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# An evaluation of the effects of a web-based modular teaching programme, housed within a virtual learning environment on orthodontic training for specialist registrars

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*Objectives:* A new modular teaching programme, housed within a virtual learning environment (VLE) was introduced in Bristol in 2004 to complement the academic training of orthodontic postgraduates. The aims of this study were to evaluate whether its introduction had reduced travel commitments for trainees, reduced demands on academic staff and whether it had any effect on teaching and learning.

*Design:* An investigative mixed methods study designed to collect and analyse verbal and written data.

*Setting:* The South West Region of the UK subjects and methods: semi-structured interviews and focus groups with nine trainees and 14 trainers were taped and transcribed. Written data were coded and analysed thematically. The qualitative data from interviews and focus groups were complemented with written data from trainee diaries and a limited amount of quantitative data collected from the VLE.

*Conclusions:* Travel commitments for trainees have reduced as a result of introducing the web-based resource, but not as expected. Demands on academic staff have not reduced but have changed. The resource has had positive effects on postgraduate orthodontic teaching and learning. Important themes of interest emerging from the data are improvements in the flexibility and efficiency of learning and the value of the resource as a repository of information and in the organization of teaching and learning. Despite the popularity of this web based learning resource, trainees continue to value the opportunity to interact face to face with their teachers and peers and are prepared to travel for organized teaching sessions.

*Key words:* Specialist registrar training, orthodontics, virtual learning environment, evaluation

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## Introduction

The advent and subsequent development of computer technology and the internet have greatly enhanced opportunities for teaching and learning. ‘Tomorrows Doctors’<sup>1</sup> recognized the importance of using such technologies in medical training and recommended that: ‘Teaching and learning systems must take account of modern educational theory and research, and make use of modern technologies where evidence shows that these are effective’.

Computer assisted learning (CAL) is a term used to describe any use of computers to aid instruction or

learning.<sup>2</sup> This can range from lectures on a CD to a fully interactive educational resource utilising online or e-learning over the internet.<sup>3</sup> A virtual learning environment (VLE) is a term used to describe an integrated set of online tools, databases and management resources that exist as a coherent system, functioning collectively in support of education.<sup>4</sup> A VLE usually contains some sort of course or curriculum mapping, whereby the curriculum is broken down into a series of manageable units. It can contain a wide variety of learning resources, including written and recorded learning material, e.g. videos. Links to additional learning resources are also a

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common feature. A VLE may include interactive elements and communication tools for students to interact with each other and to access tutor support. Examples would be e-mail, blogs, discussion boards, chat lines and facilities for video conferencing. Online assessment tools and feedback mechanisms can also be incorporated into a VLE. Management resources to support the educational material may include course information, timetables and notice boards.

Although computer and internet technologies offer exciting new learning opportunities and the potential for greater flexibility in learning, most experts stress that technology alone is not enough to ensure a high quality educational experience. Computer and online resources must be appropriately designed to enable effective learning.<sup>5-7</sup> 'Tomorrows Doctors'<sup>1</sup> recommended that any new technology used to enhance learning should be evaluated for educational merit. The effective evaluation of different educational interventions continues to be a challenge for researchers.<sup>8</sup>

In 2004 a modular learning resource housed in a VLE (Blackboard™, Blackboard Inc., Washington, DC, USA) was developed at Bristol University to facilitate the academic orthodontic training for Specialist Registrars.<sup>1</sup> The VLE contains organizational tools such as a course timetable, an announcement board and relevant course documents. A modular curriculum covering most of the required knowledge base for specialist orthodontic training is an important part of this learning resource. The 40 online modules provide comprehensive, up to date, peer reviewed and fully referenced summaries of relevant orthodontic topics. Many of the references are displayed in hypertext format allowing either the full text of the paper or an abstract to be accessed easily. In addition to the modules the VLE also contained video lectures and short videos of clinical procedures as well as communication tools such as a discussion board and a facility for video conferencing.

The objectives when developing the modular teaching programme within a VLE were to:

- reduce travel commitments for Specialist Registrars in regional units, in order to comply with the European Working Time Directive;
- reduce demands on orthodontic academic staff in the long term;
- enhance teaching and learning.

