Developing Reusable Learning Objects for Assessment

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Abstract:- E-Learning needs further refinements to enhance its appeal for widespread adoption in organizations in these aspects: interoperability, reusability and effectiveness. This paper discusses the approach proposed to improve these aspects with regards to developing assessment objects. The two stages of our project: (i) the adoption of standards to ensure the interoperability and reusability aspects of the assessment objects are fulfilled; and (ii) the refinement of the e-learning pedagogy frameworks for effective learning. Our discussion herein focuses on the Stage 1 approach. Details covered in this paper include conversion to IMS QTI standard, and learning performance profiling.

Keywords:- E-Learning, Reusable Learning Objects, Online Assessment, Learning System, Standard.

1. Introduction

Our project aimed at developing a software tool for content migration, standardization and management, focusing on e-learning assessment objects. Existing e-learning standards were investigated in enforcing a standard adoption program. This is to ensure the interoperability, reusability and effectiveness aspects of the assessment objects are fulfilled.

Various emerging standard bodies and their propriety standards in managing learning objects were evaluated: International Management System (IMS), Advanced Distributed Learning Initiative (ADL) and IEEE Learning Technology Standard Committee (LTSC). Evaluation of each of the e-learning standards, in term of features, properties, compatibility, Interfacing, connectivity and system bridging, was conducted. The strength and weakness of each standard is the key parameter in determining the feasibility for standard adoption for the program. From the evaluation, Sharable Content Object Reference Model (SCORM) of ADL and Question & Test Interoperability (QTI) of IMS were adopted.

The software framework with content migration and management capability, and the QTI Standard Compliant Content Manager was developed. The framework featuring Text File conversion, Authoring Tool, Question Bank, XML output and equipped with Approximate Auto Marking Algorithms (AAA). The content XML output was wrapped into Package Interchange File (PIF) for the purpose of content playing, and serving as part of testing strategy. To accommodate the mentioned purposes, SCORM Sample Runtime environment was used to evaluate the selected PIF to launch the assessment content.

2. E-Learning Standards

Standards in E-learning are desirable for interoperability, reusability, shareability in increased efficiency, flexibility and convenience in delivering the learning courseware across the network.

2.1 Standards for Courseware

The standard for courseware is categorized into two collections. The first group is the interoperability standards define on communication protocol between the courseware and the administrative systems

such as Learning Management System (LMS) and Learning Content Management System (LCMS). The communication path is established to exchange data about the candidate learning progress. Data that can be exchanged are like learner identification, time spent, quiz scores, etc.

Another collection of the standard for courseware is the content packaging standards. It defines the method in packaging learning objects or groups of learning objects, including complete courses for import into administrative system. The transportation between systems and content repository are essential so that they can be easily search for, access and reused.

Existing standard for courseware interoperability are AICC AGR 010 and SCORM Run Time Environment. The major different between this two standards is the AICC HACP (HTTP-based AICC CMI Protocol) for data exchange between content and administrative systems, while SCORM is apply its API (Application Programming Interface) in the communication.

In the aspect of standard compliance, the API conforms to both AICC and SCORM specifications, but HACP is not part of SCORM specification. In term of history, the API is newer than HACP and originated from LAN-based AICC mechanism. Therefore, the potential for API in accepted by the market is relatively higher than HAPC.

In comparing these two standards, other characteristics include the ease of use in courseware development, potential problems with firewalls and browsing security features, and fully compatible with HTML and JavaScript are the strength of API. Therefore, API by is more likely to be chosen for standard adoption.

2.2 Standards Bodies

The API developed by standard bodies, such as ADL, has a high potential to be adopted in future. SCORM is another standard developed by ADL. The specifications created by the standard bodies mostly compatible with SCORM. Therefore, the adoption direction in e-learning standards should move closer to SCORM and ADL.

2.2.1 The Instructional Management System (IMS) Global Learning Consortium [1]

Several IMS specifications have become worldwide de facto standards for delivering learning products and services. The scope for IMS specifications, broadly defined as "distributed learning," includes both online and off-line settings, taking place synchronously (real-time) or asynchronously. The learners can be in a conventional academic environment, in a corporate or government training setting, or at home. This group of people can utilize the metadata specifications by IMS, IMS Learning Resources Meta-data Specification.

