

## Chapter 7.19

# Behaviour Analysis for Web-Mediated Active Learning

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### ABSTRACT

Software-mediated learning requires adjustments in the teaching and learning process. In particular active learning facilitated through interactive learning software differs from traditional instructor-oriented, classroom-based teaching. We present behaviour analysis techniques for Web-mediated learning. Motivation, acceptance of the learning approach and technology, learning organisation and actual tool usage are aspects of behaviour that require different analysis techniques to be used. A combination of survey methods and Web usage mining techniques can provide accurate and comprehensive analysis results. These techniques allow us to evaluate active learning approaches implemented in form of Web tutorials.

### INTRODUCTION

Since its inception, the Web has been widely and successfully used as a platform for teaching and learning. Technology-mediated teaching and learning, however, requires adjustments in the teaching and learning process for both instructors and students. The complexity of the symbiotic relationship between learning and instructional design on one hand, and technology and tool mediation on the other needs to be understood. Rose (1999) observes that the words “interactive” and “interactivity” proliferate in texts on educational computing, despite their apparent lack of denotative value. However, it seems to be understood widely that interactive instruction is learner-controlled, an opportunity for students to engage in active, hands-on exploration (Northrup, 2001). Interactive tools can enable active learning in a constructivist style if they create a representation of reality in which learning is relevant. According to Ravenscroft, Tait, and Hughes (1998), students

integrate the use of computer-based learning resources into their study habits in an incremental fashion. Instructors need to carefully analyse the learning behaviour with new educational technologies in order to support new student learning processes through an incremental instructional design approach.

The Web-mediated interactive tutorial system that we are going to analyse is part of an undergraduate course in computing. This tutorial allows students to construct programming knowledge and acquire programming skills in the database language SQL through engaging and interactive exercises based on meaningful problems, (Pahl, Barrett, & Kenny, 2004). At the core of the tutorial is an interactive submission feature that allows students to execute programs and that gives feedback on those submissions. Engagement in the learning process is, according to Northrup (2001), a key objective in interactive instruction. In self-controlled environments, students actively construct meaning to determine how to proceed in the learning activity.

The goal of this investigation is the behaviour analysis of tool-mediated active learning. We demonstrate novel analysis techniques for the evaluation of learning behaviour in tool-mediated, interactive environments that combines classical survey-based techniques with Web usage mining technology. The motivation to analyse and evaluate the students' learning behaviour and learning processes is to gain an understanding of student learning in interactive learner-controlled environments. This is a prerequisite for the successful and effective implementation of instructional design for active learning and for the empirical evaluation of the implementations.

## **THE INTERACTIVE TUTORIAL**

An interactive tutorial is a software tool that facilitates active learning in a guided learning process. Learners learn to solve problems in a

dialogue with the tool. The interactive tutorial we analysed is part of an undergraduate courseware system for a database course, part of a computing degree, with online lectures, tutorials, and labs that is implemented using Web technologies and accessed through Web browsers and plug-ins and that supports active and autonomous learning (see Figure 1). This environment is the target of our experimental and empirical study of learning behaviour.

Solutions to programming problems, which are presented as a guided tour through the material, can be submitted through a Web interface to a remote database server, which executes the input and replies with data from a database, or error messages (right-hand side of Figure 1). Scaffolding in form of feedback, self-assessment functionality, and links to background material is available (bottom and left-hand side of Figure 1). The tutorial prepares the student for coursework, such as lab tests and projects, and final exams. The courseware system aims at providing the student with a realistic learning context by integrating features and problems into a learning environment that are similar to tools and tasks that would be faced by a database engineer in a real development scenario.

## **METHODS**

Our research goal is the analysis and evaluation of student learning behaviour in tool-mediated active learning environments. We define tool-mediated active learning as a software-supported approach to learning where a learner creates knowledge, in other words, a meaningful representation of some part of reality, within the software environment. Behaviour in learner-controlled environments is determined by the learners' motivation, their acceptance of pedagogical approach and technical environment, their learning organisation, and their activities in the environment (i.e. tool usage). Consequently, the instruments for the behaviour

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