A Virtual Learning Environment to enable CPD for Orthopeadic Surgeons across Europe

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Abstract

The Virtual Orthopaedic University (VOU) is an EU-funded project which has developed a learning environment which links explicit pedagogical approaches to a set of specialised tools and resources, which will enable orthopaedic surgeons to facilitate the transfer of specialised expertise and knowledge in Image Guided Orthopaedic Surgery[1] (IGOS) techniques. It includes the development of a specific surgical course model for creating IGOS surgery multimedia courses, as well as the population and use of a Virtual observatory for collecting and describing different IGOS interventions. In addition material from the Virtual Observatory is being used in conjunction with the Dynamic Review Journal, as the basis for real life case discussions using the using the communication tools available in the learning environment.

The development of VOU is underpinned by a pedagogical approach built on current education research in terms of learning being situated and authentic; with learners adopting an active and constructive approach. An aim of the project is to maximise the relationship between different pedagogical approaches, tools and resources in a novel learning environment, while providing support for the decision making using a toolkit approach. The Virtual Orthopaedic University architecture can be used in a variety of different ways to support different types and levels of users and different syllabi. This paper describes the rationale behind the development of the system, the overall architecture, and the relationship between the architecture and the adopted pedagogical strategy.

This paper will describe the pedagogical strategy which underpins the VOU learning environment. It is based on the premise that surgeons have specialised needs in terms of the requirements of a learning environment. Specifically there is a need to analyse and build on an understanding of the:
- unique nature of the orthopaedic surgical knowledge and in particular the relationship between theoretical and pragmatic surgical concepts,
- rigour and validation requirements of orthopaedic surgery knowledge and the role and importance of apprenticeship as a means of ensuring standardisation and conformity.

[1] Arthroscopic techniques and computer assisted surgery (CAS) techniques

Introduction

Continuing Professional Development (CPD) is an essential part of the healthcare professions and the use of (Information and Communication Technologies) ICT provides an opportunity to improve the efficiency of both the teaching and the learning in the context of lifelong learners. Furthermore, surgeons are mobile well-educated individuals, whose work demands excellent availability of educational material that is up to date and focused to their particular learning situation. With the advent of virtual infrastructures, there is the potential to manage most of the administrative, research and educational workload associated with CPD within the digital domain. This has potentially huge benefits for surgeons by providing greater access to information without the friction associated with traditional infrastructures. Nonetheless really effective virtual learning environments are still relatively rare, in particular embedding innovative pedagogical practices is still problematic, This paper reports on a virtual learning environment which attempts to make particular pedagogical approaches explicit. The paper reports on the pedagogical strategy adopted within the VOU project and its relationship to the developed architecture.

VOU Implementation

VOU provide a working environment to help with familiarisation of new surgical procedures and the management of clinical case audit. The implementation enables users to communicate using material mediated for their specific needs allowing presentation of media to be adaptive to the user experience and knowledge base. This combines declarative (factual) content with feedback from a clinical (procedural) case-based training and evaluation environment.

The Orthopaedic Syllabus for training Higher Surgical Trainees (HST) is arranged by sub-specialty, the current version of the syllabus is a static entity (Gregg, Sher et al. 1999). It has no relationship to the learner's previous experience, beyond tacit acknowledgement of the fact that the trainees must have attained entry-level knowledge to attend the courses. The learning agreements allow the trainee and the tutor to agree the plan for the clinical experience and select suitable posts of a level of experience for the trainee to use for structured training purposes. The individual contract must be specific for the clinical post and the template can be used only as a recommendation. It is not prescriptive.

To ensure enhanced interoperability the construction of the metadata standards for the core components within the system confer to approved standards such as the Dublin core, Learning Object Metadata and Information Management System (IMS) (Smythe C, Shepherd E et al. 2002). Applicability (the ability to apply the technologies for other applications), and expandability (Wactlar, Christel et al. 1999; Witten, McNah et al. 1999) are vital characteristics of components in VOU. There are three underlying characteristics of the training needs of orthopaedics which need to be accounted for in the system developed:

1. There is a need for constant updating of the knowledge base for both procedural and declarative learning.
2. The learners typically have limited user time and computing expertise.
3. The specialist knowledge base varies according to experience and application.