The aim of this study was to evaluate whether the modular teaching programme within a VLE has been successful in achieving its original objectives, and also to investigate the effects on teaching and learning

for the Bristol based postgraduate orthodontic training programme.

The objectives of this study were to:

- investigate how the modular programme housed within a VLE is used;
- investigate whether it enhances teaching and learning;
- investigate whether using a VLE has been effective in reducing travel commitments for Specialist Registrars in peripheral units;
- investigate whether it will be effective in reducing demands on academic staff in the long term;
- investigate other effects of the use of a VLE;
- make recommendations for changes to the modular programme within the VLE as it is developed and used nationally.

## Subjects and methods

Research and Development approval was received from the University of Bristol (reference no. DE/2006/2470) and Derriford Hospital, Plymouth. The University of Bristol also acted as sponsor and insurer of the study. Ethical approval was obtained from the South West Devon Regional Ethical Committee (reference no. 06/Q2103/105).

A mixed method, but principally qualitative research methodology was chosen to fulfil the objectives of the research. This included:

- semi-structured interviews with orthodontic trainees who have used the programme;
- focus group discussions with trainers who have used the programme;
- transcription of verbal data and subsequent thematic analysis;
- collection and analysis of diary data recording the use of the VLE by trainees over a specific time period;
- analysis of numerical data downloaded from the VLE recording frequency and timings of trainee use over a specific time period.

## Subjects

The subjects involved in the study were trainees and trainers involved in the South West and Wessex regional orthodontic training programme who were using, or had used the modular teaching programme housed within the VLE. Nine trainees were invited to take part, seven from a single cohort, and two who had started their training the year before. Fourteen trainers were invited

to take part. All trainees and trainers who were invited to attend the interviews agreed to take part.

### Trainee interviews

Nine students attended individual semi-structured interviews. An information leaflet was provided before taking part and each interviewee signed a consent form. The preconditions of each interview were as follows:

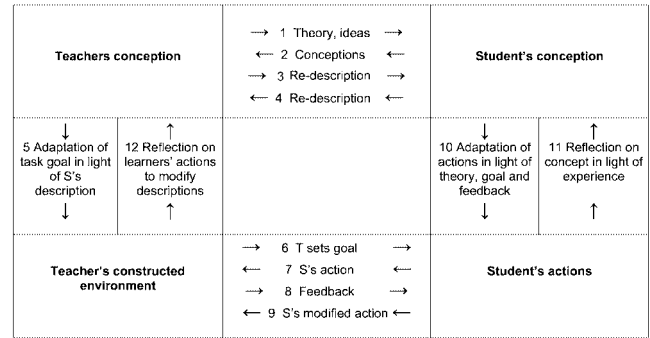
- the interview should last no more than 30 min;
- anything said would be confidential and anonymous;
- the interview would be recorded and transcribed;
- consent could be withdrawn at anytime;
- quotes may be used in the writing up of the dissertation, in subsequent publications and presentations, however anonymity would be retained;
- during the study all digital recordings and transcripts would be stored securely (any computer data would be password protected). On completion of the research and following a specified time the recordings and transcripts would be destroyed.

Although a topic guide was used, the interviewees were encouraged to give detailed responses and to explore the topics further if they wished to do so. One researcher conducted all the interviews. The interviews took place between March 2007 and December 2007 at locations and times that were convenient for the interviewees. The interviews were recorded on an Olympus™ WS-320M digital voice recorder (Olympus UK Ltd, Watford, UK).

### Trainer focus groups

Three focus groups were arranged at different locations within the South West and Wessex regions, between July and November 2007, at times convenient for participants. An information leaflet was provided before taking part and each consultant signed a consent form. Inevitably there were difficulties in accommodating busy NHS clinicians and a pragmatic decision was taken that any consultants who could not attend a focus group would be interviewed separately using the topic guide developed for the focus groups.

The preconditions of the focus groups were the same as for the interviews in most respects. However, anonymity could not be totally assured within focus groups and focus groups would last longer than interviews (but should last no more than one hour). Although the topic guide provided the framework for discussion, participants were free to explore other relevant areas. One researcher facilitated the three focus groups and necessary interviews. The focus groups were also recorded on an Olympus™ WS-320M digital voice recorder.