2.2.2 Advanced Distributed Learning Initiative (ADL) [2]

It is intended to accelerate large-scale development of dynamic and cost-effective learning software and systems to stimulate an efficient market for these products in order to meet the education and training needs of the Military Services and the nation's workforce in the future. The outcomes of ADL include:

1 The Sharable Content Object Reference Model (SCORM) - is a reference model that defines the interrelationship of course component, data model and protocol so that learning content objects are sharable across systems that conform within the same model.
2 The ADL Real Solutions at Work shows how the technical specification, the SCORM, facilitates this support and will revolutionize the learning in non-emergency situations as well.

2.2.3 E-learning Competency Center (ECC) [3]

ECC began its operations as an independent

body representing the joint collaborative efforts of Singapore's e-learning industry, government and educational institutions in 2001. Main tasks responsible by ECC include the followings:

1 Establish guidelines and procedures for standards conformance
2 Set up mechanisms to ensure the quality of e-learning products and services
3 Develop the competency framework for e-learning professionals
4 Develop Singapore Standards on e-learning reference systems
5 Showcase standards-based e-learning reference systems

Other than the formation of ECC, the Singapore Learning Standards Technical Committee (LSTC) was formed in July 2000 to cater to the national needs of standardization in E-learning industry. The Singapore e-Learning Framework (SeLF) [3], was developed by LSTC which provides a basis for the e-Learning industry in Singapore to develop content and systems, which conform to international e-Learning specifications. SeLF consists of following parts:

1 Learning resources identification
2 Learner profile
3 Competency definition
4 Learning content packaging
5 Assessment and progress tracking
6 E-Book
7 Enterprise integration
8 Digital rights management

2.2.4 IEEE Learning Technology Standards Committee (LTSC) - was formed in 1966 and initiated to work with the International Standard Organization (ISO) by establishing the ISO Joint Technical Committee 1 (JTC1) on learning technology.

The mission of LTSC is to develop accredited technical standards, recommended practices and guides for learning technology. LTSC is operating criteria for new work with existing specification, industry implementation and support and material relevant to learning technology.

The accomplishments of LTSC include:

1 Learning Object Metadata (primary sources – ARIADNE, DCMI, IMS, and others for bindings)
2 CMI (primary sources – AICC, ADL)
3 Learning Technology System Architecture (primary sources – developed in committee)

2.2.5 The Aviation Industry CBT (Computer-Based Training) Committee (AICC).

The objectives of the AICC are to assist airplane operators in development of guidelines which promote the economic and effective implementation of computer-based training (CBT), to develop guidelines to enable interoperability, and to provide an open forum for the discussion of CBT training technologies. It is actively coordinates its efforts with broader learning technology standards organizations like IMS, ADL, and IEEE/LTSC. AICC has developed several Guidelines and Recommendations (AGRs). These AGRs are responsible for interaction between CMIs (Computer Managed Instruction) and CBT component, and standard navigation for students of CBT.

3. Adoption of E-learning Standards for Assessment Object Interoperability

The adopted standards are QTI specifications developed by IMS and the SCORM model constructed by IMS. The QTI specification is mainly used in developing the QTI Standard Compliant Content Manager. The software was entirely designed based on the framework in the QTI specification.

Meanwhile, the specifications of SCORM and LMS were mainly catered for assessment content packaging and launching. These activities required an administrative server like LMS platform complimenting the SCORM Run Time Environment. However,

the launching of the assessment content is essential as part of the testing strategies of the QTI Standard Compliant Content Manager. This is to validate and verify the XML output of the program.

3.1 Assessment Objects

3.1.1 Courseware Objects

Commonly, the E-learning contents are courseware materials prepared as PowerPoint slides, Macromedia Flash presentations, PDF files, assessment objects, multimedia objects, assessment objects, etc.

PowerPoint courseware object type was handled in our previous project [3], via the SCMP (SCORM Based Content Migration Procedure) approach by using the P2SC (Power Point to SCORM Converter) tool.

Assessment object would be the other major courseware object type to address to complete the reusable learning objects conversion framework. Assessment activities play an important role in substantiating a learning process. Therefore, the potential for assessment content development and management is relatively higher as compared to other object types. Online assessment enhances a courseware and promotes active learning across the network.

3.1.2 Common Assessment Objects

The common assessment objects found today range from simple text files to complicated xml, flash and java script. Although these assessment objects are carefully prepared, most do not conform to standard.