Specialist knowledge includes both essential and important knowledge. The essential knowledge includes the part of the core curriculum relating to safety issues and with respect to this every trainee must be evaluated and demonstrate passable skills on every occasion. Important knowledge is also part of the core curriculum, although time is not formally available to test this, it will be included within the questions of the core modules. Important knowledge is that required to achieve a high quality of service, such as knowing a wide range of detail regarding conditions. The varying ability to pass this will constitute the grade of performance. The system developed to meet these requirements included the following components.

- *Multimedia Educational Modules*, which provide the declarative (factual) base of material for the education of the users.

- A *Virtual Classroom* environment for exchange of views, and monitoring of progress.
- A *Virtual Observatory* for the collection of data from simulation systems and the actual intra-operative data collection
- A *Dynamic Review Journal* (DRJ) is a web-based archive of medical and technical material, which is peer reviewed. The DRJ will allow students and tutors to analyse data from existing journals, investigate hypotheses, comment on reviewed articles, and even prepare and submit articles for review. In addition, tutors will be able capitalise on these reviews to include the corresponding declarative and procedural knowledge in the educational modules.
- Novel Modalities of *Simulation* [5,6] for the emulation of surgical procedures for training and experimentation focusing upon micro-surgery (Grange, Bunker et al. 1996; Grange, Bunker et al. 1997).

Pedagogy

The aim of the project was to create a novel learning environment which tries to maximise the relationship between different pedagogical approaches used to support learning, and the associated tools and resources available to support them (see Figure 1). The project builds on current thinking in educational research upon pedagogy in terms of learning being situated and authentic; with learners adopting an active and constructive approach, In particular it builds on the problem-based learning literature (Savery and Duffy 1996; Gallegher 1997), constructivism (Piaget 1954; Papert 1980), communities of practice (Wenger 1998), situated learning (Suchman 1988; Brown, Collins et al. 1989; Lave and Wenger 1990) and activity theory (Engestrom, Miettinen et al. 1999). The pedagogical strategy aims to create an environment, which allows the different benefits of each of these pedagogical approaches to be made explicit. Guidance and exemplars of how, for example, problem-based learning can be used in conjunction with collaborative learning, through the use of the case based learning (case scenarios), the *Dynamic Review Journal (DRJ)* and the communication environment, will be included as part of the learning environment.

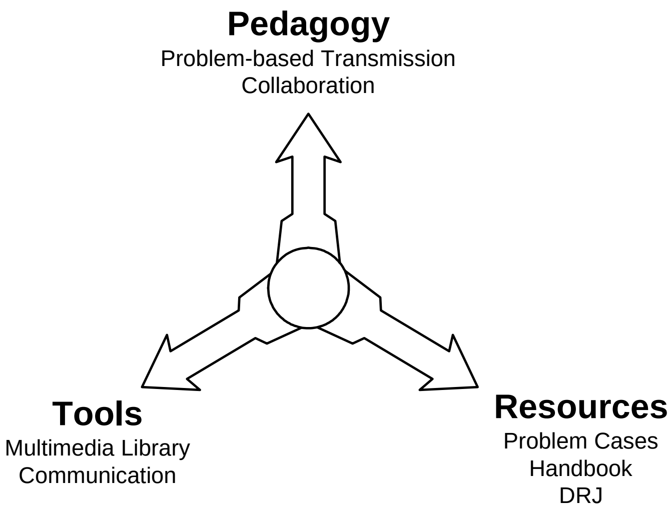

Figure 1 Relationship between pedagogy, tools, and resources

The pedagogical strategy is designed to invoke active participation using the multiple resources available in the learning environments. In addition, it is designed so that the users are motivated to learn about a topic by searching for, evaluating, and using authentic information. This learning experience mimics real life in targeting the learner as the routine information hunter and interpreter who constructs knowledge by problem solving with information tools. The advantages to this approach are that, this approach:

- Adopts a student-centred approach to learning;

- Promotes the development of thinking skills (problem solving, reasoning, and critical evaluation);
- Improves the research skills of the students, supporting the research-led mission of the partners;
- Is adaptable to students with different learning styles;
- Aims to ensure that work the students carry out is deeply interrelated with their work on academic and key skills.

The VOU learning environment consists of a supportive underpinning technical architecture and a range of supplementary guidance and tools. The tools and resources are designed to be flexible to enable their use at a number of levels, from major pedagogical re-engineering of courses through to enrichment of aspects of the learning process with engaging and illustrative resources. The process of using the environment consists of the following stages:

1. Mapping of curricula to pedagogical approaches.
2. Identification of appropriate teaching and learning methods.
3. Evaluation and selection of appropriate resources
4. Identification and integration of resources and tools
5. Delivery, evaluation, and refinement.