**Figure 1** Laurillard's 'conversational framework' identifying activities necessary to complete the learning process<sup>2</sup>

### Thematic analysis

Two researchers were responsible for analysing the interview and focus group transcripts. Initially there was a need to become familiar with the raw data by reading and rereading the transcripts. Key themes and sub-themes emerging from the data were identified and assigned codes. Codes were then applied to all data within each transcript by annotating the transcripts appropriately. Sorting of all the coded data into themes and sub-themes allowed the consequent analysis and interpretation of the data.

### Diaries

The cohort of seven trainees who were at the time of the study using the VLE, were asked to keep a diary of their use over a specific 2-week period leading up to a scheduled in-course assessment, in order to provide a picture of use at a particular point in training. The trainees were given a diary and asked to record when they logged onto the VLE and what was viewed between the 19th March and the 2nd April 2007. Each section of the VLE was given a code to aid recording of use.

### Data from the VLE itself

Quantitative data available within Blackboard were used to complement the qualitative data derived from the interviews, focus groups and diaries. This included:

- total number of hits for each day of the week;
- total number of hits at different hours of the day;
- frequency of access to different areas of Blackboard.

### Comparison of the VLE with Laurillard's conversational framework

Using data from interviews, focus groups and diaries, the Bristol programme was compared with Laurillard's

conversational framework (Figure 1).<sup>2</sup> The results are shown in Table 1.

## Results

### *Thematic analysis of interviews and focus groups*

The main themes which emerged from both interviews and focus groups were: learning, teaching, monitoring the use of the VLE and communication/interaction. An additional theme which emerged from trainer focus group discussions related to barriers to VLE use. Summaries of the main themes and sub-themes were as follows.

### *Learning: organizational aspects of the VLE*

In their interviews trainees stressed the importance of the timetable to the organization of the course. The

timetable allowed them to check in advance and therefore to plan ahead. Trainees also liked the way the timetable was set out and found it easy to use.

*'The whole course is based on Blackboard. So I know exactly what I am doing for the rest of the year with the timetable so that's really useful, so I can plan ahead.'*

Trainers also found it very helpful to have the facility of finding out in advance what their future commitments would be:

*'...you can search the timetable to see when you are due to give a talk or seminar or whatever, which I think is useful.'*

### *Learning: flexibility of access to learning resources*

The VLE provides access to a wide range learning material through the modular curriculum and online journals. Access for authorized users can be at any time and from any location with internet access. Trainees

**Table 1** Comparison of the Bristol VLE with Laurillard's framework

| Characteristic  | Description of Bristol VLE  |
|---|---|
| 1. Teacher can describe conception.   | Each module includes a comprehensive list of learning objectives setting out clearly what is expected of the students.  |
| 2. Student can describe conception.   | At the present time, elements within the VLE that could be used by students to check their understanding of concepts and by teachers to give feedback are under utilized. Online discussion between students and between students and teachers would be possible using the discussion board, but this has not been popular. |
| 3. Teacher can redescribe in light of students conception or action.                        | Completion of module tasks by trainees and subsequent feedback from trainers would also help teachers check students' understanding and clarify issues as necessary. However these tasks are not mandatory and if carried out have not routinely been assessed.   |
| 4. Student can redescribe in light of teacher's redescription or students action.           | Online formative assessments would help check student understanding and these are not available within the VLE.   |
| 5. Teacher can adapt task goal in light of student's description or action.                 | Student feedback about module content and structure would be useful to help teachers to redevelop teaching material and goals. This does not appear to be happening effectively.  |
| 6. Teacher can set task goal.   | Completion of modular tasks by trainees and subsequent feedback from trainers would help achieve these elements. Teachers are unable to modify and set new task goals because of lack of feedback.  |
| 7. Student can act to achieve task goal.  | In the future online assessments would go some way to allowing students to interact with the VLE itself and to get feedback allowing them to modify their learning.   |
| 8. Teacher can set up world to give intrinsic feedback on actions.                          |   |
| 9. Student can modify action in light of feedback on action.                                |   |
| 10. Student can adapt actions in light of teacher's description or student's redescription. |   |
| 11. Student can reflect on action to modify redescription.                                  |   |
| 12. Teacher can reflect on student's action to modify redescription.                        | Currently the VLE itself does not enable the teacher to assess student progress and understanding.  |

appreciated the flexibility of access to learning material which allowed them to organize their study around their other commitments.

