International Symposium on Learning Management and Technology Development
in the Information and Internet Age.
The convergent paths of Public and Private Organizations.
University of Bologna November 2002

Assessment Feedback supporting E-learning

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Abstract

With the rapidly development of distance learning and the XML (Extensible Markup Language) technology, metadata becomes an important item in an e-learning system. Today, many distance learning standards such as SCORM, AICC CMI, IEEE LTSC Learning Object Meta-data (LOM), and IMS Learning Resource Metadata XML Binding Specification, use metadata to tag learning materials, shareable content objects, and learning resources. However, most metadata is used to define learning materials and test problems. Few metadata is dedicated for assessment in learning. In this paper, we proposed an assessment metadata model for e-learning operations. With the support from the assessment metadata, we can collect information at the question cognition level, Item Difficulty Index, Item Discrimination Index, questionnaire style, and question style. The assessment analysis model provides individual questions, summary of test results, and analytical suggestions. The suggestions and results can tell teachers why a question is not suitable and how to correct it. Teachers can see the test result analysis and fix some problematic questions. With the cognition level analysis, teachers can correct their cognition level to avoid missing items in teaching. The mechanism developed also suggests to an e-learning system, to adaptive learning content and test to individual learners, as well as provides good advice to the teachers.

Keyword: cognition level, Item Discrimination Index, Item Difficulty Index, questionnaire, Assessment Analysis Model, distance learning

1. Introduction

As the popularity and importance of distance learning increase, learning materials and group communications are widely established on Internet and wireless infrastructures. Whether in distance learning programs, e-learning portals, or the traditional education environment, teaching

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and assessment cooperate as a complete and perfect learning cycle. But, how could a teacher realize the blind spot of a learner? It is the weakness of this learning and teaching cycle. Assessment provides a suitable method to gather student feedback. A good assessment not only offers test, but also analysis test results for a teacher. With the interaction and analysis, teachers can fix their teaching strategies, and reedit or reorganize learning materials. In addition to the teacher can derive benefit from the assessment; students also realize what is the key point of learning materials. Assessment responses to the learners in terms of what is the major and most important part in each subject and course.

In the first part of this paper, we discuss several e-learning standards. In the second part, we introduce the assessment meta-dada elements and their meanings. Then, the detail information model and definitions are defined in the third part. We also calculate and analysis the test result. There are several analysis methods proposed in that section. Finally, we illustrate the implementation before our conclusion and future work.

2. Related work

There are many e-learning standards exists. But, each standard emphasis on a different topic. We make a simple summary of these e-learning standards.

2.1 Architecture and Reference Model

The standard for learning technology-Learning Technology Systems Architecture (LTSA) [LTSA, 2002] provides a framework for understanding existing and future systems. The architecture is refined into five layers. These layers are called (highest to lowest levels), Learner and Environment Interactions, Learner-Related Design Features, System Components, Implementation Perspectives and Priorities and Operational Components and Interoperability. Only layer 3 is normative. Each layer describes a system in different level. The higher layers are abstract conceptions of the lower layers and the lower layers are the implementations of the higher layers.

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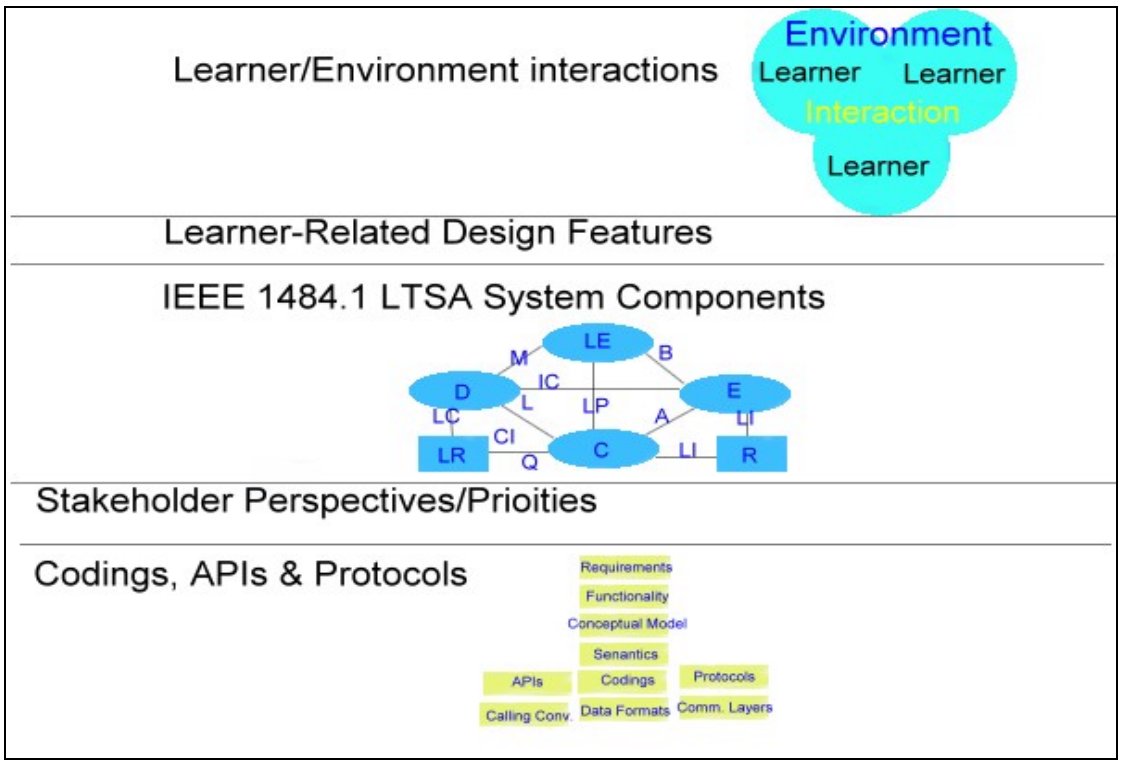
Figure 1. The LTSA [LTSA, 2002] abstraction-implementation layers.



