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E-TESTING BASED ON SERVICE ORIENTED ARCHITECTURE

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Abstract

The extensive use of technology in learning and working, is forcing its use in the assessment process. A lot of software packages exist in the market to realize automated assessment. Several of them are very comprehensive, but most of them are stand alone applications without possibilities for interoperability, adaptability according to learner characteristics and possibilities for content reuse.

In this paper we describe the purposes and the process of designing an interoperable E-Testing Framework by remodelling an existing E-Testing system and introducing new structured Service Oriented Architecture, based on encapsulating existing business functions as loosely coupled, reusable, platform-independent services which collectively realize required business objectives. This common framework should support interoperable content, exchange of data and learner profiles, and give the possibility for search and retrieval of any data bank content in local and remote repositories.

Keywords

E-Testing, E-Assessment, E-Learning, web based assessment, SOA, web services, interoperability

Introduction

The characteristics of the society in which we live, where knowledge and the ways of its use are the most important in everyday life, brings new challenges for higher education. Student-centred learning and constructivist approaches

are just some of the paradigms which have emerged, and are being supported by technological advances. Higher education institutions have the main role in the process of redefining the models for acquiring knowledge and skills. Technology is more often used in learning as a tool for lectures, delivery of materials, and assessment of student knowledge.

There are several systems for automatic assessment on the market, mainly as part of distance learning systems. However, there are independent software packages for computer based assessment, web based assessment or electronic assessment. Many of these systems are very comprehensive but most of them are stand alone applications without possibilities for interoperability, adaptability according to learner characteristics and possibilities for content reuse. [7] [6] [17]

The system for electronic testing at the University "Ss Cyril and Methodious" is known as 'eTest'. This is the result of continuous development of concepts and software used for conducting frequent assessments. More that 500 students take part. The original idea was to create a system to help realization of exams for cases where the number of students is very large (several hundred on each exam), and in the case where each student is allowed to apply for an exam each month. This idea was later expanded to realize an intelligent and independent system for testing applicable both to conventional and distance learning.

The system is very comprehensive, catering for many aspects in the assessment of student knowledge. The basic structure of the system consists of courses for which material is divided into lectures, and organized in a tree like structure. It evaluates a different test for each student each time a test application is made, and has innovative procedures for exam strategy definition, cheating prevention, grading and results reporting. The concepts and the architecture of the system are described in [1].

In this paper, we analyse the weaknesses of the system, and propose its redesign according to the latest recommendations by the e-Learning community with a common goal to produce an interoperable, easily adaptable and more flexible system supporting pedagogical diversities.

Background

The system has been in use since 2001. Until the end of 2005, a series of 589 assessments have been realized with 9861 tests generated. The question database has 12391 questions from 26 courses. The effects of using the system were analysed in a separate study, both from a teacher and student perspective [2].

In 2005 the system was installed in 3 other Universities in the country, where it is used for assessment of student knowledge. The creation of 4 different environments posed new challenges to the research and development team.

The current system architecture does not provide complete interoperability between systems in these locations. It does not allow searching, using or modifying interoperable questions. Neither does it support the creation of joint courses where students from different universities can participate. Cross institutional cooperation through the sharing of information is required arising from the fact that many courses are beginning to be taught collaboratively, realizing the concepts of student mobility and lifelong learning.

We have decided to remodel the existing system by introducing new structured service oriented architecture. This is based on encapsulating existing business functions as loosely coupled, reusable, platform-independent services. This is to achieve better interoperability with other systems, exchange of data and content between systems using current widely adopted standards, increase flexibility and provide greater pedagogic diversity,

Service Oriented Architecture

In the past few years, world leading organizations in the e-learning community were focused on creating a joint vision for a common technical framework in the e-learning area, and in defining *international learning technology standards and specifications, in order to allow systems to "support organisational and cross-organisational processes for enabling effective e-learning*" [20]. These standards and specifications are supposed to promote interoperability, flexibility and pedagogic diversity in the e-learning process.

