A Knowledge-Based Instructional Assistant to Accompany LEO: A Learning Environment Organizer

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Abstract

This paper describes preliminary work on enhancements to a computer-mediated instructional program entitled LEO: a Learning Environment Organizer. LEO is a non-linear course presentation program that is based upon the notion of an advance organizer (Ausubel 1968). The Knowledge-based Instructional Assistant described here combines knowledge of the learner's attainment in the course with knowledge of various attributes of the instructional media in order to make recommendations of media that might benefit the learner. Matches between attainment profiles and media are based upon weighted nearest neighbor measures (Wettschereck & Aha 1995) of similarity.

Introduction

This work takes its impetus from several essential elements of Ausubel's (1968) Assimilation Theory. The most fundamental idea of Ausubel's theory is to "determine what a student knows and teach accordingly." Ausubel was, of course, referring to a strategy for traditional teachers in traditional face-to-face classroom settings. The principle still holds (perhaps especially so) in distance learning settings that tend to create greater difficulties for teachers in their efforts to assess and understand what their students know.

A computer program entitled LEO, a Learning Environment Organizer (Coffey 2000; Coffey & Cañas 2001), provides the framework for the approach described here. LEO is an editor/browser based upon concept maps (Novak & Gowin 1984). LEO presents a graphical representation of the topics in a course of study, essential dependency or prerequisite relationships among the topics (if any exist), and links to instructional media that contain content pertinent to the topic. The student utilizes the organizer to view and access information pertaining to the topics to be studied. The system tracks student progress through the topics, displaying an indication of those that have been completed and those that have not.

This basic system is augmented by a Knowledge-Based Instructional Assistant that can combine knowledge of the content in a course with knowledge of the student, in order to suggest materials that might be of interest to the student. These suggestions are based upon an emerging learner attainment profile that starts with a pretest and evolves as a student works through the course, taking tests and having deliverables evaluated. The remainder of this paper will present a brief survey of work in knowledge-based instructional systems, a description of LEO, and a discussion of how the Knowledge-Based Instructional Assistant (KnowBIA) augments LEO's capabilities.

Knowledge-Based Instructional Systems

The idea of knowledge-based instructional systems arises from the fields of user modeling (Finin & Drager 1986), adaptive hypermedia (Brusilovsky 1996), and intelligent tutoring systems (Burns & Parlet 1991). A basic distinction in knowledge-based instructional systems can be made between those that are generic – that are not constituted in a specific knowledge domain – and those that are domain specific. Recent literature has described generic tutoring system approaches such as a multi-agent approach that uses planning techniques to plan tutoring actions and presentations (Nkmbmou & Kabanza 2001), case-driven approaches such as Riesbeck and Schank's case-based tutors (Riesbeck & Schank 1991) and Goal-based Scenarios (Schank 1996).

Domain-specific systems have been created in areas that include the teaching of language (Heift 2001; Mayo Mitrovic & McKenzie 2000), algebra (Canfield 2001; Virvou & Moundridou, 2000), cataloging (DeSilva & Zainab 2000), etc. Typical approaches of these systems include assessing student work at problem solving and pointing out errors in the student's solution. Others provide suggestions for the improvement of the emerging solution. Some provide pertinent example solutions to help the student solve problems. Other adaptive systems may allow the user to control the amount of intervention the system provides (Kay 2001). The current work describes a generic system shell used to create environments in specific instructional domains that recommend instructional materials for the individual student.

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