2.2 Metadata

Metadata provides a common nomenclature for learning resources to communicate and exchange with the others in a common way. A good metadata need completeness, carefulness, and flexibility. The most famous metadata is the IEEE LTSC's Learning Object Metadata (LOM) [LOM, 2002]. It provides nine categories to describe learning resource. These metadata are attribute, version, classification, attribute value, and educational element. Several international e-learning standards, such as IMS [IMS, 2002], ADL [ADL initial, 2002], ARIADNE [ARIADNE, 2002], are based on LOM [LOM, 2002].

2.3 Course hierarchy and structure

In an e-learning environment, course structure will effect on the learning resource transformation and educational knowledge constitution. About course hierarchy, the previous idea is content-block-sco. With the AICC [AICC, 2002] nomenclature, the course structure is divided into two elements. One is assignable unit, which is used to present to students, for example a HTML file, an image file, a video file. Another is block, which collects assignable units. However, in order to include some additional features and reference metadata formats.

Course structure and hierarchy occurs in several versions, which is concerned the relation, semantic meaning, metadata and web environment need [Dodds, 2001].

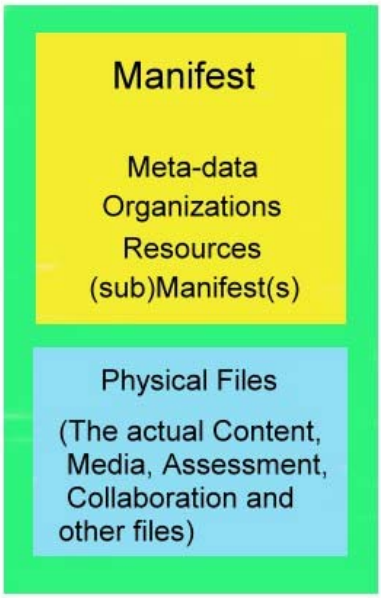
2.4 Assessment

IMS Question &Test Interoperability (Q&TI) [Smythe, 2002] specification allows systems to exchange questions and tests. This standard is a powerful standard for complex assessment. The other distance learning standard (such as ADL SCORM [Dodds, 2002], ULF [ULF, 2002]) offers item difficulty index and question style. IMS Q&TI [Dodds, 2002] provides a specific assessment metadata to describe and some feedback to the test.

2.5 Content Packaging and Encapsulation

Exchanging the learning resource between authoring tool and learning management systems makes content packaging and encapsulation development and establishment. The IMS Content Packaging specification [Anderson ,2001] defines the content packaging format (Figure 2). Most standard follow IMS Content Packaging format [Anderson ,2001], it would easier to edit the learning resource with XML parser authoring tool for all kinds of content. The special file called the Manifest file (imsmanifest.xml). All the content packaging and organization are described in the file.

Figure 2. Content Packaging Conceptual Diagram



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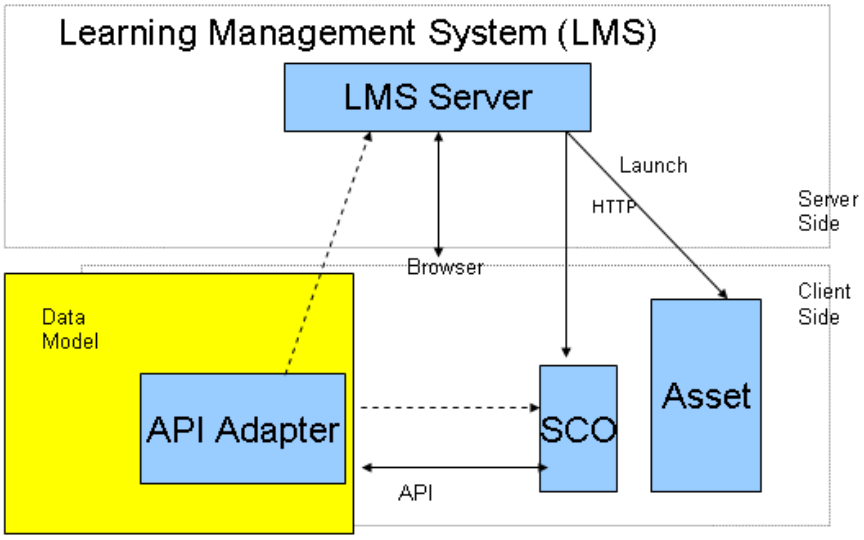
2.6 Environment