For an ordinary author, the assessment content is created in documents like MS Words, and PDF. But these formats are not playable on the e-learning servers. Some authors prefer to use all kinds of authoring tools in assessment content creation. One of the reason is the tool is easy to use and enable many data type including multimedia files. The created content is presentable using assigned player by the authoring tool. For the assessment content created in this method, normally the authoring tool will encode the content into XML format and eventually a player like flash will present the content by reading the XML file. This however does not conform to any standards either.

3.2 Standard Adoption for IMS QTI

Of the existing specifications developed by the various standard bodies evaluated, the most practical and relevant one is the QTI specification of IMS which is SCORM compliant, hence ready for standard adoption.

3.2.1 IMS Question & Test Interoperability (QTI) Specification 1.2.1

This specification is important to describe a basic structure to represent question (item) and test (assessment) data. One of the important features is to enable data exchange between assessment objects and Learning Management System (LMS) as well as content administrator and collection library. To archive this, the specification defines a powerful set of instructions that enable it to exchange a wide range of question types as well as a number of extension facilities that allow it to support proprietary features.

The IMS QTI specification is defined in XML so that it is extendable and customizable to allow ready adoption. The specification provides a standard XML language for describing questions and tests. It has been produced to allow the interoperability of content within assessment systems. This will be useful for many parties such as the publishers, certification authorities, teachers as well as the creators of assessments. The users may publish in XML and the data can be imported into other authoring tools and delivery systems.

3.2.2 QTI Terminology

The QTI specification describes how to tag questions and tests. The standard question types, such as multiple choices, fill in the blank and true/false, are being constructed using a core set of structure while the results

of these questions can be collected and scored by other methods. To represent it, QTI defines the 'Item' which contain all required data elements to compose, render, score and provide feedback from the questions. The defined 'Test' is an 'Assessment' object which consists of many 'Item's that are contained within a 'Section'. In addition, 'Assessment' can be formed from a blocks of 'Item'. This group also defined as 'Section' and therefore 'Assessment's are composed of one or more 'Section's which themselves are formed by 'Item's or more 'Section's.

Term	Description
Item	A combination of interrogatory, rendering and scoring information
Section	A collection of zero or more items and/or other Sections
Assessment	A collection of one or more Sections
Object Bank	A group of items and/or Sections that have been bundled
Participant	The user interacting with an assessment
Result Report	Results of response analysis

Table 3.1: Key Definition of QTI Terminology

3.2.3 Software Design

The Assessment Engine which contains IMS QTI XML is the backbone of the system. Basically it has two item repositories. One of the repositories consists of authoring system and external repository. The authoring system enables user such as the publisher, training departments, instructional designers, faculty, school, etc. to create and edit the learning objects in the system in the format of Standard XML. The external repository is accessible for some other purposes.

Another item repository is acting as data storage for the answers of the assessment objects as well as eligibility and performance records of the client or student. These data in the repository will provides sufficient information to the reporting system to generate reports such as user's performance and past records. The repository is connected to LMS as well. It is important to manage the contents of the system in an ordered manner. Meanwhile, the LMS, reporting system, and the item repository are accessible to the administrating authority for system maintenance.

The assessment engine is connected to the delivery system which can be the Internet or Intranet. It creates a gateway for the assessor, scorer, candidate and invigilator or proctor to access the system. This is probably the user interface of the system where candidates or students will retrieve the test or assessment data here.

3.2.4 Assessment, Section, Item (ASI)

The ASI consists of Item, Assessment, Section as well as Object-bank. The ASI model can be designed in many ways but restricted to the definition under the QTI Terminology.

(A) Item

Item is the smallest exchangeable object in IMS QTI. It has the following characteristic:

a. component of question itself;
b. online rendering mode for the question;
c. processing of the user response;
d. feedback associated with the question;
e. meta-data describing the question.

Depends on the design of ASI, these Items can be bind together under a Section or Assessments but constraint to the QTI standard.

(B) Section - is used to construct hierarchical evaluation objects. A section may contain one or more other sections. A section is important to:

a. Represents different grouping, in another word it could be a subject topic.
b. Constraints the extent of the sequencing instructions or control the sequence of constructing the sections.