*'...in the evenings at home as well and during exam times, I used it quite a lot to study. Weekends too if I was feeling really conscientious. I just logged on whenever I needed to really.'*

A strong theme emerging from trainer focus groups related to the benefits of the flexibility of the VLE, allowing the trainees to use the available learning resources to suit their chosen way of learning. There was evidence that trainees used the VLE at different times of the day and week, depending on their other commitments and in different venues. Truly flexible learning would mean that students learn how, when, what and from wherever they wish.<sup>3</sup> With this, VLE opportunities for flexibility in terms of choosing what to learn were limited. Most trainers felt that the modular learning resource was presented in a fairly structured and didactic way.

#### *Learning: modular curriculum and efficiency of learning*

The modules housed within the VLE provide comprehensive summaries of relevant orthodontic topics with hypertext links to related resources. In general the opinions of the trainees and trainers about the modular curriculum were extremely positive and agreed with previous work on attitudes to computer assisted learning.<sup>4,5</sup>

*'What is useful is having so much information all in one place, with the modules and particular the fact they have so many references as well. So you have the information itself and then you have a link to further information.'*

The modules were singled out as being the most useful part of the VLE. This was particularly because unlike a textbook, the modules have the potential to be instantly modified or updated. Trainees felt that learning with these modules was easy, convenient and efficient. An important theme was that time was saved for trainees both in selecting and accessing relevant learning material. A concern expressed by some of the trainers was that the modules were a form of information 'spoon-feeding' and therefore could discourage self directed learning.

*'...the way that blackboard is set up actually doesn't prompt you and stimulate you and actually make you go out and look. It lends itself to complacency.'*

Effective adult learning is usually more self-directed and problem centred than children's learning<sup>6</sup> with learners taking more responsibility for what is learned.<sup>7</sup> Although some trainees made comments suggesting that the VLE discourages exploration, others felt that it

actively encouraged self directed learning. From the data collected in this study there is no clear evidence to support the view that the programme either encourages or discourages self directed learning.

#### *Learning: reducing travelling time*

Interestingly, most trainees felt that use of the VLE did save travelling time, but this was not in the way that had been anticipated. Trainees said that they saved time that would previously have been spent travelling to libraries.

*'...most of the information I would need to study my course is all there you know. It saves me a trip to the Library and around the South West as well.'*

Time travelling from peripheral training units to Bristol did not appear to have been reduced. Trainees clearly valued face to face teaching and if this was available, were prepared to spend time travelling in order to take part. Most trainees also enjoyed and benefited from regularly meeting their peers. The VLE includes a video conferencing facility that was introduced to help reduce the travel commitments for trainees based in regional units. This facility had been most useful for the two trainees who were a year ahead of the main cohort. This was because they did not have the opportunity to take part in the teaching programme of tutorials and formal teaching that had been organized for the larger group. These two trainees used video conferencing for some of their formal teaching and found this was an acceptable substitute for face to face teaching.

*'The fact that I didn't have to travel to Bristol was useful. When it worked it was quite good. It felt quite innovative. It was good to be involved in a slightly different way of doing things.'*

However, even these two trainees felt they needed the opportunity for regular face to face teaching and interaction to prevent them feeling socially isolated.

The use of the video conferencing facility for the main cohort of seven trainees was limited to journal clubs. In general, if there was just a journal club to travel for, trainees would try to use the video conferencing facility. However, if there was other formal teaching arranged, the trainees felt that they benefited more if they travelled to Bristol for this.

#### *Learning: learning strategies*

For the majority of trainees, using the VLE did not appear to have changed the way in which they learnt.

*'Probably not. I seemed to have found a reasonable way of learning that I didn't really want to change.'*

The two trainees who were a year ahead of the main cohort both felt that their learning had become more self directed during the course.

*'It's certainly made me a lot more independent, in that I no longer feel the need (sort of) to be taught formally.'*

These trainees were relying more on the VLE for their academic teaching than the majority of trainees. The circumstances promoting the need to become more self directed learners probably had a greater effect on their learning strategy than the use of the VLE itself. The evidence from this study is that the VLE can provide a good opportunity for learning at a distance when other opportunities are not available.