An environment to support e-learning operation, such as course management, student management, learning resource delivery, tracking service, integration of course and teaching methods and common format for exchange. DoD's ADL [ADL initial, 2002] proposed SCORM which has a clear concept and environment. In the Run-Time Environment, there are data model, SCO, Asset, API, Launch mechanism and LMS.

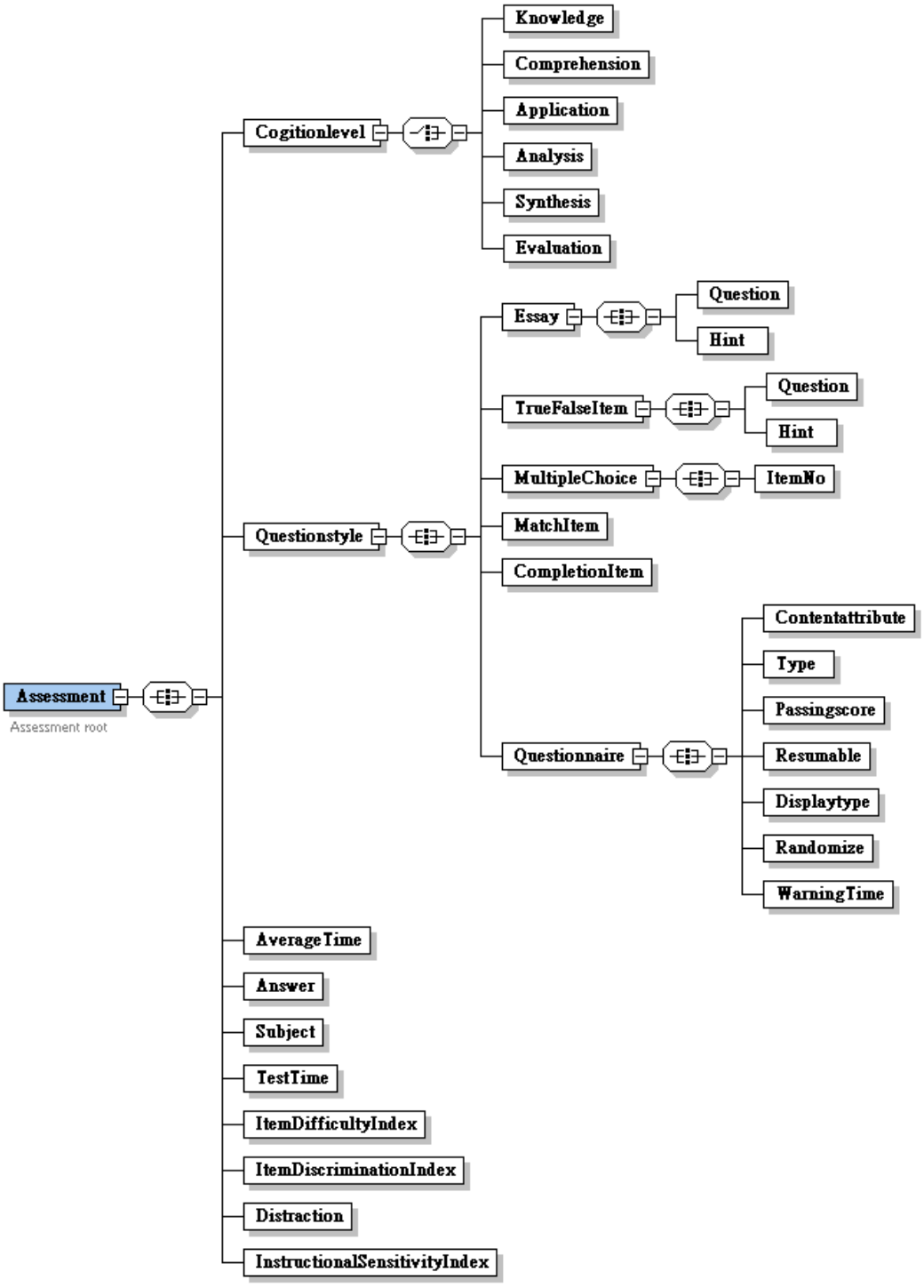
Figure 3. Run-Time Environment



3. The MINE SCORM Meta-data

We defined an assessment metadata for e-learning. We reference SCORM as our e-learning standard. We hope the assessment metadata is conductive to e-learning. We call the assessment metadata MINE SCORM Meta-data Model. MINE SCORM Meta-data is designed specially for assessment in distance learning. Including assessment record, assessment analysis, and questionnaire and cognition level. The whole MINE SCORM Meta-data is represented in a tree-like structure in Figure 4.

