USING A VIRTUAL REALITY LEARNING ENVIRONMENT (VRLE) TO MEET FUTURE NEEDS OF INNOVATIVE PRODUCT DESIGN EDUCATION

G. Thorsteinsson and T. Page
Department of Design & Technology, Loughborough University, UK

ABSTRACT
Innovation Education (IE) is a recently developed subject area in Icelandic school education. The aim of IE is to train students to identify needs and problems in their environment and to develop solutions: a process of ideation. Until recently, this activity has been classroom-based but now the ideation process is supported by a customised Virtual Reality Learning Environment (VRLE). Furthermore, this technology supports online communications between students and teacher and enables them to develop drawings and descriptions of their solutions. The VRLE is based on computer supported collaborative learning (CSCL) and proffers future directions and opportunities in product design education. As this learning environment is new it is important to explore and evaluate its use and value. This paper describes the pedagogical model for design based collaborative learning and research underpinning its evaluation. These are discussed in relation to constructivist learning theories. This work has been partly funded by the European Comenius research and curriculum development funding body in collaboration with the FISTE project.

Keywords: Product design Education, Ideation, Pedagogy, Virtual Reality Learning Environment.

1 INTRODUCTION

Novel and exciting ways of stimulating and simulating design education through the use of ICT need to be more fully explored. However, it is clear that the use of Computer Supported Collaborative Learning (CSCL) environments have given rise to new and innovative ways of teaching and learning in product design education. Further to this, it is acknowledged that teaching and learning processes have been technologically driven as opposed to pedagogically led. Previous research in the field of human computer interaction has studied the effect of presence, within such environments [1]. This research has identified the need to map the pedagogical and theoretical implications of using VRLE technologies in product design education. This has led to the creation of a pedagogical model as a foundation for using such advanced technology. This paper will describe this model and its implementation.

1.1 Computer Supported Collaborative Learning (CSCL)

Individual learning has been at the root of much learning research particularly from the behaviourist school. The role of others in this learning process is often regarded as supportive at best. Nevertheless, more recently, such approaches of the way in which learning occurs are being disputed. Of particular note is the inventive empirical work of researchers who base their theoretical framework [2], [3].

Vygotsky's suggestion of the "zone of proximal development" (ZPD) as the site where learning occurs [2]. This zone is formally defined as: "the distance between the actual developmental levels as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." [2]. This concept has been at the heart of the educational research of several groups that is very relevant in the current context, as they all emphasise the importance of studying learning as a collaborative process, and they have also used the computer as a medium in which to provide new contexts in which this collaborative learning might take place [4].

Greater emphasis on field research and actual observation of joint problem solving activity is evident. In this work, we can see several papers, besides this one, that are influenced by this framework [5]. It is difficult to view the studies on collaborative learning as a whole, however, as the studies themselves often differ radically in both the theoretical perspective adopted and in the research paradigm used. Let us just note here some of the differences in the research on "collaborative learning". Who or what is collaborating with whom, and under what conditions? While most papers do not address this issue specifically, the range of meanings appears quite broad, in that for some it consists of a single individual collaborating, not with another person at all, but with a computer system [6]. For others it is the study of two randomly chosen subjects collaborating on solving an artificial task, chosen by the experimenter, on a computer.

At the most basic level, the computer can be used simply as a data-gathering tool that can support the investigation of collaborative learning processes between people, allowing for presentation of a task, and perhaps recording of responses, and later analysis of these responses. In this case, the computer makes the task of the researcher easier but does not really affect the collaborative learning process per se. The computer is playing a rather passive role that could be replaced, though more awkwardly, with other possible tools such as pencil and paper. This does not really fall under the rubric of what CSCL implies. More innovative work provides a rich micro world on the computer, which students can interact with individually, and collaboratively.

1.2 Future Innovative In-Service Teacher Education (FISTE)

Previous pedagogical models have failed to take into account new contextual and mobile methods of learning with the advances in technology-mediated learning. This article put forward a pedagogical model namely future innovative in-service teacher education (FISTE). The work was sponsored by the European Union Comenius fund and directed by the University of Targoviste in Romania. The FISTE project is concerned with educational use of information and communication technologies (ICTs) in support of product design education. In particular with the development and

dissemination of a new pedagogical model for distance learning through in-service teacher education (FISTE), in schools across Europe.

The model is based on the use of a virtual learning environment, with supporting Internet and database technologies, to facilitate collaborative learning in the context of in-service teacher education in support of product design education. The project use the on-line Virtual Learning Environment platform BSCW as a tool to facilitated the way the participants work together. It is a continuous meeting place for them, a stable base to work from and at the same time an easily accessible archive of the entire FISTE project teaching material all the undertaken activities are based on.

