

Chapter 6

An Adaptive Course Generation Framework

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ABSTRACT

Existing adaptive e-learning methods are supported by student (user) profiling for capturing student characteristics, and course structuring for organizing learning materials according to topics and levels of difficulties. Adaptive courses are then generated by extracting materials from the course structure to match the criteria specified in the student profiles. In addition, to handle advanced student characteristics, such as learning styles, course material annotation and programming-based decision rules are typically used. However, these additives demand certain programming skills from an instructor to proceed with course construction; they may also require building multiple course structures to handle practical pedagogical needs. In this paper, the authors propose a framework based on the concept space and the concept filters to support adaptive course generation where comprehensive student characteristics are considered. The concept space is a data structure for modeling student and course characteristics, while the concept filters are modifiers to determine how the course should be delivered. Because of the “building block” nature of the concept nodes and the concept filters, the proposed framework is extensible. More importantly, the authors’ framework does not require instructors to equip with any programming skills when they construct adaptive e-learning courses.

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INTRODUCTION

E-Learning is a technology supported learning approach, where the students' learning activities are assisted with communication and multimedia technologies (Li et al., 2008). This provides students with virtually unlimited access to knowledge and improves their learning through multi-modality materials. In addition, learning may also be adapted to individual paces, allowing students to learn at any time and place to match their own needs. On top of this, student (user) profiling can be added to capture student characteristics, such as learning preferences, background knowledge and learning progress, to help generate tailored learning materials and support adaptive e-learning.

Early work, such as InterBook (Brusilovsky et al., 1998), utilizes a hierarchical structure to organize course materials according to the topics and levels of difficulties, and uses student profiles as matching criteria to extract tailored learning materials from the course structure to produce adaptive e-learning courses. Recent work (Wu et al., 2001; De Bra et al., 2003; Stash et al., 2004) resorts the adaptive course generation to course material annotation and programming-based decision rules. They facilitate the generation of adaptive courses for students with different learning styles, such as example-oriented or activity-oriented learners (Honey et al., 1992) by selecting appropriate type of course materials and presenting them in a desired sequence. However, such methods demand more technical skills from an instructor for constructing adaptive courses. In addition, it is not straight-forward to apply such methods to handle certain practical pedagogical needs, such as constructing a course for students with very different academic backgrounds, balancing learning workload across course aspects when accommodating student learning preferences, and dynamically adjusting the depth of a course topic for delivery based on its popularity or other factors.

To allow ordinary instructors constructing adaptive courses, which account a variety of peda-

gogical needs, without acquiring prior programming knowledge or relying on technical assistance, we have developed a framework based on the concept space and the concept filters. The concept space is a data structure for modeling student and course characteristics, while the concept filters are modifiers to determine how the course should be disseminated. Based on them, we also provide a unified three-tier profiling mechanism, which comprises student, course and resource profiles, to facilitate the adaptive course generation. The rest of this paper is organized as follows. Section 2 gives a survey of related work. Section 3 presents the proposed framework. Section 4 evaluates the proposed framework through a number of experiments. Finally, Section 5 briefly concludes the work presented in this paper.

RELATED WORK

A learning process is driven by “what to learn”, i.e., the scope of learning, and “how to learn”, i.e., how a student approaches such learning scope. Adaptive e-learning addresses these two questions by offering students with tailored learning materials. Existing work on adaptive e-learning tackles this problem by applying student profiles on well organized courseware. More specifically, a student profile captures the learning preferences, background knowledge/experiences and learning progress of the student. It forms the basis for filtering a pool of course materials to pick out relevant ones. For instance, InterBook (Brusilovsky et al., 1998) organizes course materials in a hierarchical structure along with indices according to the topics and level of difficulties. (Middleton et al., 1998) improves the discovery of relevant course materials by knowledge classification based on ontology and collaborative choices made by a group of users. The ontology (Studer et al., 1998) formulates the grouping and the relation among concepts. It is commonly applied to organize course materials and to form the

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