Figure 4. Assessment root and his child nodes. It is divided into ten sections. Cognition level and Questionnaire has six child nodes.



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(1) Cognition level:

Instruction objective plays a very important role in teaching progress. If the instruction objective is clear, it guides teaching activities and evaluation precisely and properly. Bloom proposed the taxonomy of educational objectives into three domain, they are cognitive domain, psychomotor domain and affective domain [Bloom, 1956] [Fleishnan ,1984] [Kropp ,1966] [Seddon, 1978]. In cognitive domain, it includes knowledge, comprehension, application, analysis, synthesis, and evaluation.

I. Knowledge

A. Remembering previously learned information, such as observation and recall of information, knowledge of major ideas, and mastery of subject matter and knowledge of dates, events, and places.

II. Question Cues:

list, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.

A. Example: Someone can write down the formula about the product of multiplication and difference

B. Question example: What is the interior angle sum of a triangle?

(1)600 (2)1200 (3)1800 (4)3600

III. Comprehension

A. Grasping the meaning of information, such as understanding information, grasp meaning, translate knowledge into new context, predict consequences, interpret facts, compare, contrast and order, group, infer causes

B. Question Cues:
summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend

C. Example: Someone can make an example to illustrate the meaning of set

IV. Application

A. Applying knowledge to actual situation, such as use information, use methods, concepts, theories in new situations and solve problems using required skills or knowledge.

B. Questions Cues:
apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover

C. Example: Someone can use the four fundamental operations of arithmetic to calculate one variable's value

V. Analysis

A. Breaking down objects or ideas into simpler parts and seeing how the parts relate and are organized, such as seeing patterns, organization of parts, recognition of hidden meanings and identification of components.

B. Question Cues:
analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer

C. Example: Someone can point out the signals' interrelations in the equation

VI. Synthesis

A. Rearranging component ideas into a new whole, such as use old ideas to create new ones, generalize from given facts, relate knowledge from several areas and predict, draw conclusions.

B. Question Cues:
combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite

C. Example: Someone can design an experiment to prove water existence

VII. Evaluation

A. Making judgments based on internal evidence or external criteria, such as compare and discriminate between ideas, assess value of theories, presentations, make choices based on reasoned argument, verify value of evidence and recognize subjectivity

B. Question Cues:
assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

C. Example: Someone can estimate research papers' advantage and disadvantage according to research principles

(2) Question style:

I. Essay: Defines the text of an open-ended essay question. You can also use it to represent shorter fill-in-the blank. Two elements are Question and Hint.

II. True False Item: Defines a question whose answer is either true or false. Two elements are Question and Hint.

III. Multiple Choice: Defines a question with multiple choice answers

IV. Match Item: Define a question with proper matched choice

V. Completion Item: Design a question like fill-in blank or cloze.

VI. Questionnaire:

A. Content attribute: The content could be text, graph, and draw a picture. In this metadata, we focus on text.

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B. Type: The questionnaire supply to test, survey or assessment.

C. Passing score: Defines the passing. Score for a test.

D. Resumable: True means resumed and false means paused at a later time.

E. Display Type: Fixed Order — for tests with a fixed number and order of questions. Random Order — for tests with a random order.

F. Randomize: The randomize attribute indicates that the questions on a test should be presented in random order.

G. Warning Time: warning time Specifies the time before the end of a test to display a warning.

(3) Average Time: Each people take different time answering questions, we use average time for operation.
(4) Answer: Correct answer for explain and query.
(5) Subject: Define each question a main subject.
(6) Test Time: A default time limit for testing.
(7) Item Difficulty Index: A simple explain is below.

P=R/N (100), which P: Item Difficulty Index, R: The number which people have right answer. N: Sum

For example, R=800, N=1000, then P= R/N=800/1000=0.8 (80%)

Generally speaking, the more Item Difficulty Index increase, the question is easier.

(8) Item Discrimination Index: An index for judging a question's discrimination.
(9) Distraction: With the analysis to define the distraction of students.
(10) Instructional Sensitivity Index: With the comparison between the test result before teaching and the test result after teaching to analysis Instructional Sensitivity Index.

4. The MINE SCORM Meta-data Information Model

In order to cooperate with SCORM and other e-learning metadata standard, we define a metadata model with reusability and interoperability (Table 1 and Table 2). The MINE SCORM Meta-data Information Model refers to ADL SCORM metadata information model. Therefore it supplied the same runtime environment and learning management system. Just embed a new metadata schema or DTD and metadata generator to generate some metadata tag our analysis model requires. We'll talk about the assessment analysis model later.

