

Using the REDEEM ITS Authoring Environment in Naval Training

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Abstract

REDEEM is an ITS authoring tool that allows instructors to create simple ITS from existing CBT. In this paper we consider the application of REDEEM to Naval training. Two Subject Matter Experts created learning environments for Naval Cadets and Reservists. They did so operating within a very different context to our prior experience of authoring for the school classroom. In this paper, we consider if the adaptive pedagogical features that REDEEM provides are appropriate to the needs of adult trainers.

1. Introduction

In the last few years, there has been an increasing attempt to transfer advanced educational technologies from the laboratory to practical application in schools and colleges (see [1,2]). In so doing, systems are required to be effective, robust, usable, and appropriate to the pedagogical and curricula needs of their intended milieu. At the forefront of such developments lie Intelligent Tutoring System (ITS) authoring tools. By definition, they were conceived as a solution to the challenge of cost-effective, quick and large-scale development of ITSs. By allowing end-users with appropriate subject and pedagogical experience to create ITSs, it is also hoped to improve effectiveness and ensure better fit to organizational requirements. Consequently, practical deployment of ITS authoring tools must account for the needs of authors in addition to those of the learners.

REDEEM is an ITS authoring tool that was initially developed in the context of the school classroom. The ITS tools take extant Computer Based Training (CBT) and allow teachers and subject matter experts (SMEs) to overlay their instructional expertise. The REDEEM shell uses this knowledge, together with its own default teaching knowledge, to deliver the courseware adaptively. REDEEM ITSs are limited by the domain content of the CBT and have a small number of tutorial actions. Thus, REDEEM ITSs are less adaptive than a normal ITS.

However, a teacher with no computing experience can use REDEEM to create such an ITS from CBT in substantially less time than that reported for other ITS authoring tools ([3]), at around two hours per hour of instruction. REDEEM has been judged to be among the most usable of ITS authoring tools. We argue that for the vast majority of teaching situations where ITSs are not available, minimally adaptive ITSs designed by experienced teachers will be more effective than non-adaptive CBT. We are exploring the validity of this claim by conducting empirical studies in a variety of situations.

In this paper, we discuss the experience of using REDEEM in a context that tests many of our assumptions concerning its design. It reports on how REDEEM has been used by Naval Trainers to create ITSs for use in Naval Colleges and for Naval Reservists. We focus on whether the underlying philosophy of REDEEM's design is appropriate to this context.

2. Authoring with REDEEM

REDEEM involves a number of authoring stages, but each is designed to be relatively straightforward. Essentially authors create a domain model by describing characteristics of the existing material to allow the ITS Shell to sequence and structure it. They supplement the material with additional questions and provide hints to their solution (see Figure 1). Authors then individualize a course to meet the requirements of their specific learners. They classify their students into categories (based upon any dimensions that they like) and then assign different content to these categories. For example, an author could stretch their high performing students by assigning more difficult content or make sure learners with reading problems have limited text to read. Different teaching strategies are created by manipulating dimensional sliders of eight components of instruction (*e.g.* amount of student control, position and amount of question, amount of help, number of attempts at questions). They also identify questions of appropriate styles and difficulty to strategies. These strategies are then assigned to different student categories. Thus, there are essentially two stages

