

*X World Conference on Computers in Education
July 2-5, 2013; Toruń, Poland*

Haptics Environments to Enhance Teaching and Learning in Higher Education

The interdisciplinary hapTEL experience

Chair: Margaret J. Cox, *mj.cox@kcl.ac.uk*

King's College London, University of London. UK

Discussant: Patricia Reynolds: *p.a.reynolds@kcl.ac.uk*

King's College London, University of London. UK

**Margaret J. Cox,
Jonathan San Diego,
Tim Newton,
Jon Hindmarsh,
Stephen Dunne,
Mark Woolford,
Alistair Barrow,
Lewis Hyland,
William Harwin,
Barry Quinn,
Tracy-Ann Green,
Arash Shahriari Rad,
Jenny Wright,
Neil Shah,
Stephen Scrivener
Patricia Reynolds**

Abstract – Session summary

The **hapTEL** project, has been developing and evaluating a virtual dental work-station since July 2007, with over 400 dental undergraduate students learning clinical skills. This involved three overlapping strands with a strong interdisciplinary focus:

- Strand 1 (technical) involving the development, evaluation and refinement of haptic devices and simulations in a 3D VLE setting;
- Strand 2 (curriculum and context) developing and refining the dental curriculum and associated teaching strategies through a blended learning approach;
- Strand 3 (educational evaluation) measuring the impact of the Technology Enhanced Learning (TEL) devices on teaching and learning.

Since July 2011 the work of the project has been augmented to include extending and evaluating the work-station for other health science teaching and studying the relationship between students' clinical and drawing skills. The symposium will present a range of recent interdisciplinary project results and draw on the symposium discussions to form the basis of an IFIP position paper on researching haptics in education.

Keywords

Curriculum; evaluation; higher education; interdisciplinarity; innovation; knowledge representation; theoretical models; multimedia; research; user interface; virtual reality

INTRODUCTION

There is now substantial evidence spanning 40 years of the positive effects which different types of Technology Enhanced Learning (TEL/(ICT) can have on students' learning (e.g. Voogt and Knezek, 2008), which includes recent evidence from the hapTEL project of the impact of haptics on students' learning in dental education (San Diego et al., 2012). However, apart from the hapTEL results there is as yet very limited evidence of the effects of new multimedia technologies on teachers' pedagogies, the integration within the curriculum and the transformation of learning in **post-compulsory** education for the professions. An important approach to address these gaps in the research is to involve researchers and end users across a range of disciplines including clinicians and users with expertise in instrumentation, psychology, sociology, clinical practice, human computer interfaces (HCI) and educational research. Using the work of the HapTEL project's interdisciplinary team, this symposium will draw on the results and experience from the last five years to identify:

- strategies for the development and incorporation of innovative techniques in higher education;
- effective methods for evaluating the impact of these multimedia devices on the curriculum and on learning;
- strategies and methods to promote interdisciplinary research and development in E-learning.

SYMPOSIUM ORGANISATION – 120 MINUTES

Aims of the symposium:	5 minutes
Contributions:	5* 18 minutes
Discussant:	5 minutes
Feedback from the audience:	20 minutes

REFERENCES

- San Diego, J.P., Cox, M.J., Quinn, B., Dunne, S., Newton, T., Woolford, M., (2012) Researching haptics in higher education: the complexity of developing haptics virtual learning systems and evaluating their impact on students' learning. *Computers and Education*. 59 (1) Pergamon. 156–166
- Voogt, J. & Knezek, G. (Eds.) (2008). *International Handbook of Information Technology in Primary and Secondary Education*. Berlin, Heidelberg, New York. Springer

Copyright

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/3.0/>

Haptics Environments to Enhance Teaching and Learning in Higher Education

Researching the Impact of Haptics in Higher Education: Matching the Methods to the Technology and the Theories

Margaret J. Cox, Jonathan San Diego, Tim Newton, Jon Hindmarsh, Stephen Dunne and Mark Woolford

Abstract

Prior to the start of the hapTEL project, the interdisciplinary team identified many different factors which needed to be considered when measuring the impact of haptics on teaching and learning, drawing on two theoretical frameworks (Entwistle, (1987, 2009) and Webb and Cox (2004)). These frameworks formed the foundation for using a range of quantitative and qualitative methods to measure the impact of TEL on curriculum change, teachers' pedagogical practices, students' learning and on institutional practices.

These included ICT surveys, psychometric tests, self-assessment questionnaires, task performance evaluation scales, observational techniques and computer logs of students' performances. The results, a range of which will be presented and discussed in the symposium, show that institutional and departmental factors should be considered when evaluating the impact of TEL in higher education and that these had a major influence on the design and curriculum integration of the hapTEL systems. The conclusions from this presentation confirm earlier reviews of researching TEL that technology integration is extremely complex and the related research requires a comprehensive approach of both quantitative and qualitative methods if one is to take account of the range of variables identified by theoretical frameworks.

REFERENCES

- Entwistle, N. (1987). A model of the teaching-learning process. In J. T. E. Richardson, M. Eysenck, & D. Piper (Eds.), *Student learning: Research in education and cognitive psychology* (pp. 13–28). Milton Keynes: Open University Press.
- Entwistle, N. (2009). *Teaching for understanding at university: Deep approaches and distinctive ways of thinking*. Basingstoke Hampshire; New York: Palgrave Macmillan.
- Webb, M., & Cox, M. J. (2004). A review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education*, 13(3), 235–286.