(C) Assessment - An Assessment object is analogous to a test. It contains:

a. the collection of items used to determine the level of mastery;
b. all the necessary instructions to enable variable sequencing of the items (questions); and
c. the corresponding aggregated scoring for all of the items to produce final result.

(D) Object-bank

Object-bank is a collection of items, sections or a mixture of items and sections. It has:

a. own unique identifier and metadata to enable its contents to be searched; and
b. the database of evaluation objects for constructing a new assessment.

3.2.5 Response Type

It is a unique identifier for the type of response required from the user such as selection of multiple choice questions or a string for fill-in-blank question. Standard question type is designed based on the response characteristic of the questions. In IMS QTI, the standard response types are Logical Identifier, XY Co-ordinate, String, Numerical, and Logical Group.

3.2.6 Rendering / Formatting

Rendering refers to the presentation formatting of an Item or question. Under each response type, there can be many rendering types such as multiple choices with text and multiple choices with hot spot rendering.

3.2.7 Standard Question Types Models

Listed below are the standard question types based of QTI specification. It is designed according to response type and rendering characteristic of the questions in the XML format.

(A) Logical Identifier
- Standard True/False
- Standard Multiple Choice (Text)
- Standard Multiple Choice (Image)
- Standard Multiple Choice (Audio)
- Standard Multiple Response (Text)
- etc.

(B) XY Co-ordinate
- Standard Image Hot Spot
- Connect-the-Points

(C) String
- Standard Fill-in-Blank (Text)
- Standard Multiple Fill-in-Blank (Text)
- Standard Short Answer

(D) Numerical
- Standard Fill-in-Blank (Decimal)
- Standard Fill-in-Blank (Integer)
- Numerical Entry with Slider

(E) Logical Group
- Drag-and-Drop (Images)

3.3 SCORM Standard Adoption

The Sharable Content Object Reference Model (SCORM™) defines a Web-based learning Content Aggregation Model and Run-time Environment for learning objects. It is a model that references a set of interrelated technical specifications and guidelines designed to meet high-level requirements for Web-based learning content.

3.3.1 Content Aggregation Model

Learning experiences consist of activities that are supported by both electronic and non-electronic learning resources. The SCORM Content Aggregation Model represents a pedagogically neutral means for designers and implementers of instruction to aggregate learning resources for the purpose of delivering a desired learning experience. A learning resource is any representation of information that is used in a learning experience.

The process of creating and delivering learning experiences involves the creation, discovery and consolidation and aggregation of simple items into a more complex learning resource. The resources were then organized into a predefined sequence of delivery. The SCORM Content Aggregation Model supports this component and is made up of the following:

(a) Content Model: A Nomenclature defining the content components of a learning experience.
(b) Meta-data: A method for describing specific instances of the components in

the content model.

(c) Content Packaging: Defines how to illustrate the intended behavior of a learning experience and package learning resources movement within different environments or platforms.

3.3.2 Run Time Environment

One of the missions of SCORM is to create the learning resources to be reusable and interoperable across multiple Learning Management Systems (LMS). For this to be possible there must be a common way in creation of learning resources and a common mechanism for learning resources to communicate with an LMS. The communication is basically established by using a predefined language or protocol. The three aspects of the Run-Time Environment are Launch, Application Program Interface (API), and Data Model.

3.2.3.1 Launch

The launching mechanism defines a common way for LMS to start Web-based learning resources. The mechanism describes the procedures and responsibilities in the communication establishment between the delivered learning resource and the LMS. The communication protocols are standardized through the use of a common API.

For learning resources that used Shareable Content Objects (SCO), the launch model in SCORM allows the LMS to launch and activate only one SCO at a time. Under the launch model, only a LMS may launch SCOs, and a SCO may not launch other SCOs. The LMS must launch the SCO in a browser window that is a child window or a child frame of the LMS window that exposes the API Adapter that provided by the LMS.

3.3.3.2 Application Program Interface (API)

The API is the communication mechanism for informing the LMS various state of the learning resource such as initialized, finished or in an error condition. It is used for getting and setting data like scoring algorithms, time limits, and other form of assessment justifications between the LMS and the SCO.