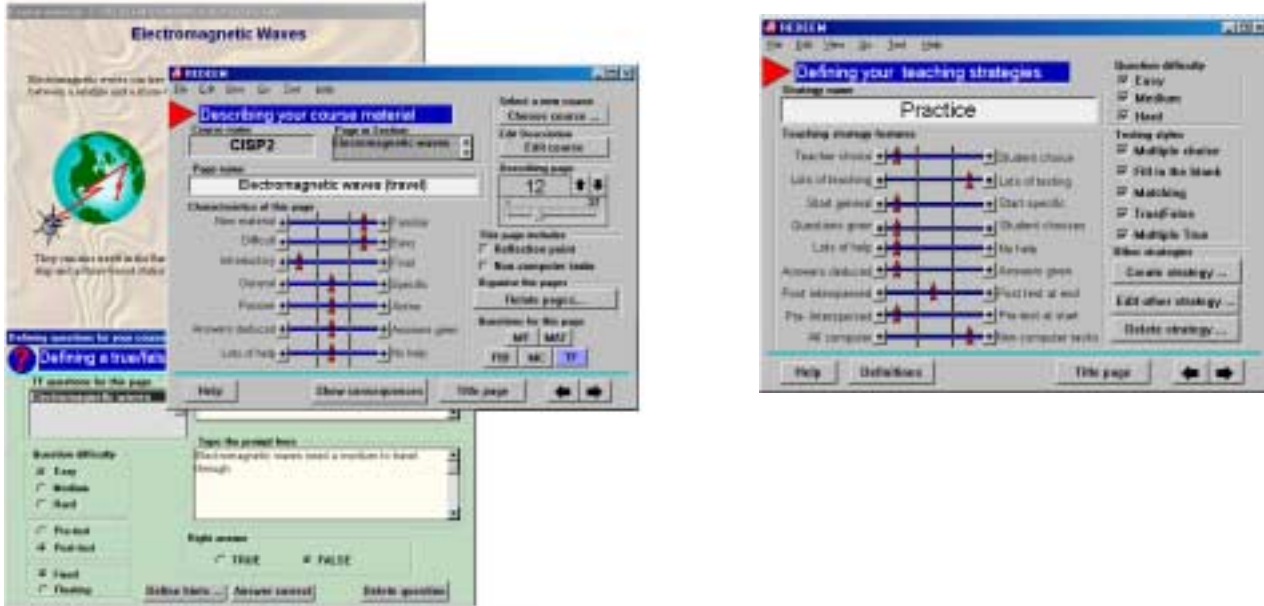


Fig 1. Authoring a Page of CISP and Developing a Teaching Strategy

to REDEEM authoring; in the first stage the domain material is enriched but it remains essentially non-adaptive CBT; in the second stage the CBT is individualized to the perceived needs of learners by macro-adapting the teaching strategies and the content to student categories. This can then dynamically adjust during a student's interaction with the system.

3. Authoring in Real World Contexts

Previous studies with primary and secondary school teachers and teacher-trainers have shown that teachers use the enriching and adaptive features that REDEEM provides to turn CBT into learning environments that are customized to their class. The teachers created a number of student categories and assigned both different content and strategies to these student categories [3,4]. The REDEEM ITSs that resulted from this process were differentiated by perceived student ability and by learning goals such as revision or initial learning.

However, adult training in a Naval context provides a very different set of opportunities and constraints to the school classroom. Positively, the Navy has substantial amounts of legacy CBT. Such software contains much good material, but some of it may have dated and can be very limited in its interactivity. The CBT has been developed over a number of years and hence employs a number of styles. REDEEM imposes a common house style, which minimizes time to learn by students. The legacy CBT rarely allows multiple modes of operation. Such software will have either been designed to support whole class teaching or individual practice in an onshore classroom. But, it cannot adapt to new situations. For example, there is a growing recognition of the need for

just-in-time training delivered on ship. Thus, if REDEEM proves appropriate to the Navy's needs, it should allow such software to be reused in a variety of new contexts with minimal redevelopment costs.

Conversely, there are set of constraints imposed by Naval Training that interact with REDEEM's intended operation. One such constraint is an organizational context that precisely specifies the content of CBT during a formal Quality Assurance procedure. Thus, the authors now working with REDEEM are not normally allowed the flexibility to sequence and structure material that the tools provide. Secondly, Naval trainers tend to be SMEs rather than trained teachers. The way that REDEEM decomposes pedagogical processes may not be appropriate to this user group. Thirdly, at least some of the authoring stages with REDEEM are based upon teachers having an intimate knowledge of their students. This is less likely in Naval Training which has many short courses with different trainers being the norm. Finally, there is the fundamental issue of whether Naval trainers want to shift from conventional CBT to the knowledge-based adaptive teaching that systems such as REDEEM provide.

4. REDEEM and Navy Training

The current study involved two authors working independently on the same material; SME1 teaches at a Naval College and SME2 teaches at a Naval Reservist Centre. The course material that was REDEEMed was a seven-chapter course on Communication and Information Systems Principles (CISP). This consists of ToolBook courses written by the Royal Navy School of Educational and Training Technology. It teaches by presenting declarative material with an occasional question. The

courses have limited interactivity and contain high-quality video, animation etc. They are organized in a linear fashion and learner control is very limited. Their content was based upon an original ‘chalk and talk’ course (C&T), and this analysis of authoring took place as part of a learning outcomes study comparing the effectiveness of C&T, v CISP, v REDEEMed CISP.

To discover how the use of REDEEM is influenced by the constraints described above, we analyzed the REDEEMed courses to discover if Naval trainers use the adaptive features that REDEEM provides. Table 1 summarizes these findings. The most striking first impression is the way that both authors essentially replicate the linear sequence of the underlying CBT. This is in contrast to previous studies where schoolteachers imposed their own views on appropriate course structures for groups of learners [4].

The reasons for this are two-fold. The first is the inherent linear sequence in the original courseware. It was designed with a strong prerequisite structure which is reflected in the resultant REDEEMed courses. Given this rigidity, it made authoring with REDEEM a time-consuming way to return to where the CBT started. This is a strong limitation on the REDEEM philosophy, which suggests that if REDEEM is to be used with such linear courseware in future, we need to create a quicker way for authors to achieve this. Additionally, REDEEM may be most appropriate for material that does not already have a linear narrative. The second reason may be authors’ familiarity with CBT rather than ITSs. They were keen to ensure that the course for the most part was delivered according to a specification document and were used to a storyboarding model for learning environment design.

