Chapter XVII

Computer–Aided Personalised System of Instruction for Teaching Mathematics in an Online Learning Environment

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ABSTRACT

This paper presents a case study of a university’s discrete mathematics course with over 170 students who had access to an online learning environment (OLE) that included a variety of online tools, such as videos, self-tests, discussion boards, and lecture notes. The course is based on the ideas of the Personalised System of Instruction (PSI) modified to take advantage of an OLE. Students’ learning is initially examined over a period of 2 years, and compared with that in a more traditionally taught part of the course. To examine students’ behaviour, learning strategies, attitudes, and performance, both qualitative and quantitative techniques, were used as a mixed methodology approach, including in-depth interviews (N=9), controlled laboratory observations (N=8), surveys (N=243), diary studies (N=10), classroom observations, recording online usage behaviour, and learning assessments. In addition, students’ attitude and performance in 2 consecutive years where PSI was applied to the entire course...
provides further understanding that is again in favour of PSI in the context of OLE. This chapter aims to increase understanding of whether PSI, supported by an OLE, could enhance student appreciation and achievement as findings suggest.

INTRODUCTION

As Online Learning Environments (OLEs), such as WebCT® and Blackboard®, are becoming more widely used, the role of teachers changes as they adapt to their new mode of teaching (Coppola, Hiltz & Rotter, 2002). It remains a challenge however for teachers to use these technologies effectively (Hiltz & Turoff, 2002), and benefit from the suggested advantages of OLEs over traditional classroom learning. These include being more learner-centred, providing flexibility as to the time and the location of learning, being cost-effective for learners, and potentially serving a global audience (Zhang, Zhao, Zhou & Nunamaker, 2004). This paper arises from the experience obtained in delivering a mathematics module for both Computer Science and Information Systems undergraduate students in a UK based university. The first term of the module, which focuses on discrete mathematics, makes extensive use of OLE tools, such as online self-tests, video clips and a discussion board, whereas the second term, which focuses on statistics, is taught by a more traditional lecturer based approach. Comparing the data obtained in the two terms during the academic years 2003-2004 and 2004-2005, gives an insight into how students perceive these OLE tools and into how they affect students’ learning strategy and the learning outcomes.

The teaching method used in the first term is based on the principles of the Keller Plan (Keller & Sherman, 1974), also known as the Personalised System of Instruction (PSI). Although these principles were already published in the sixties (Keller, 1968), the observations presented here suggest that they can be highly relevant when teaching is supported by an OLE. The principles of PSI can be summarized as “(1) mastery learning, (2) self-pacing, (3) a stress on the written word, (4) student proctors, and (5) the use of lectures to motivate rather than to supply essential information.” (Keller & Sherman, 1974, p. 24). PSI has been applied to courses in various areas such as psychology (Kinsner & Pear, 1988; Pear & Crone-Todd, 2002), physics (Austin & Gilbert, 1973; Green, 1971), mathematics (Abbott & Falstrom, 1975; Brook & Thomson, 1982; Rae, 1993; Watson, 1986), and computer science (Koen, 2005). PSI has received extensive attention in the literature. For example, ten years after its introduction Kulik, Kulik and Cohen (1979) could base their meta-analysis on already 72 different papers, and today PSI is still a topic that receives research attention. In all these years teachers have successfully used PSI, although often they have made some modifications so that it fits into their academic environment (Hereford, 1979). The trend towards high marks has been a recurring observation. The original PSI description talks of a self-paced learning approach where students have to prove mastery of learning material that is divided into small learning units. For each learning unit students receive written material, which includes the learning objective for that unit. Students study the material on their own or in groups, and when they think that they have mastered the unit they take a test. An instructor or a student assisted, called a proctor, immediately marks this test in the presence of the students. If they answer all questions correctly, they receive the written material for the next unit. If they fail,
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