The participants build up expertise together and develop the in-service teachers' skill and knowledge through the on-line courses. The whole group goes through a number of separate and clearly structured stages with each other, with rotating independent responsibilities (to keep each one of us alert and motivated), pooled resources and knowledge for making joint selections. The development of the appropriate pedagogical model focuses on the practical uses of information in product design education and the educational use of ICTs. A pedagogical model and number of teaching, studying and learning processes have been devised and implemented, within this virtual learning environment and current research considers strategies for their assessment and evaluation [7].

The participants are from six countries: Romania, United Kingdom, Finland, Iceland, Spain and Latvia. The participants have used problem based learning (PBL) to create a course that integrates both face-to-face and web-based learning tools. In-service teacher education is not efficient if it is not a real part of teachers' daily work. The costs for courses prohibit schools from sending their product design teachers to be trained in the such courses. The future demands more and more up grading in knowledge and teaching methods. In-service teachers find it difficult to be away from work for a long time. In-service teachers must experience learning by using ICT for open and distance learning through such CSCL environments.

The on-line course is for product design teacher trainers in Europe that want to use ICT in their teaching in a professional and pedagogical manner. Basic skills and knowledge will be given in relation to use of Internet based Collaborative Platforms (BSCW©); pedagogical theories for using ICT in teaching and learning and how ICT based technologies can be implemented in teaching. The course presents methods for integrating face-to-face and web-based learning tools. It will be available not only through traditional Internet services (like e-mail), but mainly it will be provided to teachers on the Basic Support for Cooperative Work (BSCW©) e-learning environment, see figure 1.

2 SPECIALIST-BASED ACTION RESEARCH METHODOLOGY

The Fiste project implemented action research over the project's three years period. Action research was chosen as a way to observe the educational activity in the project in order to develop the online in-service teacher course. One of the key principles in action research is participatory: it is research through which practitioners work towards the understanding and improvement of their own practices.

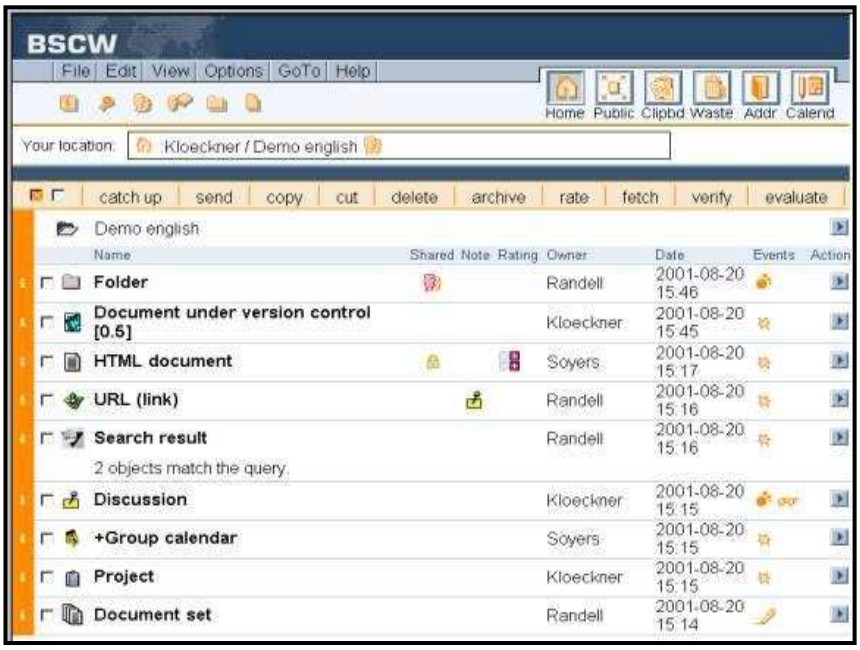

Figure 1. Screenshot from the online collaborative platform (BSCW©)

Action research can be described as a style of research rather than a specific method. The term was first used, a social scientist concerned with inter-group relations and minority problems in the United States. The term is now identified with research in which researchers work explicitly with and for practitioners rather than undertake research on them. Action research focuses on generating solutions to practical problems and its ability to empower practitioners, getting them to engage with the researcher and the subsequent "development" or implementation activities. The important characteristic of each cycle is that the researcher plans before acting, and reflects on the findings and the method after acting. The reflection at the end of each cycle feeds into the planning for the next cycle. Knowledge and understanding builds up through data analysis, see figure 2.

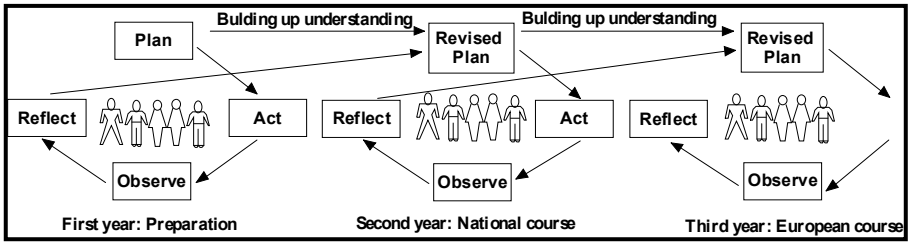

Figure 2. The action research cycle supported the project's progress.