However, there were many ways that the authors did change the courseware. Even with linearly structured

content, not all learners need to see the same material. SME2 who trains reservists identified two types of topic in CISP - Naval specific issues and general information about information systems. He used REDEEM to ensure that learners with good general knowledge of the underlying physics and information technology could concentrate solely upon the Naval specific content.

Both authors added significant numbers of additional questions and these were also used for different purposes. For example, SME1 might add a question as a pre-test (i.e. before the material was covered) when he felt that learners would have covered the content in an earlier course or when he wanted them to realize that material about to be covered was complicated and that they needed to pay attention! SME2 added questions to remind learners that they already have the necessary knowledge to understand upcoming complicated materials. Along with the addition of reflection points, hints and feedback, it can be seen that the courseware that resulted from this process is far more interactive than the original CBT and that this interactivity is focused around key pedagogical issues. The authors who have significant experience in teaching on these courses took account of cognitive and motivational characteristics of the learners, unlikely to be known to a centralized software creation team. This can also be seen in the teaching models they created. There is an implicit teaching strategy in the CBT: no student control, questions immediately follow material, no help on questions, and a mix of questions that require multiple attempts or just one attempt. Furthermore, this is true for all learners in all situations. The authors in this study were able to impose their own teaching strategies. They tended to agree about no student control, but used questions either before material or as a refresher later as

Table 1: Comparing REDEEMed Courseware to the CBT

Similarities between REDEEM and CBT	Dissimilarities between REDEEM and CBT
<p>Domain Model Underlying sequences very similar to original CBT Limited use of non-computer tasks No differentiation by content by SME1</p> <p>Teaching Model No differentiation by strategy for SME1</p>	<p>Domain Model Flat structure replaced with a hierarchical one that provides summaries of progress and introductions to topics Reflection points to indicate where students should take notes. Significantly more questions added (around a factor of three). Questions were of the same type (e.g. multi-choice, true-false) but were used for different purposes. Contingent hints to some questions provided.</p> <p>Teaching Model Both SMEs created their own teaching strategies, which differed to the (implicit) one in the CBT. SME2 authored multiple strategies for different learner needs. Allowed trainers to monitor trainees’ performance more successfully (e.g. answers to questions, times etc).</p>

well as immediately post material. They provided help both on error and request and were able to enforce

consistency about whether answers to questions should be deduced or given. SME2 also created more than one

strategy. He developed a standard strategy for most occasions and an advanced strategy for learners who were revising, which included more student control and more challenging questioning.

5. Conclusion

In considering whether REDEEM is appropriate to the constraints imposed by adult training in the Navy we have found a generally positive response that may have wider implications for other authoring tool use. Most importantly, we asked if Naval Trainers wanted the adaptability that REDEEM provides and we obtained a mixed response. In contrast to the school classroom studies, we have found less individualization to the needs of specific learners and a limited use of the more adaptive features of REDEEM. This may in part be due to the specific CBT that was created with a strong, underlying narrative. It is also likely that this reflects wider organizational goals. All trainees taking CISP at the Naval College are expected to achieve the same outcome (the faultless operation of Information & Communication systems). With such a goal there may be less need or less opportunity for the individualization that REDEEM and other ITSs provide. However, Naval Reservists have differing experiences and objectives. In this situation, REDEEM's adaptive and individualization features were more widely used and seemed more appropriate. This serves as a timely reminder to us not to treat a large organization as if it has monolithic training needs.

Both authors were more concerned to achieve flexibility to adapt to different functions (revision, CAI, just-in-time teaching) rather than flexibility to meet individual students needs and used REDEEM to achieve this in a way that the CBT could not achieve. In addition, their knowledge of previous students taking the course allowed them to author for different proto-typical students, even if they did not have knowledge of the specific learners taking the course.

The selective use of REDEEM's functionality apparent in this study did not undermine the utility of the approach. Both trainers stated that they thought the ITSs they had produced would provide more effective teaching than the underlying CBT, despite their limited course re-sequencing. In this case, it may have been preferable to provide trainers with a partially authored solution, which they could then individualize to their students' needs. In this way REDEEM's decomposition of the teaching process could be retained but different experts could take responsibility for appropriate aspects of ITS creation.

In addition, REDEEM played some positive roles that we had not initially envisaged. The authors used it to create far more interactivity than the original courseware, hopefully enhancing its effectiveness. It also was useful as a rapid prototyping environment. Authors were able to

try out many of their pedagogical decisions, altering a feature and then running the ITS shell to experience the consequences of that decision. Authoring also provided a good way of identifying missing or erroneous information. This suggests that REDEEM could be used earlier in the development of a course.

The REDEEMed courses created by Naval trainers in this study are a compromise between full-blown ITSs and non-adaptive CBT. They maintain the requisite structure of the underlying CBT, but benefit from the local expertise of experienced trainers who enhanced the CBT and then customized it to their different situations. As such REDEEM is one solution to producing successful partnerships between ITSs and creative teachers.

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