The SCORM is allocated directly on the run-time environment functionality defined in AICC's CMI001 Guidelines for Interoperability document. ADL collaborated with AICC members and participants to develop a common Launch and API specification and to adopt Web-based data elements

API Adapter is a piece of functional software that implements and exposes the functions of the API. How the insides of an API Adapter are implemented should not matter to content developers provided they use the same public interface. The LMS need only provide an API Adapter that implements the functionality of the API and exposes its interface to the client SCO. All communication between the API Adapter and the SCO is initiated by the SCO. There is currently no supported mechanism for LMSs to initiate calls to functions implemented by a SCO.

3.3.3.3 Data Model

The Data Model is a standard set of data elements used to define the information being communicated, like the status of the learning resource. In short, the data model defines elements that both the LMS and SCO are expected to understand. The LMS must maintain the state of required data elements across sessions while the learning content must utilize only these predefined data elements when the reusing across multiple systems.

The data model in this section is defined as the SCORM Run-Time Environment Data Model derived directly from the AICC CMI Data Model described in the AICC CMI Guidelines for Interoperability. The AICC CMI Data Model was chosen for inclusion in the SCORM since it is well defined and has been tried out in the past.

The purpose of establishing a common data model is to ensure that a defined set of information about SCOs can be traced by

different LMS environments. For instance, if it is determined that tracking a student's score is a general requirement, then it is necessary to establish a common way for content to report scores to LMS environments.

Standard data models help to gather information sets to be exchanged between SCOs and LMS environments. For Examples, student profile information, question and test interactions, state information, assessment, etc. are grouped for exchange.

3.3.3.4 Shareable Content Object (SCO)
SCO represents a collection of one or more Assets. The collection includes a specific asset that using the SCORM Run-Time Environment to communicate with the LMS.

A SCO is the lowest level of granularity of learning resources that can be tracked by an LMS in a SCORM Run-Time Environment. To achieve its reusable property, a SCO should be independent of any learning context. For example, a SCO should be reusable in different learning experiences to accommodate different learning objectives. In addition, one or more SCOs can be aggregated to form a higher-level unit of instruction or command that fulfills higher level learning objectives.

Each of the following Assets represents the smallest SCO: whole web page, Javascript function, XML Doc, Flash Object, JPEG, WAV, HTML Fragment, GIF, etc.

Since a SCOs is the smallest unit, the reusability across multiple learning objectives is feasible. The SCORM however does not impose any particular constraints on the exact size of each SCO. During content design and authoring creation, the size of a SCO should be given to the smallest logical size of content. On top of that, SCO can be described with SCO Meta-data to enable search and querying within data repositories, which enhance the reuse of learning objects. For the metadata consolidation, there is a standard mechanism for binding SCOs to SCO Meta-data - the Content Package in the SCORM specification.

4. Standard Content Manager

4.1 QTI Standard Compliant Content Manager (QCM)

It is a software tool outfitted with various features and functionalities developed to fulfill the needs of a typical e-learning author.

Although many related software packages are flooding in the market, each of these software is only satisfying a small part in the full requirement of assessment content management. Ultimately, with the QCM Content Manager containing many authoring functionalities in a single unit, it provides a good candidate for offering great choices and adding more value to the users. The flows assessment content and the role of QCM is illustrated in Figure 4.1. Our project only covers the highlighted portion for the whole content migration and management framework.

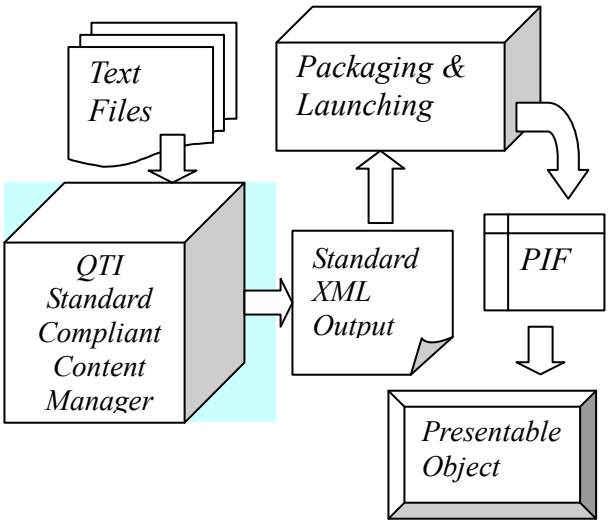

Figure 4.1 QTI Content Migrations and Management Framework

The output of the program is a XML document that fulfills the QTI Standards. The XML document will be fed into another software module which packages and launches the assessment contents.