All trainees reported that prior to starting the course they had used a lot of books and notes to aid learning, but their learning had become increasingly computer based as they became accustomed to using the VLE. Some trainees found studying from the computer screen quite easy, whereas others felt they still needed a paper copy and printed out the modules. Trainees on the course are of varying ages and have had different career pathways and computer experience. Browne *et al.*<sup>8</sup> found a difference in acceptance of e-learning between dentists at different stages of their careers. It is possible that in the future, younger students who may be more comfortable with computer assisted learning will make more use of computer learning.

### Teaching

It was felt by several trainers, that in comparison to previous cohorts, the students using the VLE were more prepared when it came to seminars and tutorials. There was a sense that the comprehensive knowledge base provided within the modules allowed face to face teaching to be more interactive than previously, which the trainers and trainees found enjoyable. This process of learning from modules and then having the opportunity to check understanding may enhance deeper learning, encouraging trainees to understand the concepts and principles involved, rather than just remembering the facts. Deep learning is more likely to be retained in the long term than surface learning.<sup>9</sup>

Trainers felt that feedback was essential in order to improve and update the modules. Disappointment was expressed by some of the trainers at a lack of feedback from editors when they originally wrote the modules and from students who were currently using it. Most trainers emphasized the need for continuing feedback and subsequent modification of teaching resources if the programme is to develop.

### Teaching: time spent preparing teaching material

The majority of teachers said that their teaching time had not changed but that their time was now spent differently. It was generally felt that the teaching workload would increase again when it came to update the modules, but that the input required would not be as much as when writing them for the first time.

### Monitoring the use of the VLE

Computerized data were available to show how often a person or group logged onto the VLE. Trainees had concerns about this monitoring. Their main concern was uncertainty relating to the purpose and validity of the monitoring. Some trainees felt that they were not being trusted and were being treated like children.

*'A bit like 'Big Brother'...I don't think they should do it really. We are all adults and it is up to you how much you use it and people learn differently...'*

Most trainers shared the concerns of the trainees and were wary of the validity of trying to draw conclusions about student learning from the data available. One trainer even said they thought it was dangerous. Most trainers acknowledged that trainees may be studying other material not on the VLE and also may have downloaded or printed out modules. The trainers understood how the trainees may perceive the system as being like 'Big Brother'.

### Interaction and communication

Online learning has a potential advantage over book-based learning in that learning material can be interactive.<sup>9</sup> Data collected from focus groups in this study suggested that most trainers felt that the VLE was not particularly interactive and that it would be more effective if it was.

*'...but what I think is the not so positive bit, is that I don't think that we have ever got it to be as interactive as it should be. So I think it is still based very much on the model that I am the teacher and I give you the information.'*

Initially when the first two regional trainees used the VLE for distance learning, interactivity was a vital component. Interaction was partly promoted by encouraging these trainees to complete the tasks within each module and to submit these for feedback to the relevant trainers. However, the main cohort of seven students who have used the VLE have not completed the tasks and submitted their work to a trainer.

*'In terms of the tasks – you can do them, but there is no way of discussing them to see if you have got them right.'*

*'Nobody has ever come back to me and said, "I have done this task, can we talk about it?" and so I don't know*

*whether that method of learning has come to anything in the modules.'*

Trainers and trainees appeared to be unsure of whether tasks were compulsory, whether they should be assessed formally and by whom.

Video conferencing also had the potential to make the VLE interactive. There were some inherent technical problems in the video conferencing system because of differing internet band widths between hospitals and because of hospital firewalls. Technical problems frequently led to feelings of frustration for the trainees who were using video conferencing. However, when the video conferencing facility worked well there was generally a positive opinion towards it from the trainees, particularly in terms of travel time saved. It appeared that video conferencing worked much better for one to one seminars leading to positive feedback from both trainees and trainers who had used it in this way.

The discussion board is a communication tool that both trainees and trainers felt had been under utilized. The main reason for trainees not using the discussion board was that they found other methods of communication easier e.g. talking or using web-based communication tools such as Skype®. Uncertainty about the role of trainees and trainers in online discussions also contributed to the lack of use of the discussion board. Some trainers were not sure if the discussion board was for them or just for the trainees.

