

# A Novel Multimedia Assessment System Architecture With Duration Evaluate

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## Abstract

*The development of assessment management system has been discussed for a long time. The motivation always focuses on the evaluation of learners' ability or on the difficulties of examination. The common examination content could be composed by text or simple figures, and the assistant functionalities could also be developed to meet the individual needs. But these functionalities couldn't interoperate with each others in this situation, and the text content isn't enough to represent the examination content. In this paper, we proposed a novel system architecture to make interoperability realizable based on web service technologies then we also tried to integrate the multimedia streaming resources into our MAMS (MINE Assessment Management System). Through this architecture, we could easily integrate external functionalities without redeveloping the system. Besides, we propose another way to evaluate student's learning performance by duration of exam, and we will discuss the difficulty coefficient and duration of exam.*

**Keywords:** *multimedia streaming assessment, assessment management system, service interoperability*

## 1. E-Learning Background and Motivation

E-Learning could be considered as the process that learners get knowledge through digital media. These media include the internet, personal computers, video tapes, interactivity TV or satellite broadcasting. With the development and improvement of internet infrastructure and computer hardware devices, e-learning industries have been regarded as powerful impetus by the governments that propose life-long learning. We look back to the e-learning history, the assistance systems like CAI (Computer Assisted Instruction), CBT (Computer Based Training), CMI (Computer Managed Instruction) and CEI (Computer

Enriched Instruction) present the teaching materials in digitalization rather than traditional ones in sequence. To apply HTML (Hyper Text Markup Language) documents in learning environment has received attention from all over the world through WWW (World Wide Web) in later 1995. In 1997, the U.S. DoD (Department of Defense) proposed ADL (Advanced Distributed Learning Initiative) project. It focuses on providing a common standard for construction and development of digital learning content.

In e-learning environment, computer-based assessment provides a simulation for learners to understand what they have learned from instructors through various ways. Besides the advantages from digital resources, computer-based assessment could make review time shorter than traditional paper-and-pencil based test and reduce the mistakes that could happen when reviewing by human. IMS (IMS Global Learning Consortium) proposed a unified standard named QTI (Question and Test Interoperability) for computer-based assessment in 1999. It utilizes the XML (eXtensible Markup Language) to format the assessment content and users could easily share these content based on it.

The IT (Information Technology) has developed more and more robust. The integration between e-learning and other technologies becomes no longer an assistant but a key point for the last years; meanwhile, we surveyed current assessment management systems and found the common disadvantages as follows:

1. The lack of assessment content authoring functionalities through web browsers
2. The online assessment systems don't take the multimedia streaming information into consideration. They only support the multimedia resources based on discs.
3. As to online assessment management systems, the use of IMS QTI specification only limits in a few countries and still only a few organizations adopt it.

The assessment content achieves no reusability and sharability and reduces no efforts for the instructors.

4. The redundant development for the same system functionalities also makes extra efforts to the system developers. Besides, these functionalities couldn't interoperate with each others. That is, these functionalities couldn't be reused in other systems.

Based on previous analysis for the web-based assessment systems, the creative application of internet platforms appeal academic and industrial organizations so much. For this reason, our aim is to propose a novel method to enhance the traditional assessment environment and this task has to be divided into several parts to be completed. In this paper, we firstly propose the system infrastructure for the whole task. The aim of this paper is as follows:

– **Integration with multimedia streaming technologies:**

In the past, the assessment content only focus on text file. It is sometimes not easy for learners to realize the meaning of assessment content. Hence, we propose to develop a web-based assessment management platform which follows the IMS Common Cartridge specification and integrate multimedia streaming resources into both authoring and testing aspects.

– **Integration with external services:**

For example, the past search technologies only return the weight of Google Page Rank based on the frequency of keywords contained in context. In computerized assessment environment, we could achieve reusability by collecting electronic content through Item Bank. In this paper, we not only aim to achieve the search service mechanism but also like to integrate other external services which might be developed through different technologies and for different purposes.

The organization of this paper is as follows: Section 1 introduced the motivation and the overview of this paper. Section 2 introduced the relevant systems that widely used in the world. The proposed system architecture would be discussed in the Section 3 and our implementation results will be shown in Section 4. At last, we will give a short conclusion and the future works in the Section 5.

## 2. Related works

To achieve this goal, we have already surveyed lots of relevant assessment systems widely used all over the world and survey the learning performance through interactive learning. Through this, we could analyze the system development architecture for each of them, and assessing the learning impact of on-line multimedia platform. It could help us to propose the

useful and essential architecture to integrate the problems we listed in the previous section.

TOIA (Technologies for Online Interoperability Assessment) is also a web-based assessment management system. It includes the online authoring functionalities and provides friendly user interface. It could assist authors in making various types of examination items. TOIA defines the relationship between assessment system and its components like basic activities, interoperability standards, learning theory ... etc. Besides, TOIA also provides assessment process flow. It could be regarded as the most complete assessment system.