As a result of those activities few detailed frameworks were developed. Some of the most successful and comprehensive are:

- JISC Technical Framework to support e-Learning (ELF). [12]

- IMS Abstract Framework (IAF) [13]

- LeAPP Learning Architecture Project [14]

- Carnegie Mellon's Learning Services Architecture [5]

One common structural issue for which these organizations reached a consensus was the adoption of a Service Oriented Architecture (SOA). SOA has many advantages including reusability and flexibility of implementation, higher compatibility with the Grid, lower over all costs, protection of legacy investment, lower cost of entry, rapid development, potential for business processes to drive technology" [4].

In [21] Willson discusses the pedagogical aspects of SOA e-learning system analysing 6 pedagogical choices in e-learning, and concludes that a "Brave New World' of web-service driven environments" offers much greater pedagogical diversity than the monolithic systems.

The comparison of the above mentioned frameworks shows that they all have layered architecture consisting of a set of services which can be used in an e-learning context, and collectively realize required business objectives. The basic idea behind this is that anyone wanting to develop e-learning applications can select services, integrate them and incorporate them into the application.

SOA in Assessment

Although Assessment is present as one of the main services in all the mentioned frameworks, JISC [11] as the organisation developing the E-Learning Framework (ELF) has made significant steps forward in the definition of the Assessment domain.

Following its strategy for the creation of Reference Models for a number of domains, assessment is extensively a subject of research. Several projects have been funded [10], among which FREMA (Framework Reference Model for Assessment) is the most comprehensive. The project defined the domain, created a map of resources and "concept map of the common processes" [15], identified common usage patterns, developed use cases and defined Web Services in the domain. [9]

Another project (TENCompetence) [19] has identified assessment as a main tool for achieving its goal and have developed an assessment model based also on SOA. [18]

Modelling a Common Framework

Concentrating on remodelling the existing eTest system architecture, we have identified Web Services which will collectively realize required business objectives of our system, namely: Item Construction, Test Construction, Test Delivery, Results Collecting, Marking, Decision Making, and Statistical Analysis. Our supporting services are: Schedule, Notify and Announce, Authentication, Track, and User Management.

Recently developed frameworks and reference models are still on an abstract level and have little support in practical implementation. For example in the assessment area there isn't yet a complete product. Because of this investigation on standards and development work is underway in order to see what the results from the implementation of the proposed models will be.

A comprehensive overview of assessment projects is given in [8]. Most of them give practical realisation of particular services identified by the FREMA project, and propose extensions to (or verify) already existing standards. Some projects are more comprehensive, demonstrating the use of multiple services in SOA (ASSIS [3]).

Besides practical implementation of the proposed SOA framework in eTest, analyses of the results from its implementation, and comparison to the other

identified frameworks, our future work will pay close attention on the Test Construction Service (in FREMA identified as Author Assessment, or Assessment Construction in TENCompetence). Very few projects in the assessment area to date had analysed and discussed the problem of test construction and delivery algorithms. According to [17] there are different kinds of test delivery models.
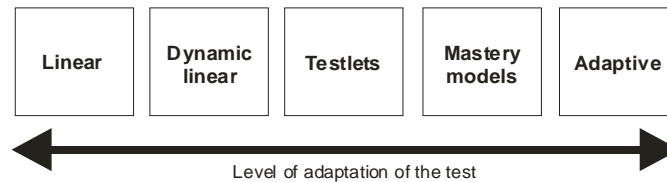

| Linear | Dynamic linear | Testlets | Mastery models | Adaptive |

Level of adaptation of the test

Figure 1. Models for test delivery [16]

In order to support wide pedagogical diversities, any assessment system should be able to provide all models of test delivery. By using different models for test delivery in the learning process we can simulate the world of interactive games, and hope to motivate students more than would be achieved through traditional means.

Conclusion

In this paper we have shown how our system for eTesting can be remodelled and upgraded by introducing new structured service oriented architecture.

By identifying and implementing unique functionalities, we expect to update and fulfil the existing SOA frameworks and models, creating a common framework which will provide greater interoperability, exchange of data and content, and greater pedagogical diversity.

In its practical realisation we will use the experiences and results from already developed projects in the assessment area [8]. By researching the possibilities for using different models for test delivery depending on context specifics, we expect to contribute in improvements of the diversity and quality of the learning process.

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