Figure 2 outlines the overall process showing the relationship between each of the stages. It is anticipated that these steps will be completely interactive.

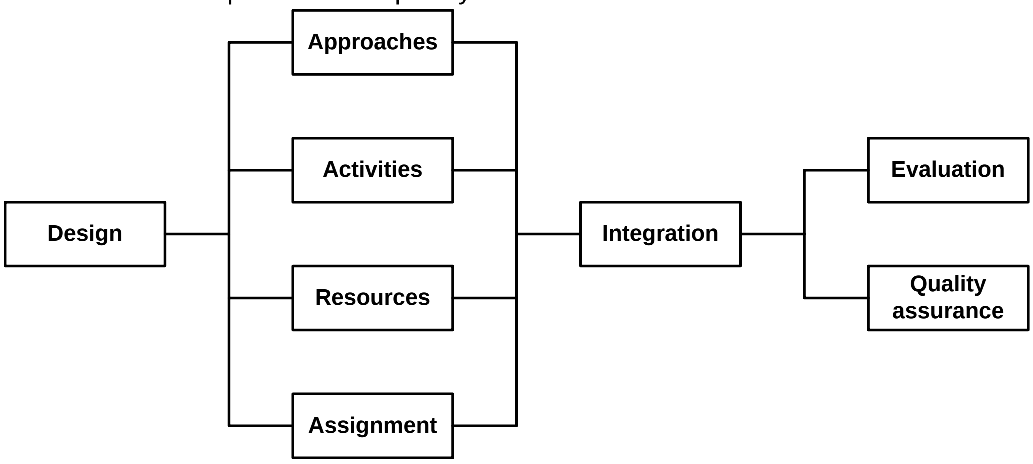

Figure 2 Educational Tool Development Process

The On-Line VOU Syllabus for Orthopaedics

The VOU architecture can be used in a variety of different ways to support different types and levels of users and different syllabi. The project also includes some specific courses and specific routes through the system, but can also be used flexibly by the user. An educational contract is drawn up to bring the educational syllabus and the learning agreements together. These provide a two-way proposal for the tutor and trainee to agree initially and then review as the clinical post progresses. The aim of the contract is to identify areas of overlap between the trainees's learning needs, the tutor's ability to focus upon specific clinical areas, the resources of the clinical department and case mix to provide relevant learning material and clinical experience. It maps on to the personal profile of the individual and can be used as the basis of providing a personalised route through the VOU system in accordance with their clinical role.

The benchmark for the syllabus and the learning agreements is the requirement for individuals to pass the Certificate of Completion of Specialist Training (CCST) exam. This will enable

1. Preparation of an *outline course infrastructure* for educators – such as course convenors or instructors and the tutors of individual trainees for specific courses or periods of in-house training (posts of usually 6 months duration).
2. *Curriculum* development which can be built dynamically, with units that can be combined and decomposed in meaningful ways. These can then be mapped onto the syllabus and structured to suit the individual learner's needs.
3. Documenting and recognizing the completion of existing or new *learning and performance objectives* developed as part of VOU.
4. Education, training, and learning organizations involved in VOU, to *monitor an individual's progress* as related to covering the syllabus.
5. The necessary *security and authentication* procedures (including non-repudiation) for the distribution and use of Learning Agreements in particular – in accordance with the data protection act and the laws of consent regarding patient information.

Surgical Ontology and the Learning Agreement

Within the VOU system, a surgical educational ontology is used as the basis for the learning agreements, this is coupled with the need for VOU to accommodate the organisational approaches of different individuals. By formalising the process, the VOU Learning Agreement ontology provides part of the pedagogological framework for the development of courses so that these may be integrated with the trainee's specific needs and the trainer's (clinical tutor's) ability to accommodate the specialised learning needs of the individual within the context of the most suitable caseload and experience within the setting of the clinical post. This contributes to the VOU philosophy of embracing all possible learning models by providing learning object metadata, which allows course convenors to build their own course structures, whilst focusing upon the problem-based learning model to allow multiple modalities to be presented to the trainee.

