Chapter 10
Capturing Learning over Time for Supporting Pedagogical Decision Making: A Process Modeling Approach

Peter Reimann
University of Sydney, Australia

Wilfrid Utz
BOC, Austria

Roland Unterberger
Joanneum Research, Austria

Wolfgang Halb
Joanneum Research, Austria

ABSTRACT

This chapter aims for a methodological contribution to online learning research and to the practical use of temporal information for pedagogical decision making. The authors address two interconnected concerns: how to describe the temporal features of teaching/learning activities and how to capture learning activities across learning applications and time. The main argument is that the analysis of temporal processes based on student data that can be automatically captured (in log files and through other means) will benefit from an explicit modeling of the teaching process,

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because in this way, some of the problems associated with a purely inductive approach to process and sequence mining can be overcome. In terms of advancing the state of the art, the authors suggest an approach that is grounded in meta-model architectures for process modeling and demonstrate its advantages with respect to tracking and monitoring students’ learning activities across learning applications. After providing some background on long-term learning, the chapter describes the conceptual as well as several of the implementation solutions developed in the EC-funded NEXT-TELL project.

INTRODUCTION

An important step to enable technically captured data, (e.g. log files from learning management systems), useful for teachers’ and students’ ‘tactical’ decision making (i.e. What to do next?) is to express the information on the level of knowledge and skill development, processes of learning, motivation and engagement. Teachers usually obtain this information from direct observations, and from formative assessments, such as quizzes or problem solving exercises. In the online classroom, the main source of information in addition to quizzes and exercises are the recordings of learning activities as they unfold in digital media. It may be in the form of software applications, learning management systems (e.g., Moodle), and increasingly on “Cloud” tools and services (such as Google Docs). While these digitally enacted learning activities are easily recorded, they are usually in need of further processing in order to be interpretable as information on learning and knowledge development. So far, methods to do this automatically have been confined to so-called Intelligent Tutoring Systems, e.g., Cognitive Tutors (Koedinger & Corbett, 2006) and personalized learning systems (Heller, Steiner, Hockemeyer, & Albert, 2006). They need a very detailed analysis of the knowledge/skill structures to be learned, and specifically designed learning applications in order to trace the students’ activities on a level that is appropriate for diagnostic algorithms (Reimann, Kickmeier-Rust, & Albert, 2013). As a consequence, such systems have so far only been developed for a few curriculum areas where the diagnostic methods have been coupled with specifically designed learning software. Examples are systems for teaching diagnostic reasoning in medicine (Suebnukarn & Haddawy, 2006), and for computer programming (Pirolli & Recker, 1994).

In more general online learning situations, such as working in an online university course based on a Learning Management System, the data available in log files pertain to records of activities, such as uploads of assignments or contributions to forums, and to whatever can be captured from online quizzing and testing. Finding meaningful information in such data—for example, relating activity sequences to knowledge gains (Perera, Kay, Koprinska, Yacef, & Zaiane, 2008)—is difficult when