end of the training programme successful candidates should not only show adequate knowledge, but also demonstrate high levels of professional performance.

## Using a VLE to deliver on-line learning

Much time and effort has been invested in developing electronic modules to deliver the academic content of the DDS in Orthodontics at Bristol. These are housed within a VLE (Blackboard Inc<sup>®</sup>, Washington, DC, USA) that is fully interactive, and incorporates web- and video-links. This approach is teacher-determined, task specific, e.g. the content is supported by alternative technology, such as lectures, seminars, video links and peer-review. The content is a resource that is readily available to the students over the Internet with interactivity between trainee and trainer. This has been a development that has integrated other advances within the programme, such as the use of clinical digital photography, interactive whiteboards and faster

Internet connections. Blackboard Inc® has helped us move student interactivity to a new level, with facilities for discussion boards, web-based assessments, including on-line multiple choice (MCQs) and multiple short answer (MSAs) questions to test knowledge and electronic student feedback.

There are currently 36 modules in total and we hope these modules will be finalized within the next 12 months. Tasks and reflection points are also integrated into the modules and give an opportunity for the postgraduate to reflect on their understanding of what they have learnt. These are used alongside peer review and audit, which are already of use in the development of skills in professionalism. A wide range of assessments is encouraged in order to ensure all outcomes are sufficiently assessed. Electronic feedback has been improved to allow formative assessment for the post-graduates and feedback for the module writers. This has been invaluable in the development of the system to date.

In mid-2003, we added a new dimension to the Bristol VLE with the introduction of web conferencing. Two Specialist Registrars in Portsmouth and Dorchester are piloting this scheme, initially through journal clubs, some lectures and seminars. This has been facilitated with a grant from the Learning and Teaching Support Network (LTSN). Initial teething troubles with the system included the NHS firewall and issues with sound quality between the two sites. However, these have now been rectified, and we believe the added value of web conferencing to be a considerable and important feature of the VLE in the future.

Currently, the lecture program is being revisited with a view to making it part of the virtual environment. At present it is merely available as a series of PowerPoint slides. To make this more interactive and appealing, it is hoped to introduce a virtual lecturer (as a video) into each presentation. The SpR will be able to hear the teacher deliver the lecture, as well as having access to the written text. It is hoped this will improve the flexibility of the course and reduce travel commitments.

## The future of teaching with a VLE

Just as Blackboard Inc® opened several avenues for us at the Bristol Dental School, this project could be of real benefit to other postgraduate programmes and other specialities nationally. The development of a nationally-based orthodontic programme that is not prescriptive in its pedagogy, but can be customized for individual departments could be an extremely useful tool and a valuable source of educational material. It is hoped that

when this project is complete, the burden of travelling for SpRs and trainers will be significantly reduced. The delivery of teaching is likely to become more efficient, allowing all those involved to better cope with the other pressures associated with a clinical career. The VLE will need to be appraised by learners and evaluated within the context of educational outcomes. Work on these aspects is currently in progress.

## Conclusions

There is no doubt that e-learning offers an opportunity for a shift towards a more learner-centred approach to orthodontic education. Delivery of academic material through a VLE may improve both efficiency and effectiveness, yet also has the added advantage of flexibility for the student. It has the potential to become a way to share faculty resources amongst dental schools. The incorporation of learning outcomes in the development of this programme, as suggested by the SAC, aims to produce orthodontists with skills to solve the problems of today and face the challenges of tomorrow.

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