Table 1: Definition about symbol meaning and attribute

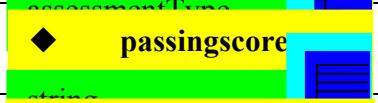
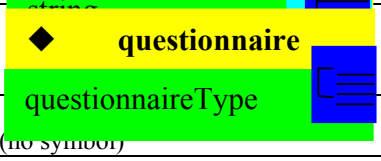
Symbol	Meaning
	This symbol denotes that the element has one or more child elements.
	This symbol denotes that the element contains data.
	This text denotes the XML Schema Definition (XSD) type assigned to the element.
(no symbol)	When no multiplicity symbol is present, this denotes that the element may exist one and only one time.
+	The Plus sign denotes that the element may occur one or more times within its element.
□	The question mark denotes that the element may occur zero or one time within its parent element.
*	The asterisk denotes that the element may occur zero to many times within its parent element.

Table 2: The MINE SCORM Meta-data Information Model

The MINE SCORM Meta-data Information Model				
Nr	Name	Explanation	Multiplicity	Data Type
1	Assessment	This category groups the assessment information that describes the resource as a whole	1 and only 1	Container
1.1	Cognitionlevel	MINE assessment Vocabulary: Knowledge Comprehension Application Analysis Synthesis Evaluation	0 or 1	VocabularyType (Restricted)
1.2	Questionstyle	MINE assessment Vocabulary: Essay True False Item Multiple Choice Match Item Fill in Blank	0 or 1	VocabularyType (Restricted)
1.2.1	Essay	Defines the text of an open-ended essay question. You can also use it to represent shorter fill-in-the blank.	1 or More (smallest permitted maximum: 10)	LangStringType (smallest permitted maximum: 2000 characters)
1.2.2	TrueFalseItem	Defines a question whose answer is either true or false.	1 or More (smallest permitted maximum: 10)	LangStringType (smallest permitted maximum: 2000 characters)
1.2.3	MultipleChoice	Defines a question with multiple choice answers	1 or More (smallest permitted	LangStringType (smallest permitted

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			maximum: 10)	maximum: 2000 characters)
1.2.4	MatchItem	Define a question with proper matched choice	1 or More (smallest permitted maximum: 10)	LangStringType (smallest permitted maximum: 2000 characters)
1.2.5	CompletionItem	Design a question like fill-in blank or cloze.	1 or More (smallest permitted maximum: 10)	LangStringType (smallest permitted maximum: 2000 characters)
1.2.6	Questionnaire	a written list of questions that are answered by a number of people so that information can be collected from the answers:	1 or More (smallest permitted maximum: 10)	LangStringType (smallest permitted maximum: 2000 characters)
1.2.6.1	Content attribute	The content could be text, graph, drawing a picture. In this metadata, we focus on text.	1 and only 1	String (smallest permitted maximum: 1000 characters)
1.2.6.2	Type	The questionnaire supply to test, survey or assessment.	0 or 1	VocabularyType (Restricted)
1.2.6.3	Passing score	Defines the passing. score for a test.	1 and only 1	String (smallest permitted maximum: 1000 characters)
1.2.6.4	Resumable	True means resumed and false means paused at a later time.	O or 1	String (smallest permitted maximum: 1000 characters)
1.2.6.5	Displaytype	Fixed Order — For tests with a fixed number and order of questions. Random Order — For tests with a random order.	0 or 1	String (smallest permitted maximum: 1000 characters)
1.2.6.6	Randomize	The randomize attribute indicates that the questions on a test should be presented in random order.	0 or 1	String (smallest permitted maximum: 1000 characters)
1.2.6.7	WarningTime	Warning time Specifies the time before the end of a test to display a warning.	O or 1	String (smallest permitted maximum: 1000 characters)
1.3	AverageTime	The average time for testing.	1 and only 1	String (smallest permitted maximum: 100000 characters)
1.4	Answer	Correct answer for explain and query.	0 or More	LangStringType (smallest permitted maximum: 1000 characters)
1.5	Subject	Define each question a main subject for learning material.	0 or 1	String (smallest permitted maximum: 1000 characters)
1.6	Test Time	A default time limit for	0 or 1	String (smallest

		testing.		permitted maximum: 1000 characters)
1.7	Item Difficulty Index	The index is suitable for large amount of people after test. Then calculate the value for reference.	RESERVED	String
1.8	Item Discrimination Index	The index is suitable for large amount of people after test. Then calculate the value for reference.	RESERVED	String
1.9	Distraction	With the analysis to define the distraction of students.	RESERVED	String
1.10	Instructional Sensitivity Index	The index is suitable for large amount of people after test. Then calculate the value for reference.	RESERVED	String

5. The Analysis Model

A completed teaching could divided into three parts, first part is teacher's teaching strategy (for example, game, direct, discussion and experimentation), second part is the learning content (learning material, for example, handbook, music score and textbook), and last part is assessment (for example, questionnaire, test, exam and quiz). Assessment plays an important part in this model (see Figure 5). A teacher use proper teaching strategy and good learning content to teach students. However, we don't know if students receive the information or not. The only way is hold a test. With the test result and analysis, teacher may know what the students need, how the students received, what the learning content should add or delete. A good assessment analysis model provides a blueprint for teaching.