Tetrodo Framework was developed by the cooperation organization of AICC, ADL, IMS and IEEE. In this framework, it designs a framework like the library which we often used in programming. It allows developers could develop relevant system based on JSP (Java Server Page) or Java for both client and server sides.

Web tech is very popular right now, and we integrate web into assessment system that user can take exam or authoring on-line. With on-line learning tutorial, students will spend much time on this especially with multimedia resource. Spending much time on learning tutorial can help students learning more, so it will be a trend with on-line assessment platform in the future.

There is a research that compared traditional learning with interactive learning which combined multimedia. The survey indicated that students have better learning performance and learning efficiency with interactive learning, and the learning method satisfied most of students. The result indicate that e-learning environment have positive effect with interactive learning.

The systems we stated above have some common disadvantages. First, they cause the redundant development of same functionalities. Second, the interoperability only focuses on the assessment content but not on the functionalities. Third, the examination could only represent in text or figure. Besides, there are lots of research papers doing the same things in order to evaluate the learners' ability.

In the following section, we aim at providing a solution to meet these disadvantages. We focus on solving interoperability between every existing assessment systems. In addition, we also take multimedia resources into consideration. Thus, our proposed assessment system not only achieves the interoperability between functionalities but also enhances the original assessment environment by using multimedia streaming techniques.

### 3. Proposed System Architecture

we could add other services into this platform like streaming services, authoring services ... etc. We mainly separate the whole functionalities into three parts: Main Assessment Platform, External Service Pool and Communication Mechanism. The whole system architecture could be illustrated in Figure 1.

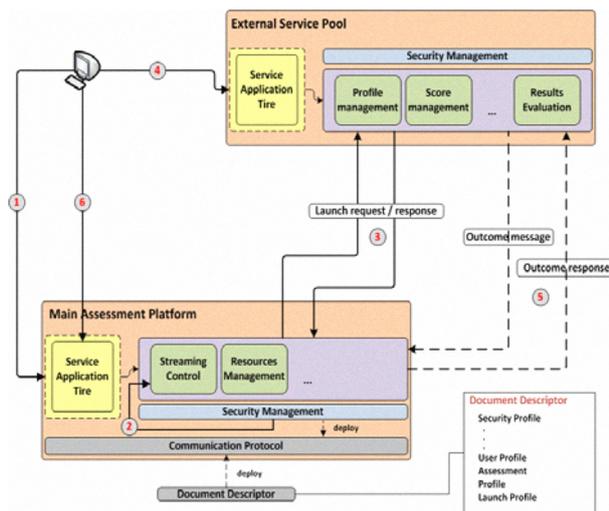


Figure 1. The system architecture and the system process of our proposed assessment system

#### 3.1 The system architecture

As we stated above, our system was composed by Main Assessment Platform, External Service Pool and Communication Mechanism.

##### – Main Assessment Platform

In this part, we focus on the construction of system infrastructure. This is the basis component of our proposed architecture. It contains the basic functionalities like authentication mechanism to maintain students' profiles and relevant testing histories, and the streaming service for multimedia resources. Besides, we also provide a protocol controller to make data exchange or integrate with other parts.

##### – External Service Pool

The External Service Pool could be regarded as a set of functionalities like authoring, test, score management, assessment tip, and etc. It is just like a kind of resource pool. The functionalities in this pool could not be developed for specific purpose at the same time. But most of them could be

considered as an essential part to construct an assessment system. Thus, we create a common protocol for them to communicate with the Main Assessment Platform. Through this way, we could easily utilize these functionalities without developing them again and again.

##### – Communication Mechanism

In order to exchange data in our proposed system architecture, we also have to provide a common protocol and data format for each part to achieve this. The solution we utilize is that we create a specific document to record the essential information. This document not only includes the required service and its corresponding destination address but also record the relevant information like security setting profile, contextual setting profile and other setting profiles. We'll give a unique handle ID to each of them. But the physical data will not be transmitted at the same time; we just create a communication protocol for the Main Assessment Platform and External Service Pool.

#### 3.2 The system process flow

As stated in previous section, we will go further to explain how our proposed system interacts with each separate part. According to the Figure 1, our system process flow could be mainly listed in six steps:

##### – Step 1.

When doing assessment activities, Main Assessment Platform will generate a URL that belongs to specific service for users to choose. It is just like when we are making the choice tests; our system might provide some relevant information for learners to help them make right choice. These relevant could be represented in various types like web pages, audio/video files or text files so that we have to send certain request to corresponding service. After receiving the requests, Main Assessment Platform will generate relevant settings and profiles through Communication Mechanism we proposed and bind them into a specific document. After that, this document will be submitted through the common protocol of Main Assessment Platform side.

##### – Step 2.

In the common protocol of Main Assessment Platform, we will add the security settings into the receiving document including authentication information gathered when learner logging in our assessment platform.