The Fiste used a Specialists' Research Methodology (SRM) similar to the Delphi method. The participants in the project were chosen because of their expertise in

product design education. The SRM recognizes the value of expert opinion, experience, and intuition and allows using the limited information available in these forms, when full scientific knowledge is lacking. The SRM is a systematic interactive forecasting method based on independent inputs of selected specialists. These specialists are asked to predict quantities. The SRM is not always a face-to-face small group technique. It is most commonly used for future forecasting by a panel of experts. It often takes place via numerous rounds of emailed reviews.

The participants in the Fiste project are from five different countries. They communicated as a team over the Internet during the developing periods. After each round, the projects' coordinator gave a review of the specialists' forecasts and their reasons for them. Then the participants met face to face to review the project further and look in to the future together before planning the next steps.

The Romanian coordinator of the Fiste project was the projects facilitator, as he facilitated the responses of the specialists' panel, which were selected for the reason of product design teachers' training. The coordinator held knowledge on an opinion or view of the project. This was based on questionnaires, surveys etc. Then the panel of specialists' followed the instructions and presented their views. Responses were collected and analyzed and common conflicting viewpoints were identified.

The first online course has been reviewed by using SRM approach through on-line communications between the participants and the organisers of the course. In the end of the project, the online course will be reviewed again to study the future of using ICT in product design teacher education. The Project it self will also be reviewed by external academic specialist to evaluate its value for product design teachers education in Europe.

3 LEARNING ACTIVITY IN ENVIRONMENT

This project is based on Computer Supportive Collaborative Learning (CSCL) using the BSCW on-line platform. As such, courses and lessons have been primarily designed for in-service training based on the application of the BSCW platform for product design teachers as well as initial teacher training providers. The overall aim is to develop knowledge and understanding for using CSCL technology and establish how information and communication technologies (ICT) can be used to encourage, practical use of knowledge and understanding through communication and collaboration in education.

The FISTE project is based on the cross-cultural collaboration in developing these ideas further in different phases, from the early stages to the present using, e.g. focus group sessions, by email and Internet-based online video and voice conferences, since the projects began in 2004. The project takes the form of an interactive CSCL environment, where students are provided with the tools, materials and necessary interactions for their independent thoughts to become ideas and ultimately become products in the form of delivered project.

A successful aspect of this work has involved schools and product design teacher training providers, building culturally different work in in-service teacher education, in

participating countries. The European meetings with the trainers in the project have been formed a sustainable outcome of the project and forms plans for the CSCL environment content. In the project, a pedagogical model for in-service teachers training based on CSCL courses developed and implemented over the Internet.

4 CONCLUSION

The work reported here has been based on experiences by the participants in each country, sharing such experiences, and structuring a flexible CSCL learning environment for teachers, students and teacher training providers in the field of product design teacher education. Thus, the second stage is the dissemination of projects content within each, product design teacher trainers, in-service teachers and using the learning environment. The third stage of this project is a European-wide dissemination of the FISTE pedagogical model based on the experience of the first two stages. The project is intended for technology education curricula across European collaborating countries involving initial teacher-training providers, in-service teaching provision for dissemination in the classroom. The deliverable of this project is a teaching, studying and learning environment integrated with a database, which stores user information, equipped with relevant tools for idea generation and development of the FISTE pedagogical model.

REFERENCES

[1] Steuer J. *(1992).* Defining Virtual Reality: Dimensions Determining Telepresence. *Journal of Communication*. 42 Issue (4).

[2] Vygotski, L. S. (1978) *Mind in Society. The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

[3] Leontiev, A. N. (1978) *Activity, consciousness, and personality.* Englewood Cliffs, NJ: Prentice-Hall.

[4] Newman, D., Griffin, P. & Cole, M. (1989) *The Construction Zone: Working for cognitive change in school*. New York: Cambridge University Press.

[5] Lehtonen, M., Thorsteinsson, G., Page, T. and Ruokamo, H.(2005) "A Virtual Learning Environment for the Support of Learning in Technology Education", *Advanced Technology for Learning*, ACTA Press, 2(3), 2005, pp 129-139, ISSN 1710-2251.

[6] Galperin, P. J. (1989). Organization of mental activity and effectiveness of learning. *Soviet Psychology*, 27(3), 65–82.

[7] Appelt, W., Mambrey, P. (1999). Experiences with the BSCW Shared Workspace System as the Backbone of a Virtual Learning Environment for Students. *GMD - German National Research Center for Information Technology.* Accessed via WWW. http://bscw.gmd.de/Papers/EDMEDIA99/index.html (16.november 2006).

G. THORSTEINSSON
Department of Design & Technology
Loughborough University
UK
cdgt@lboro.ac.uk
+44 (0) 1509 228320
+44 (0) 1509 223999