Teacher Side:

(1) Each question statistic and analysis
(2) Total test Each statistic and analysis

Student Side:

(1) Receive auxiliary test for practice
(2) Hint and answer mechanism

System Side:

(1) Deliver auxiliary test for practice
(2) Deliver questionnaire to students and teachers

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Figure 5. Teaching model

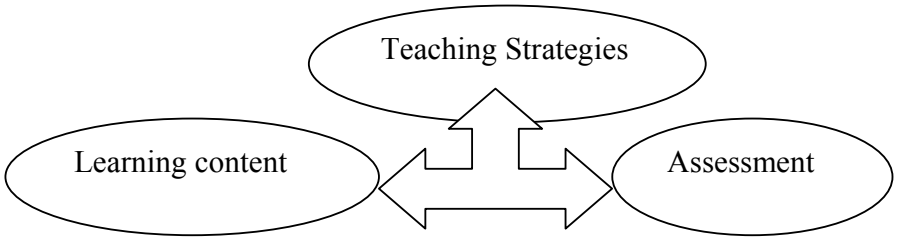
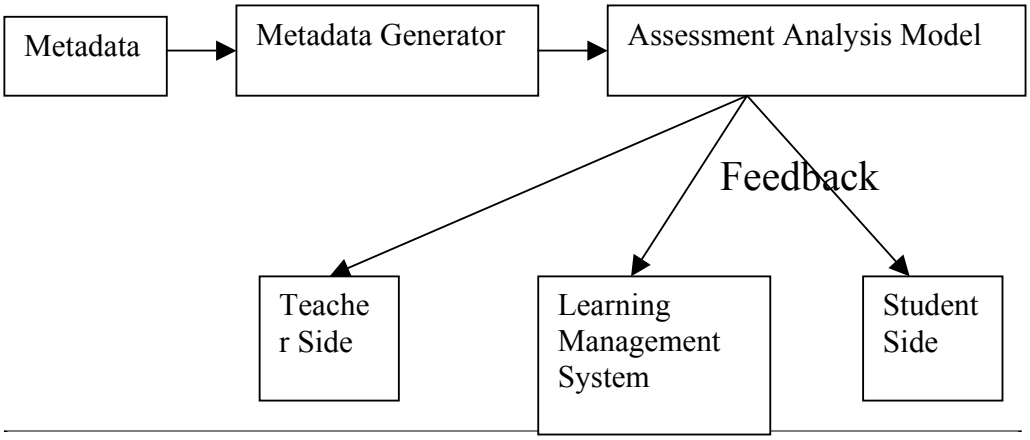


Figure 6. Analysis Model



Item analysis: (1) Provide feedback to students. (Student Side)
(2) Provide feedback to teachers. (Teacher Side)
(3) Provide the basis of improve learning content. (Teacher Side, System Side)
(4) Improve the teachers' formulate questions for a test or exam. (Teacher Side)
(See Figure 6)

5.1 Each question statistic and analysis

Number representation
Teacher can see each question's status. Also it will provide some suggestions from the test question.

No	P_H	P_L	$D=P_H-P_L$	$P=(P_H+P_L)/2$	L	W	B	N
…	…	…	…	…	…	…	…	…

No: The question's Number
P_H: the higher 25% of total student as the higher group
P_L: the lower 25% of total student as the lower group
$D=P_H-P_L$
$P= (P_H+P_L)/2$

(1) 1st step: according to score height arrange the examination paper

(2) 2nd step: we define P_H the higher 25% of total student as the higher group and then P_L the lower 25% of total student as the lower group. (The reasonable range between 25%-33%)

(3) 3rd step: calculate the people answer correct and his percentage in higher group and lower group in each question.

(4) 4th step: Calculate each question Item Difficulty Index $P=(P_H+P_L)/2$

(5) 5th step: Calculate each question Item Discrimination Index $D=P_H-P_L$

Signal representation

With signal presentation, the advice to teacher becomes more easy and simple. (See Table 3)

Table 3: Some advice and different suggestions about questions. [Dodds, 2001]

Status	Light signal	D	L	W	B	N
Good	Green	0.3-0.4				
Fix	Yellow	0.2-0.29	ˇ	ˇ	ˇ	ˇ
Eliminate or fix	Red	Lower 0.19				

L: No one choose the item, the choice becomes a useless item.
W: People in P_H choose but people in P_L didn't choose the item. But it is not the right answer. May be answer is wrong.
B: People in P_H have different choose. The different choice situation is balanced. It might have other correct answer in this question.
N: Students didn't answer the question. The question's meaning or description has some problems.