Haptics Environments to Enhance Teaching and Learning in Higher Education

Interdisciplinary TEL Research in Higher Education: the hapTEL Experience

Margaret J. Cox, Jonathan P. San Diego, Alistair Barrow, Jon Hindmarsh, Lewis Hyland, William Harwin and Barry Quinn

Abstract

Researching the impact of haptics in education required the interdisciplinary team to use a range of development and research methods relevant to the contributing disciplines. Strand 1 (technical) included: taking haptic profiles of the mouth and tooth by MRI/CT topographic images, 3D scans and anatomical cross sections; and developing hand-held haptic tools and onscreen graphics and developing interfaces for sharing feedback information between students and between the student and the lecturer. Strand 2 (curriculum) addressed the fact that the system would be embedded in the socio-interactional contexts of teaching and instruction and the methods and analysis have therefore included those informed by ethnomethodology and conversation. These included identifying the dental course components in which haptic use could be incorporated; video-based studies of tutor-student interactions with and around the hapTEL system and collecting comparative materials from more traditional clinical skills labs (CSL), followed by an ethnographic analysis of audio-visual data through the identification of themes. Strand 3 involved a 2-year full randomised controlled trials across multiple baselines comparing the standard approach to teaching with a teaching approach accompanied by haptic devices. The range of results will be presented at the symposium and a taxonomy of the influential factors which relate to haptic levels of emersion and transfer from a multidisciplinary perspective.

Haptics Environments to Enhance Teaching and Learning in Higher Education

A Proposed Behavioural Prediction Model for Measuring Students' Satisfaction with Dental Simulators: Implications for Measuring Attitudes Towards Using TEL

Tracy-Ann Green, Jonathan San Diego, Tim Newton and Margaret Cox

Presenter: Tracy-Ann Green

Abstract

An important area of research in TEL for many years has been to measure the effects of students' and teachers' attitudes on the uptake by teachers and impact on students' learning (e.g. Knezek and Christensen, 2008). Several models for measuring students' behaviour such as the Theory of Planned Behaviour (TpB), Technology Acceptance Model and general motivational models have been examined by the hapTEL project to develop a model which can be used specifically for simulators. A questionnaire containing fifteen constructs was piloted to ten Year 2 dental undergraduates. After having established its validity and reliability, 132 Year 1 undergraduate dental students completed the questionnaire at the beginning of the term. The students then went on to attend their formal studies where they were trained using either the mannequin head simulator or the hapTEL virtual dental simulator. The questionnaire was re-administered after the term to test whether the model can predict different stages of student satisfaction, e.g. perceived level of satisfaction before using a particular simulator. The results show acceptable levels of reliability and validity and the ability to predict the different stages of students' satisfaction with using the simulators. The presentation will discuss the evidence showing that this model can test student satisfaction with medical simulators and can be applied to all task-trainer simulators.

REFERENCES

Knezek, G. & Christensen, R. (2008). IT Competencies and attitudes. in J. Voogt, & G. Knezek. (Eds.) *International Handbook of Information Technology in Primary and Secondary Education*. Berlin, Heidelberg, New York. Springer. 319-420

Haptics Environments to Enhance Teaching and Learning in Higher Education

Investigating Traditional and Technologically-enhanced Assessment Methods for Dental Clinical Skills

**Arash Shahriari Rad, Mark Woolford, Margaret Cox
and Jonathan P. San Diego**

Abstract

The aim of this research was to compare different traditional and TEL techniques used to assess students' clinical skills, using standard psychometric tests as a baseline measure. The work reported here is about the relationship between psychometric assessments and their association with those used traditionally to assess clinical skills. The KCL-DI traditional methods for assessing the clinical skills of Years 1 and 2 dental undergraduates is by providing formative feedback in the clinical laboratory sessions, followed by summative assessment of their performance at the end of their second year. Previous research has shown that students' clinical skills are dependent upon their gross and fine motor skills which also play an important part in any haptic interaction such as Wii computer games. These spatial reasoning and motor skills were measured through five different psychological tests which will be described in the presentation. The third method was to record the students' performance using the hapTEL workstations through computer logs which showed the time taken, the amount of decayed and healthy tooth removed and whether or not the pulp had been exposed. The results of these three different assessment methods will be presented in the symposium to inform TEL assessment methods and their relative merits, such as, by using the virtual system through logging students computer operations, providing immediate feedback and more accurate feedback than those used traditionally to assess practical clinical skills performance (spasmodic feedback provided by the tutors in the traditional laboratory).

Haptics Environments to Enhance Teaching and Learning in Higher Education

hapTEL Related Drawing Research in Surgery and Medical Education: An Interdisciplinary Perspective

Jenny Wright, Barry Quinn, Margaret Cox, Neil Shah, Stephen Scrivener and Patricia Reynolds

Abstract

This study is part of a growing interdisciplinary area called STEAM (Science, Technology, Engineering, Arts and Mathematics) which researches the relationship between concepts, skills and processes across these five disciplines. The specific aim of this research is to identify the links between haptic and visual skills used in drawing and simple dental surgical procedures; and consequently how the haptic sensory perceptions related to drawing apply to the fields of medicine and dentistry. The hypothesis is that practical drawing activities can improve confidence in specific motor skills in conjunction with virtual learning tools. The long-term objectives are to: increase levels of awareness of sensory perception during activities that incorporate fine motor manipulation; improve confidence in using tools with two hands simultaneously; and be incorporated into practical training for a wide range of surgical procedures, especially in improving haptic learning tools. The research methods include: a dental drawing activity for the Year 1 cohort of dental undergraduate students (n=144); dental drilling tasks using the hapTEL work stations; and computer log files of every student's cavity preparation performance. The results to be presented in the symposium will show the relationship between drawing and dental skills and performance and how these can inform the development of haptic technologies particularly 3D interface design and a practical example of a pedagogical strategy that could incorporate TEL methods into undergraduate and post-graduate programmes both in dentistry, surgery and other related studies.

Copyright

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/3.0/>