The packing and launching procedures are adopts the SCORM specifications of ADL. Finally, the assessment content after packaging (PIF) will be played in LMS as a presentable object. In addition, the PIF can be tested to validate and verify for standard conformance by using a test suite.

4.3 Software Implementation

Major requirements in QTI Standard Compliant Content Manager (QCM) are: data extraction, data manipulation, database repository, XML output, a graphical user interface (GUI), database accessibility, and standard SQL program connectivity.

The overall implementation procedure is explained herein. Initially, raw data file that implies non-standard contents in other format is imported into QCM. Requirements listed in the program specification must be fulfilled in order to prevent data conflicts. This program module is to perform complete data extraction into a temporary database inventory. The content in the temporary database will then be manipulated and can be converted into the standard QTI XML format upon triggered correspondence commands.

Next, the standard XML tags will be allocated into a presentable format. This is done by a graphical user interface with authoring capability. Tentatively, an existing authoring tool in the market will be used. The assessment content author has the ability to edit the converted items as well as create the item metadata.

Several items were bundled by creating a 'section' or 'assessment'. This process is called XML binding. It packages a playable object. A XML schema tree diagram will be constructed as well.

The question bank serves as an infantry for previously created assessment items. The XML output file will then be packaged before being launched. The final package (PIF) is placed into a SCORM compliant LMS server, such as Blackboard 6.0.

5. The Conversion Software Tool

5.1 Text to XML Conversion

E-learning is not a new application practiced by many different computer users, from corporate to academic level. Due to the lacking of any E-learning standard in the past and the slow establishment of the E-learning standards, assessment objects are often created by using Microsoft Word documents or any other programming scripts in the past or even presently. According to a market survey conducted, as much as 85% of the author keeps the assessment contents in word documents. The remaining 15% using database programs such as Microsoft Access, and many other application programs.

A major concern of the e-learning authors is the compatibility of the assessment content to the standard. Practically not a single one of the common e-learning systems was found to accommodate word or text documents. Nor any of them handle the IMS QTI standard or any other e-learning standards in term of assessment objects.

The text to XML conversion tool is one of the major functionalities in the QCM. This module translates the non-standard assessment data from the text files into the IMS standard compliance objects. The module applies text mining techniques in the conversion of the text contents. The converted content will be deposited into the system repository and ready to be accessed.

5.2 Conversion Features

QCM provides the facilities for the author to migrate their existing content in the non-standard form such as plain text, rich text like Microsoft Word documents, PDF, or Hyper Mark Up format such as HTML.

It also provides a module to migrate the non-standard content in text format into IMS QTI standard XML. The module imports the contents from a selected text file and filters undesired strings and clusters from the text file. The result is stored into the system repository, or question bank.

5.3 Implementation of Conversion Module

The implementation of text file content migration is segregated into several steps. Each step has its unique features, properties, and algorithms. These steps are: text file import and extraction, content manipulation and data mining, and data repository.

5.3.1 Extraction and Import of Text Files

The non-standard text file containing assessment content is selected in the QTI Standard Compliant Content Manager. The content in the selected text file will then be transferred into QTI Standard Compliant Content Manager, stored in Microsoft Access as a temporary repository.

5.3.2 Text Processing and Data Clearning

The content at this stage is not organized in a proper manner. Many deteriorations and noisy data appear, including blank spaces, null values, text alignment and other outliers. On top of that, the content appears to be incomplete, lacking of certain attribute of interest or contains only aggregate data. The consistent of the data is not guaranteed as well. This is due to the data might contain discrepancies in codes. To filter the desired content, data mining criteria are applied.

In developing the text file content migration module, major tasks adopted in text processing are: data cleaning, integration, transformation, reduction, etc., as illustrated in figures 5.3 to 5.6.