– **Step 3.**

The common protocol will send the document generated by Step 1 and Step 2 to the protocol of External Service Pool side. The document will be received and processed by the specific service. The service application will firstly check the security setting described in document and deal with the authentication. After that, External Service Pool side will return the results to the Main Assessment Platform.

– **Step 4.**

When authenticating successfully, Main Assessment Platform will receive the document returned by the services side. Main Assessment Platform will start a new window to show the services that users choose in the Step 1. But the most important thing is that there is no interactivity between Main Assessment Platform and services, the users interact with services directly in this situation.

– **Step 5.**

After finishing all the operations, there will be some information that should return to the Main Assessment Platform. The services side will generate relevant outcome and security profiles. The profiles include the security header file that should be processed by the Main Assessment Platform side and it will return the results to the services side.

– **Step 6.**

After finishing operation, Main Assessment Platform will close the window of service that starts in Step 4 and remove the common protocol that communicates with the services side.

**4. Evaluation methods**

O: Correct Answer, X:Wrong Answer

Table1. The record of exam results

Student \Order	1st	2nd	3rd	4th	5th
Martin	O	X	O	O	X
Neil	O	O	X	O	X
Arvin	X	O	X	O	O
Livet	X	O	O	O	O
Jason	O	X	O	X	X

Table2. The record of exam duration by students (in seconds)

Student \Order	1st	2nd	3rd	4th	5th
Martin	50	42	78	103	68
Neil	67	32	87	94	63
Arvin	46	48	67	168	80
Livet	68	66	53	150	74
Jason	75	60	63	125	91

In this paper we propose a different way to evaluate student’s learning efficiency, in this way we will record the exam results (Table1) and duration of exam (Table2) by exam order which student just taking and the duration of exam are recorded in seconds. Then according to those records, we will give students some feedback. In the beginning, teacher give a default value of difficulty coefficient and suggest answering time when they taking assessment authoring. The feedback are based on those two default values, and we divide the answering situation into six situation. First, we will compare the duration time (De) and suggest answering time (Ds). For example, if De less than Ds for a value K and the exam result is correct, it means student can finish this question in a short period of time with correct answer, so student can understand clearly what the exam mean and the system will suggest student taking another exam with higher difficulty coefficient in that learning area. The detail feedback situation is described on Table3

Table3.Feedback method

De-Ds > K & Correct Answer	De-Ds > K & Wrong Answer	De-Ds = K & Correct Answer
Normal Performance	Bad Performance	Good Performance
Suggest Lower Value of Cd	Suggest Lower Value of Cd	Suggest Higher Value of Cd

De : Duration of exam, Ds : Suggest Duration,

Cd : Difficulty Coefficient

De-Ds = K & Wrong Answer	De-Ds < K & Wrong Answer	De-Ds < K & Correct Answer
Bad Performance	Bad Performance	Good Performance
Suggest Lower Value of Cd	Suggest Lower Value of Cd	Suggest Higher Value of Cd

The original relationship between difficulty coefficient and the suggest duration of exam is shown in Figure.1, it is a direct proportion relationship that suggest duration of exam will increase when the difficulty coefficient increase. But in the system, the relationship between those two values may not a direct proportion, so instructors can revise the default value about difficult coefficient and suggest duration that they designed before, because of revise, the relationship will come close to direct proportion, and this will help instructors to monitor student’s learning performance.

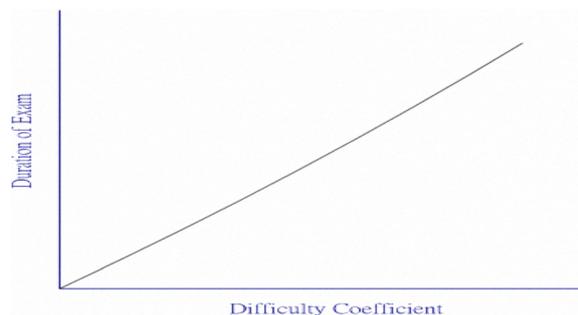


Figure 2. Relationship between difficulty coefficient and duration of exam

## 5. Discussion and Future Work

In this paper, we developed an assessment management system named MAMS based on streaming technologies. The most important part is that we separate the main system and external functionalities. It could reduce the cost of time in developing the same functionalities in assessment management system. Besides, we also create a common protocol for main assessment system could communicate with external functionalities. On the other hand, the functionalities we mentioned are based on web service technologies. Hence, we could develop extra functionalities individually by following the same web service standards. Then we could easily utilize these functionalities without developing them again and again.

Based on our development results, the service providers could follow this architecture to develop their own services, and the system developers could recompose them into a new system. Because our MAMS is based on the streaming technologies, we have to solve the cost of time when transmitting the multimedia resources. Besides, how to make use of the results of examination to model the learners' learning abilities and the difficulties of examination will be the next issue for us to achieve. For this reason, we will continue our current works and try to give a good solution to integrate the issues above to achieve the adaptive assessment mechanism, and find some precise evaluation methods that can give students more useful feedback.

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