*'I didn't use them much, because I felt a bit embarrassed after I had done it once. And then I thought this isn't really for the Consultants, it is for the registrars and I shouldn't be doing it. So I didn't really do it then.'*

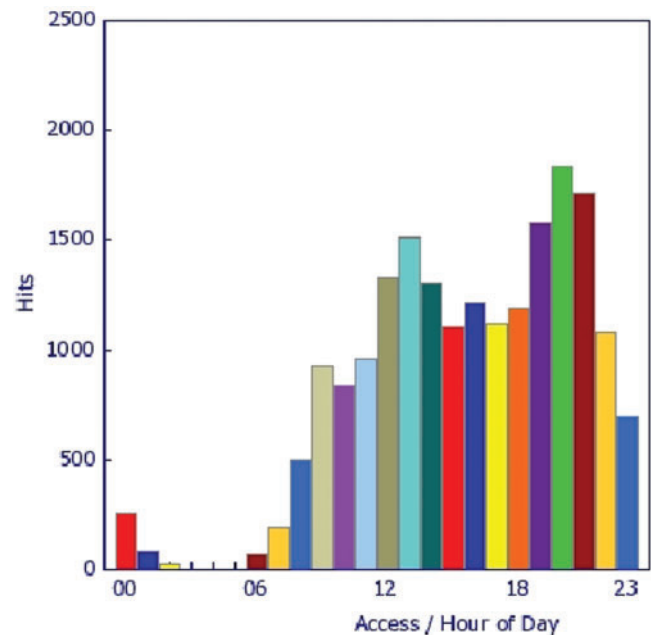
Other themes that emerged explaining the poor use of the discussion board included a fear of judgment from trainers or of looking foolish.

#### *Barriers to use of the VLE by trainers*

A lot of the trainers admitted that they do not use or look at the VLE very often. There was a perception from consultants based outside Bristol that the VLE was mainly for the trainees and the orthodontic trainers based in Bristol. This perception appeared to have been responsible for regional consultants gradually accessing it less and less. The preferred method of communication about the orthodontic course would be by email rather than via Blackboard.

A clear theme which emerged was the inconvenience of accessing yet another online site with yet another password.

*'I can get into it, but what I am finding and this just reflects life generally. I have got a password for the network here, a password for PACS. I have a different password for*



**Figure 2** Bar chart showing total number of trainee hits at different hours of the day from October 2005 to September 2006 (1 colour represents 1 h)

*the network in XXXXXX, a different password for PACS in XXXXXX. I have got email addresses at both ends. You get to the point where you have got so many passwords and pin numbers that you are kind of overloaded.'*

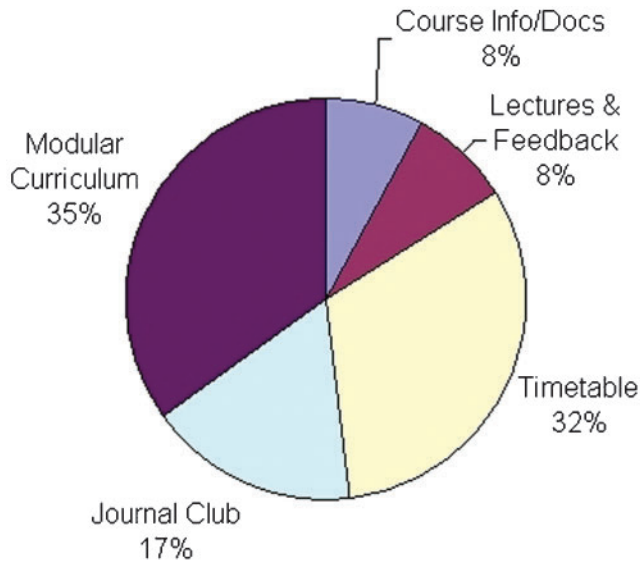
Generally it was felt that if access to the VLE could be streamlined then trainers would use it more.

#### *Diary data*

The diary data showed variation between trainees in the time of the day they accessed the VLE. Each trainee had an individual pattern of use. Data showed that the most frequently accessed areas were the modular curriculum, journal links and the timetable.

