Chapter 13
Student Models Review and Distance Education

Avgoustos A. Tsinakos
University of Kavala Institute of Technology, Greece

ABSTRACT

The current chapter is a review of the variety of student models that have been reported in the literature. The chapter can virtually be divided in two parts: The first part outlines a number of typical examples of student models that have been developed in order to indicate why these models have been developed, what are their uses and the achievements of student models in education. The second part discusses how the student models can be useful in distance education, what are the criteria for testing the applicability of such models and finally reports student models that may apply in asynchronous distance education.

WHAT ARE STUDENT MODELS?

Definitions. “In general terms, Student Modelling involves the construction of a qualitative representation that accounts for student behavior in terms of existing background knowledge about a domain and about students learning the domain. Such a representation is called a Student Model” (McCalla, 1992 a).

Other Student Model related definitions come from Barr and Greer. In more detail:

“Student Model represents student understanding of the material to be taught with the purpose to make hypotheses about student’s misconceptions and suboptimal performance strategies” (Barr et al, 1982)

Jim Greer illustrates in bullets the different interpretations that a Student Model might have indicating that such model may be:

- An abstract representation of the learner.
- Teacher’s conceptualisation of a learner.
- System’s beliefs about the learner.
Student Models Review and Distance Education

• System’s beliefs about the learner’s beliefs and skills.
• It may include history of learner actions (raw data)
• Interpretations of raw data.
• Explanations of behaviour (Greer, 1996).

He also indicates that “Student modelling is the process of acquiring knowledge about a learner, relative to the learning goals, and although some a priori knowledge might have been acquired about this learner or similar learners, normally the knowledge acquisition is carried out dynamically as the learner engages in interactions with the system” (Greer, 1996).

Types of Student Models

According Anderson, Corbett and Koedinger there are actually two types of student modelling the knowledge tracing and model tracing (Anderson et al., 1995, p. 167–207). These are their names refer to the particular techniques they used, however the distinction is somehow general. Knowledge tracing refers to the problem of determining what students know, including both correct domain knowledge and robust misconceptions.

Model tracing refers to tracking a student’s problem solving as the student works on a problem. Model tracing is useful for systems that attempt to answer requests for help or to give unsolicited hints and feedback in the middle of problem solving. In fact, to be adequate in assisting, hinting and assessing an on-going solution attempt a system has to understand at a minimum level what line of reasoning the student is attempting to pursue.

On the other hand, knowledge tracing is useful for making longer range pedagogical decisions, such as what problem to assign next or what evaluation grade to assign to the student.

Giangrandi Paolo and Carlo Tasso, who have criticised the concept of static and of temporal Student Models, provide an additional differentiation on the concept of student modelling. According to their definition a model which describes the student’s knowledge without considering the possible evolution in time is called static. A description of the temporal history of the student’s knowledge including all the information about the student which makes it possible to explain the student’s behavior for both the past and the current interaction is called temporal. (Giangrandi and Tasso, 1996, p. 184-190; Giangrandi and Tasso, 1997, p. 415-426).

MaCalla introduces two other types of Student Models, the explicit and the implicit, and makes a useful distinction between them (McCalla, 1992 b, p. 107-131). An explicit Student Model is a representation of the learner in the learning system that is used to derive instructional decisions. An implicit Student Model is reflected in design decisions that have been derived from the system designer’s view of the learner.

Core Characteristics/Components of a Student Model

Clancey, Self, McCalla and Greer introduce some of the core characteristics of Student Models.

According to Clancey, Student Models are qualitative models in the sense that they are neither numeric nor physical; rather, they describe objects and processes in terms of spatial, temporal, or causal relations (Clancey, 1986, p. 381-450).

On the other hand according to Self, Student Models are approximate, possibly partial, and do not have to fully account for all aspects of student behaviour they are interested in computational utility rather than in cognitive fidelity. A more accurate or complete Student Model is not necessarily better, since the computational effort needed to improve accuracy or completeness may not be justified by the extra if slight pedagogical leverage obtained (Self, 1994).

McCalla and Greer, described the kind of architecture they conceive for a Student Model. According to them, the tutor’s knowledge is divided into a number of conceptual spaces such
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