5.2 Total Test statistic and analysis

The assessment analysis should be presented in different aspects. A total test analysis result could show the whole status of students.

Figure representation

(1) Time (cross axle) and Number of answered question (vertical axle) figure: The figure shows the test time is enough or not.

(2) Test score (cross axle) and degree of difficulty (vertical axle) figure: The figure shows the distribution of score and difficulty.

(3) Cognition level (cross axle) and learning content subject (vertical axle) figure shows the cognition level, question number and subject. (See Table 4)

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Table 4: Two-way specification table

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	
Concept 1	A1	B1	C1	D1	E1	F1	SUM(A1-F1)
...	...	...	...	...	...	...	...
Concept i	Ai	Bi	Ci	Di	Ei	Fi	SUM(Ai-Fi)
	SUM(A1-Ai)	SUM(B1-Bi)	SUM(C1-Ci)	SUM(D1-Di)	SUM(E1-Ei)	SUM(F1-Fi)	

Definition

(1) Cognition level divided into six level, each named from A to F. Assume X is universal set, X={A,B,C,D,E,F} Ex.

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
A	B	C	D	E	F

(2) Concept in the test would be named from 1 to i, initial i=1

ex. Concept 1

(3) From concept 1, we write a question belongs to Knowledge cognition level. Then A1 is set [TRUE]. If over one question belong to Knowledge cognition level exist in concept 1. A1 is [TRUE] to represent there is a question of knowledge level in concept 1 at least. If A1 is [FALSE], there is no question of knowledge level in concept 1 at least.

(4) SUM(Xi) is the question's sum of cognition level X in concept i.

ex. SUM(F3)=3, there are 3 questions of evaluation level in concept 3.

(5) SUM(Ai-Fi) is the question's sum in concept i.

SUM(A10-F10)=8, there are 8 questions (From Knowledge to Evaluation level) in concept 10.

(6) SUM(B1-Bi) is the question's sum of Comprehension (From Concept 1 to Concept i). ex.SUM(C1-C7)=7, there are 8 questions (From Concept 1 to Concept 7).

Analysis

(1) Concept Lost
If (A1|B1|C1|D1|E1|F1)=FALSE, Concept 1 lost the test.

(2) Cognition level and question's sum relation
SUM(A1-Ai) □ SUM(B1-Bi) □ SUM(C1-Ci) □SUM(D1-Di) □ SUM(E1-Ei) □ SUM(F1-Fi)

(3) Distribution of cognition level and question (paint algorithm)

Table 5. example of concept and cognition level relation

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	
Concept 1	2	3	1	2	1	1	10
Concept 2	4	3	2	0	1	0	10
Concept 3	3	3	1	1	2	0	10
Concept 4	3	4	2	2	0	1	12
Concept 5	3	2	1	0	1	1	8

Table 6. paint algorithm procedure

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<td>If over one question belong to Knowledge cognition level exist in concept 1. A1 is [TRUE] to represent there is a question of knowledge level in concept 1 at least. If A1 is [FALSE], there is no question of knowledge level in concept 1 at least.</td>
<td>If Xi is [TRUE], paint the block black. If [FALSE], paint the block white.</td>
<td>According to the number of black block in concept level, we sort the table from max to min. If the sum of different concept level is same, the white block appears leftmost lower. For example, concept 3 is lower than concept 4.</td>
</tr>
</table>

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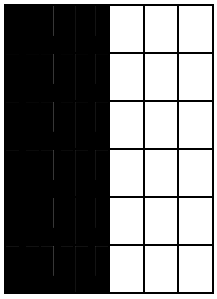
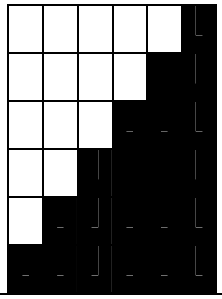
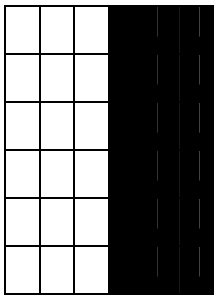
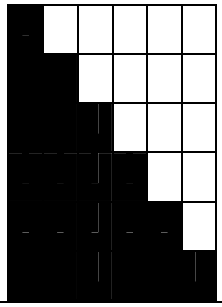
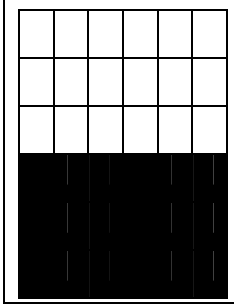
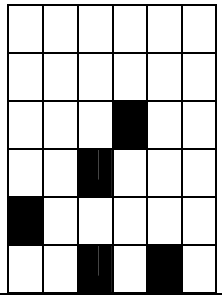
Table 7. Several suggestion type of distribution of cognition level and question (paint algorithm)

	Type A: The test is focus on knowledge, comprehension and application cognition level.		Type D: The test partially emphasis on some concept. And the test is inclined to high cognition level.
	Type B: The test is focus on analysis, synthesis, and evaluation cognition level.		Type E: The test partially emphasis on some concept. And the test is inclined to low cognition level.
	Type C: The test lost some concepts. Test key point is not the same as teaching key point.		Type F: The test's key point is too distributed for students. There is no key point in this test.