#### *Numerical data downloaded from the VLE*

Figure 2 shows the pattern of VLE use at different times of the day during the first year of the training programme. There were very few hits late at night or in the early hours of the morning. Peaks of use were at lunch times and in the evening between 7 pm to 9 pm. This pattern would be expected because the trainees have clinical and academic commitments in the mornings and afternoons of most weekdays, which would prevent them using the resource as much at these times. Figure 3 shows that during the first year of the course the part of the VLE accessed most frequently was the modular curriculum (35%). These data concurred with



**Figure 3** Pi chart showing frequency of access by trainees to different areas of Blackboard from October 2005 to September 2006

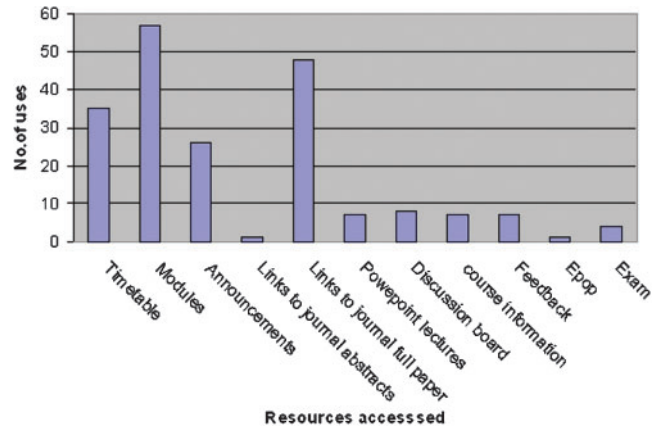
interview and diary data. The modules had been designed as the core of the programme on the VLE, to form the basis of learning. During the first year of the course it is likely that trainees would have used the VLE frequently because of the requirement to work through the modules and to complete associated essays and assessments. In the second year the modules would have been used for revision prior to an exam.

The downloaded data (Figure 4) also confirmed what had been found from interviews and diaries, that the timetable and journal links were also accessed frequently. The timetable had been designed to inform the trainees of the timing and location of their academic and clinical commitments and also to display forthcoming academic days. Trainees were able to view their commitments several months in advance and thus organize study, clinics and leave. The journal links allow students to access complete articles online thereby saving them a visit to the library.

## Discussion

### *Comparison of the VLE with Laurillard's conversational framework*

According to Laurillard's conversational framework,<sup>2</sup> optimal learning should be conversational in nature. Learning should be discursive, adaptive, interactive and reflective. The ability for interaction to take place between students and teachers and between students and the VLE itself is essential if these ideals are to be achieved. Thematic analysis of the qualitative data collected in this study and the diary data allowed us to



**Figure 4** Bar chart showing frequency of use of different areas of the VLE by trainees for a two week period prior to an assessment

compare the Bristol programme on the VLE with the different elements (characteristics) of Laurillard's framework.

The modules are the area within the VLE which describe teaching concepts. These modules have clear learning objectives and contain voluntary learning tasks and suggested activities. The students gain access to the teachers' concept by reading the modules. According to Laurillard,<sup>2</sup> for e-learning to be effective, a discussion must then take place to enable the student to describe their understanding of the concept, thus allowing the teachers to adapt their teaching in light of the students' description. For the first two trainees who used the VLE, these elements were effectively achieved in a number of ways. Video conferencing seemed to work well when online communication was restricted to a very small group of participants. This enabled discursive, interactive teaching at a distance. With the current cohort of eight students, video conferencing has only had a limited role. This is partly because of the technical problems experienced, but also because there are other opportunities for interaction which the trainees prefer e.g. tutorials and other organized teaching sessions. Indeed there was a strong feeling amongst trainees that face to face interaction with peers and teachers was essential for learning and to prevent feelings of social isolation. Interaction between teachers and students clearly takes place, but not necessarily online. Therefore although one of the objectives was to reduce the travel time for trainees this was not actually found to happen.

The discussion board, which could make online communication via the VLE more effective, has proved unpopular and there are a number of possible reasons for this. The lack of immediate interaction can make it seem impersonal and there is the fear of appearing ignorant in either posing or answering questions. There



is also anecdotal evidence that it is more difficult to sustain the discussion board when the topic is technical and quantitative, rather than qualitative in nature and where there is perhaps only one right answer.<sup>10</sup>

The first two students made effective use of the modular tasks with feedback from teachers. This was almost certainly because they had a need to do this, having only limited face to face contact with Bristol teachers. This element of the modules has not been effectively used with the main cohort of eight trainees.

