A Web-Enabled Exam Preparation and Evaluation Service: Providing Real-Time Personalized Tests for Academic Enhancement

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Abstract

We present a technology-enriched, Web-enabled, value-added Distance Exam Preparation and Evaluation Service that provides (a) offline execution of fully-featured preparatory exercises and evaluation tests in a real-life simulated examination environment; (b) content personalization to address scholastic weakness and (c) the use of data mining techniques to ensure content effectiveness and the pro-active identification of the academic needs of various student segments. The solution is designed as a client-server architecture featuring Java technology and XML-mediated information exchange over the Internet.

1. Introduction

In Malaysia, secondary-level academic evaluation is government mandated and centrally administered. The evaluation exams comprise multiple-choice questions. Traditionally, students whilst preparing for such exams tend to refer to a vast pool of past examination questions and in-house tests. However, for more thorough exam preparation students prefer to seek multiple perspectives of a topic/subject vis-à-vis evaluation material prepared by educators different than their own teachers [1].

To meet the above requirement, in this paper we present a technology-enriched, web-enabled, value-added *Distance Exam Preparation and Evaluation (DEPE) Service* that focuses to support secondary-level students in the undertaking of real-time tests, with particular emphasis on long-term scholastic support and corrective measures. [2, 3]. The DEPE system (as shown in Figure 1)—a web-based client-server application incorporating XML and Java technological components—exhibits the following technical and functional features:

The featured DEPE service exhibits four functional components: (a) *Content Compilation* vis-à-vis the population of a test bank comprising past exams together with school-specific tests prepared by an ensemble of teachers; (b) *Real-time Test Administrator* allowing for WWW-mediated generation of 'personalized' tests based on an individual's longitudinal evaluation record, offline real-time execution of the tests, followed by automatic test evaluation and reporting. Built-in regulation mechanisms ensure 'non-alterable' timekeeping, policy-enforcement and on-request hints; (c) *Solution Constructor and Performance Monitor* to track the student's overall performance on a longitudinal basis and provide the necessary guidance; and (d) *Student Response Analyzer* leveraging cohort student responses for *content review*—i.e. to gauge the relevance, quality and impact of the test questions—and *student profiling*.

2. Functional Description

2.1. Content compilation

A collaborative content representation scheme distinguishes each singular test/exercise in terms of its origin (i.e. school at which the test was administrated); date of administration; subject; class level; type (exercise, test or final exam), coverage (i.e. single/multiple chapters); topic(s) covered; duration and no. of questions.

We have developed a generic Windows-based client-side content compilation application that features: (a) electronic forms for providing test-identification information; (b) a question specification GUI—enabled with multimedia and mathematical formulae inclusion facilities—to provide the question text, multiple solutions, the correct answer, hints, difficulty level and some relatively difficult answers for enhanced testing options; and (c) an Internet-based content upload mechanism to directly send the compiled content to the DEPE service provider.

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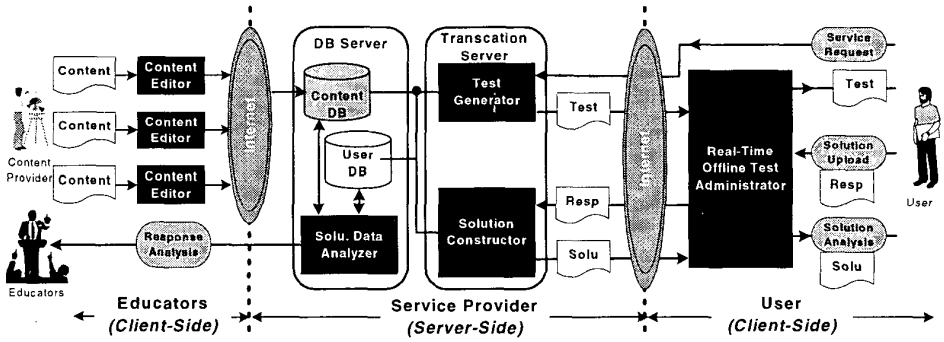

Figure 1. The functional architecture of the DEPE service. Information exchange is realized via XML document objects, whereas the functional modules are implemented using Java technology.

2.2. Real-time test administration

An operational session is initiated by a service request by a registered user which triggers the following server-side functionalities: (a) *Personalized Test Construction* (PTC) and (b) *Remote Test Management* (RTM). The DEPE service offers three options for PTC:

1) *Pre-designed Tests* that the user can undertake.
2) *Customized Test* that the user can dynamically design based on the following parameters: topic(s) to be included, single or multiple origin, test currency (a date range), difficulty level and test duration.
3) *Guided Test* whereby the DEPE system advices the user, based on observed test performances, designs tests aiming to rectify the academic shortcomings.

The dynamically designed 'test document is transmitted to the user who can subsequently undertake the test in a simulated real-life exam setting. For operational efficiency as soon as the test document is downloaded the Internet connection is automatically terminated and subsequent test administration is carried out in an offline mode at the client-side. The downloaded test document is initially 'sealed' and is activated—i.e. the test content becomes visible and the test timer starts—when the user agrees to start the test. The test activity initiates client-side RTM processes that involve:

a) Test time regulation via a timer embedded in the test document—the timer is non-alterable even if the system clock is modified.
b) User assistance in terms of hints and partial elimination of the solution options, all at the expense of reduced credit.
c) Capture of the user's responses, as an encoded response string, at the expiry of the allocated test duration and automatic up-load to the DEPE service server once an Internet connection is established.

2.3. Solution construction and response analysis

Upon receipt of the response string the DEPE system:

a) autonomously evaluates the user's test response as recorded in the response string.
b) generates a solution document comprising test evaluation, explanations, performance indicators and future preparatory suggestions.
c) pro-actively 'pushes' the solution document to the user over an active Web channel.

2.4. Student response analysis

We have implemented a data-mining agent to 'mine' population-wide student responses to effectuate detailed analysis of: (a) Population-wide student profiles as the basis for formulation of individually focused programs; (b) Difficulty level based inductive grouping of questions into different levels; (c) Effectiveness of a set of questions if presented together; (d) User response patterns i.e. whenever a user correctly responds to question x then he/she also correctly responds to question y; (e) Students performance across different schools, regions or states; and (f) Performance comparison between fundamental, problem-solving and analytical type questions.

3. Concluding Remarks

We believe that the DEPE service can provide ubiquitous access to exam preparatory material of relatively high quality and in relatively substantive quantities to students disadvantaged by their physical location. DEPE is accessible at www.eschoolplus.com.my

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