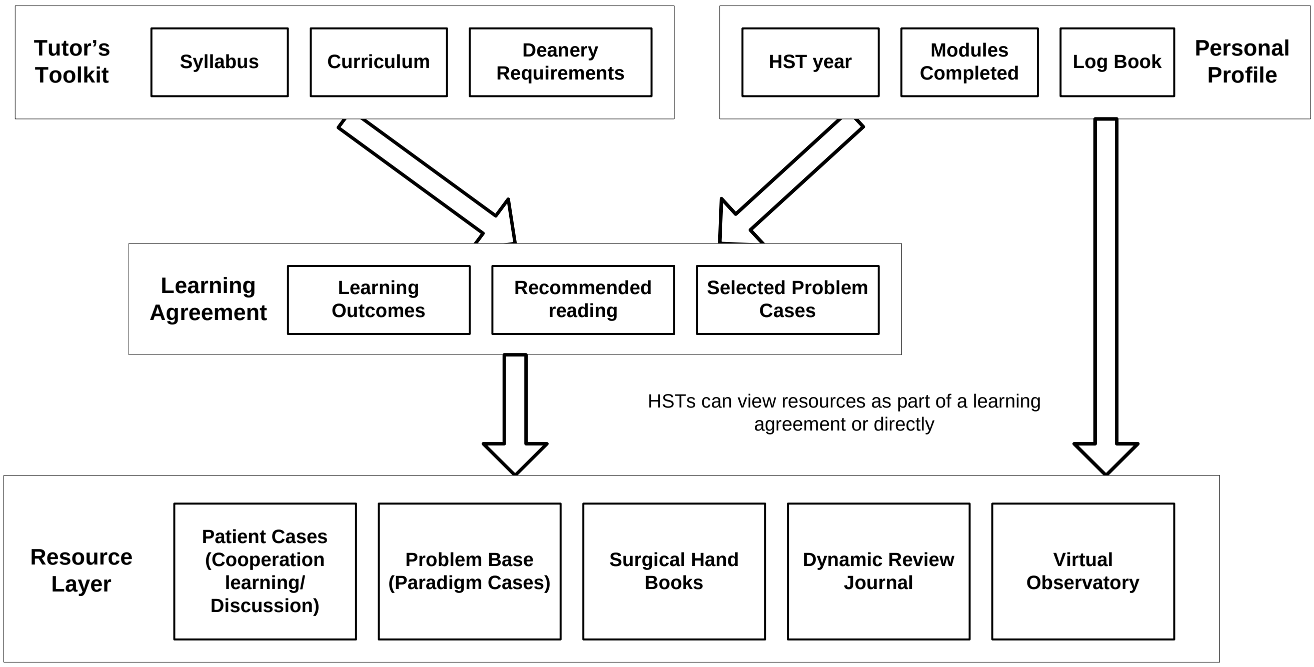

Figure 3 - Electronic Higher Surgical Training Infrastructure

Conclusions and Future work

Surgeons are mobile well-educated individuals whose work demands excellent availability of educational material that is up to date and focused to their particular learning situation. This reflects the need for life long learning material as well as the 'just in case' archives. New material is being collected constantly and this needs to be properly evaluated and integrated into the learning infrastructure appropriately. Part of the educational strategy employed relies upon the evolving university concept to allow for the updating and upgrading of educational material in light of new results, using analysis of incoming data from ongoing clinical trials for the evidence base. This acknowledges that a virtual university is a living infrastructure that evolves with time, due to changes both in its underlying philosophy and staff. To navigate the CPD requirements, new emerging and constantly changing medical world of the modern surgical professional, a cultural, technological, and social paradigm shift is occurring in orthopaedic surgical training within the UK. Technological solutions such as the VOU framework presented here have the potential to offer cost effective and timely solutions if used appropriately.

The development of a Virtual Orthopaedic University described in this paper is underpinned by a pedagogical approach built on current education research. The tools and resources are designed to be flexible to enable their use at a number of levels, from major pedagogical re-engineering of courses through to enrichment of aspects of the learning process with engaging and illustrative resources. To ensure that the different requirements from the stakeholders can be met, the Virtual Orthopaedic University architecture was designed to be flexible, that is, it can be used in a variety of different ways to support different types and levels of users and different syllabi. The Virtual Orthopaedic University has been developed in a consortium consisting of orthopaedic surgeons, educationalists and computer scientists, and has undergone expert review at several stages in its development. However, the financial implications of developing and using these types of systems, in a clinical environment, are not well understood and further investigation is required. The next phase is to conduct user evaluations of the VOU system; this will also include a multi-centre clinical trial using the dynamic review journal.

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