Theoretically the conversational framework of learning described by Laurillard could be achieved more effectively through the VLE if the discussion board, video conferencing and modular tasks were more fully utilized. Whether there is a need for this appears to depend on the circumstances of the trainees.

On line assessments were suggested by participants in this study as a way of allowing students to gain feedback on their performance from the VLE. From the data collected, it is likely that students would support this idea unless it was perceived as a form of monitoring.

## The role of the VLE in orthodontic training

The revised GDC document 'The first five years'<sup>11</sup> (GDC 2002) identified learning outcomes which define the product of undergraduate education as, '*A caring, knowledgeable, competent and skilful dentist who is able, on graduation, to accept professional responsibility for the effective and safe care of patients, who appreciates the need for continuing professional development, who is able to use advances in relevant knowledge and techniques and who understands the role of patients in decision making*'. The same qualities would be expected of a specialist orthodontist.

From analysis of data collected from interviews and focus groups and from comparison with Laurillard's framework, the Bristol programme housed in the VLE does not support the level of online interaction that would be expected of a learning environment, which is a stand alone learning resource. However, the VLE only plays a part in the overall training of an orthodontic registrar.

*'What prepares you to be an orthodontist are your clinical skills, communication skills, which you are not going to learn on a VLE system.'*

*'However, on a day to day basis – with as far as orthodontics is concerned, it's a clinical past time – I think the important thing is being a good clinician.'*

Dent and Harden<sup>9</sup> described two types of VLE: a distance mode and a blended mode. When a VLE is used in the distance mode it is the sole platform for

educational delivery and should therefore provide a comprehensive package of learning. When a VLE is used in the blended mode it supports an academic course where the teachers and students have regular face to face teaching. Orthodontic training in the UK is based on a three year clinical training. Learning in the domains of knowledge, skills and attitudes are all important. Currently the Bristol VLE provides a comprehensive, up to date, flexible and well organized resource of knowledge which is blended with a clinical training programme and face to face teaching. Evidence from this research indicates that if there is less opportunity for face to face teaching, that the VLE can take a greater role in learning. However, clinical skills and appropriate attitudes are unlikely to be learnt from a VLE. The most appropriate use for a VLE in orthodontic training will be in the blended mode. Certainly it is well known that there are a large number of learning and teaching styles, and that both students and teachers have their own preferred styles respectively and which should ideally be matched for effective learning to take place.<sup>12</sup> In the case of a practical clinical subject such as orthodontics it is therefore perhaps inevitable that different styles of teaching will be required.

## Conclusions

This study provides evidence that the VLE has proved to be an extremely useful resource, which has had positive effects on postgraduate orthodontic teaching and learning. The flexibility of the VLE in allowing students to learn where and when they want is an important benefit.

The modules within the VLE provide comprehensive, up to date, peer reviewed and fully referenced summaries of relevant orthodontic topics. This is the most utilized area of the site at the present time and the area most valued by trainees. The organizational aspects of the VLE (timetable and announcements) are one of its main strengths and trainees feel that it has made their learning more efficient, reducing the amount of time spent searching for material or travelling to the library.

Two of the principal objectives of developing the modular curriculum in the VLE, were to reduce travel time for trainees and to reduce the demands on their academic trainers. In this respect it appears to have had little effect on the time trainees spend travelling

For the academic staff, the VLE has changed but not reduced teaching commitments. However the trainers feel that teaching has been more interactive and enjoyable since the introduction of the VLE.

## Recommendations

Regular feedback is required about the quality and content of the learning resources housed in the VLE in order to promote changes, to maintain and improve quality. Further expansion and development of this orthodontic modular programme housed within a VLE should be based on sound educational principles.

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## Contributor statement

Brian Mulgrew, Karen Drage, Penny Gardiner and Jonathan Sandy were responsible for development of the research methodology. Brian Mulgrew was responsible for drafting the article. Jonathan Sandy was responsible for obtaining funding. Brian Mulgrew and Karen Drage were responsible for data interpretation and analysis. Karen Drage, Jonathan Sandy and Tony Ireland were responsible for critical revision and final approval of the article. Jonathan Sandy is the Guarantor.

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