Chapter XIII

Intelligent Books:
Combining Reactive Learning Exercises with Extensible and Adaptive Content in an Open-Access Web Application

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ABSTRACT

“Intelligent Books” are Web-based textbooks that combine computer-supported exercises with content that is both adaptive and extensible. They impose very few restrictions on the kind of exercise that can be placed within the book, and they allow students to contribute material that they have written, and to incorporate material from the Web into the book. In this chapter, the authors describe the influences that affect the design of intelligent books. These come from looking at the roles that textbooks and course notes play in education, and economic factors that affect the sustainability of intelligent books – competing for the attention of users, and ensuring that network externalities do not prevent a sufficient quantity of material from being usable within the book.

INTRODUCTION

The book you are reading now is not an Intelligent Book. It uses the same words to say the same thing to every reader regardless of whether or not they can understand it. It cannot help readers to work through problems and it cannot say anything that is not already in the book. In 2003, the University of Cambridge and the Massachusetts Institute of Technology embarked on a joint project to develop the concept of Intelligent Books – textbooks that can model what they teach, that can gather new examples and material from users, and that can make use of existing material from the Web.

The outcomes of the project were not simply to develop a software product (although we did develop software during the project) but also to understand how economic, usability, and role issues affect the useful design of intelligent online learning resources. Particularly, we wanted
to identify complementary features and design choices that would be able to take advantage of these factors. As we describe later in the chapter, we expect many of these design choices will come into mainstream practice through existing software gradually moving in a similar direction, rather than through our own product necessarily beating the competition.

The project set out from the beginning to develop “Intelligent Books” rather than tutoring systems, but there are reasons why we believe this is a valuable approach. At some point, any automated system for homework exercises has to be able to correct students about factual errors. This involves describing a piece of content, so it is useful if the exercise can be combined with some kind of content system. The conventional take-home resource that students use as a source of exercises and content is a textbook. So, we believed that if we were to develop intelligent on-line teaching materials, “Intelligent Books” replacing textbooks could be a more appropriate model than “intelligent tutors” replacing human tutors. This might sound like a petty distinction of terminology, but it has implications for the role the technology will fill: a tutor is usually a student’s master, whereas a textbook is only ever the student’s slave.

A textbook does not send you nagging emails to do your assignments like a Courseware Management System, nor does it mark you down for requiring more assistance than another student. If a textbook were to take on those roles, the way students interact with it would probably change. As a simple example, if a textbook were to grade students for course credit, that could be an incentive for students to take their learning elsewhere and only come to the textbook when they were sure they would make no credit-losing mistakes. A textbook is also not compulsory – there is nothing to prevent a student from reading a page from a different book instead. Indeed, most students use more than just the textbook: they also use Google, Wikipedia, and many other resources. The challenge, then, is how an Intelligent Book can meet these more varied use cases, without losing the value of the textbook’s traditional role.

In this chapter we describe the role, economic, and usability factors that we identified, and how these drove particular design choices for Intelligent Books. Some of the decisions that we made may appear to go against the grain of other recent research projects. For instance, Intelligent Books favour informal modelling in the content, leaving it up to individual exercises to decide what details about the student to model (and usually the exercises model the question in much more detail than they model the student) – a lot of recent research has focused on modelling users’ knowledge and skills in careful ontological detail. However, because of the open and extensible nature of Intelligent Books, there are reasons why a less restrictive model is potentially more usable and more helpful.

BACKGROUND

For many university teachers, if they are going to place content and exercises online, the Courseware Management System (CMS) is where they will place them. Systems such as the commercial Blackboard and the open-source Moodle (Dougiamas & Taylor, 2003) and Sakai (Hardin, 2006) provide common tools for content to be uploaded onto the Web and to enable student interaction with the content and with each other. However, it is rarely the teacher of a course that gets to decide which CMS should be used – they are often institution-wide systems. So, an institution’s CMS faces the difficult challenge of supporting many disparate subjects across one institution, where a textbook would support similar subjects across a number of institutions. However, there has also been a growing interest in the use of non-institutional software chosen by individual teachers or even by the students themselves, thanks largely to the rise of social networking.
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