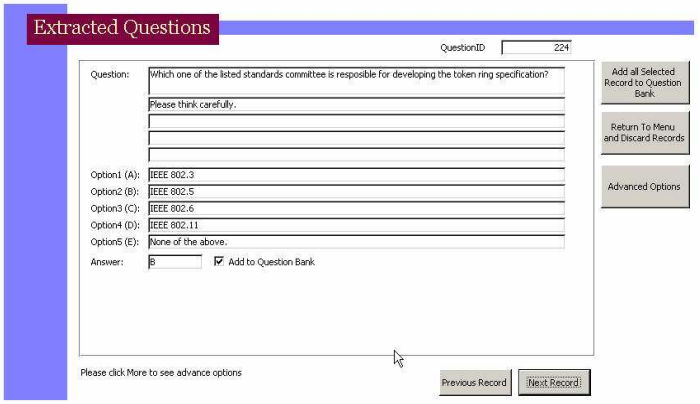

Figure 5.3: Screen shot shows the user input form for missing data filling, and editing.

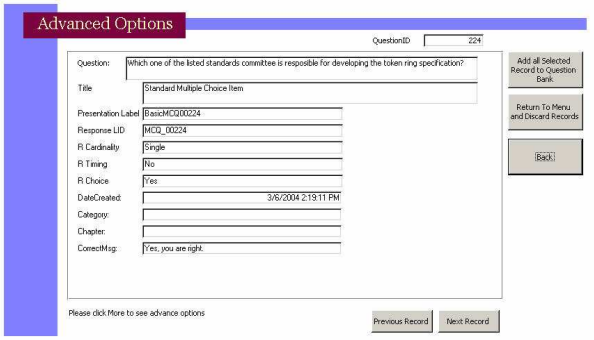

Figure 5.4: Screen shot shows the assigned values for a tuple in an editable form. There is a lot more advanced details available in other forms.

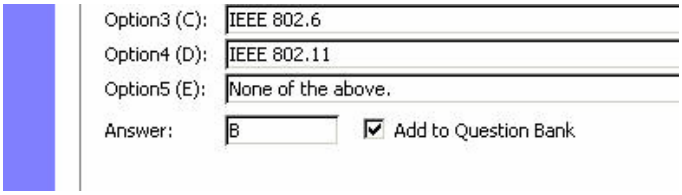

Figure5.5: Screen shot shows example of additional attribute serving as control parameter in Data mining process

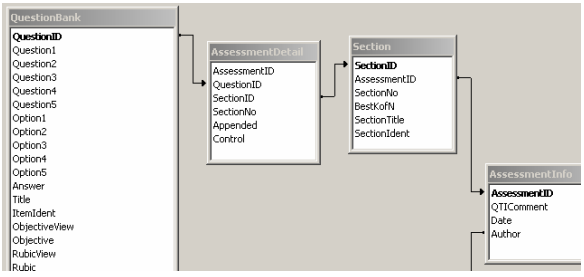

Figure 5.6: An example of normalized schematic diagram in the system repository

5.3.3 Content Repository

The transformed contents from the text file need to be kept into a data warehouse after going through the data mining processes as shown above. The content will eventually be stored into the Question Bank in QCM.

Before the content is updated to the Question Bank, the contents are actually deposited into a temporary repository. This is an important intermediate level segregate from the actual Question Bank. In this case, the temporary database is referring to a MCQ table in the system. The intermediate content is displayed in a form for further edition. The author has to make a decision to select the desired items to be kept in the Question Bank.

The selected item will then be appended into the Question Bank as new entries. The process applies the concept of data integration and consolidation in data mining. This is actually implemented by running an append query in the system.

6. Summary

The text conversion module plays an essential role in developing the QTI Standard Compliant Content Manager. It is an important tool which has yet been developed in the market. However, there are still a lot of limitations to improve on.

6.1 Limited Input Format

The conversion module in the QTI Standard Compliant Content Manager only applicable for plain text files conversion. For rich text file formats like Microsoft Words documents, the conversion tool is not able to migrate the content directly. The reason behind is these files are equipped with many non-standard coding with the plain text file such as the inclusive of tables, paragraph, bullets and other features. Another reason is these files using many different version of text coding such as Unicode UTF-8, UTF-16, UTF-7 which is not standard to the plain text files which using 16-bit ASCII, ISO-8859-15.

To accommodate rich text files direct conversion, another stage of conversion is required to translate the rich text format into plain text files. The incorporation of the Text Standard conversion into QCM should be an enhancement feature in the future.

6.2 Toleration of Text Content Input

The level of toleration of the text content input is specified during the development of the conversion module. From the specification, the program module can only archive up to certain level of toleration. This is mainly due to limitation of software algorithms in the text processing engine and constraints placed by Microsoft VBA.

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