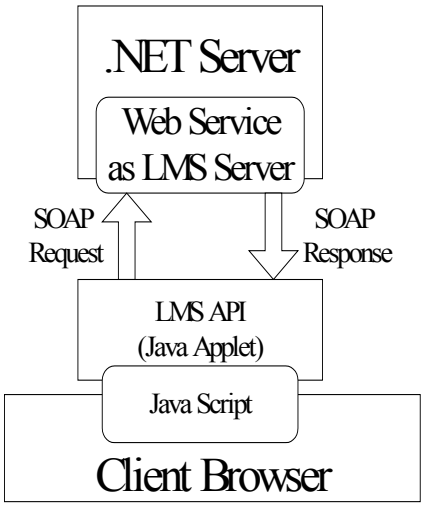


Figure 5 : Architecture with analysis model

6. Assessment Metadata and Analysis Architecture

We proposed architecture with analysis model. (See Figure 5) Microsoft .NET provides a Web Service in this environment. We use .NET [Microsoft ,2002] to construct our LMS, and use XML Schema or DTD to implement MINE Assessment Metadata. In order to solve different operation or platform operation, we choose SOAP [Gudgin ,2002] (Simple Object Access Protocol) as the basis of transportation and Java Applet as the LMS API.

With the API, java script and API adapter communication, client could track students' learning behavior. Metadata also provide assessment raw data for analysis model to generate analysis result and feedback to teachers, students and learning management system. Figure 5 is the interface for reedit and fix improper question, this part belongs to question analysis. Figure 6 shows whole analysis feedback. Each question is classified according to Item Discrimination Index. Green light means good quality of question, Yellow light means normal with little error and red light means poor quality of question with big problem.

Figure 5. Fix question interface

Figure 6. Signal represent interface for whole test

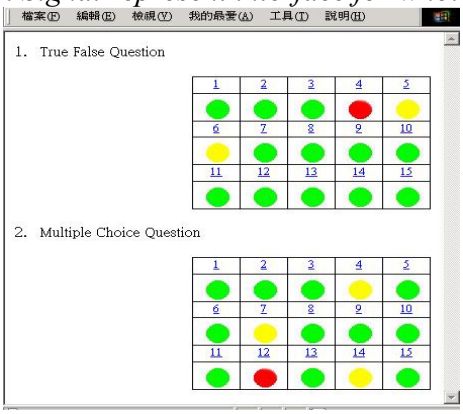


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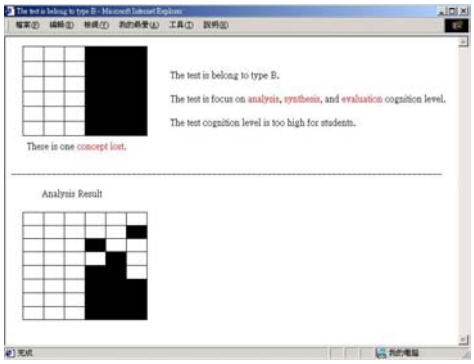
Figure 7. Item Discrimination Index and Item Difficulty Index number representation

Figure 8. Distribution of cognition level and question (paint algorithm)



In Figure 7, teacher can see the analysis result with number representation. Also with the Item Discrimination Index classification, light signal can give the advice to the teacher to fix the questions. In Figure 8, with the help of paint algorithm we can see the distribution of cognition level and question. The system will show the test belong to which type of improper tests. And give the analysis result and the detail suggestion about test.

7. Discussion

Table 8. MINE SCORM, SCORM and ULF Compared table

	MINE SCORM	SCORM	ULF	IMS Question & Test
Difficulty	●	▲	▲	●
Discrimination	●	○	○	○
Distraction	●	○	○	○
Instructional Sensitivity	●	○	○	▲
Question Style	●	▲	▲	●
Cognition	●	○	○	○

●: completed ▲:partial ○:empty

IMS LOM

Specifies the relative difficulty of the learning resource, on a scale of 0-4.

Value can be: **0** — very easy, **1** — easy, **2** — medium, **3** — difficult, **4** — very difficult

The difficulty of the learning resource is represented by the IMS difficulty element. The difficulty level could refer to the result of the Item Difficulty Index calculation result

ULF

Learning Content Format (LCF) is an interchange format for online learning content. Several standards related to online content and courses are currently in the process of being defined, including IMS Content Packaging Format [Anderson ,2001], IMS Question & Test [Smythe, 2002], and ADL Course Structure Format [Dodds, 2002]. LCF adopts these standards and consolidates their best features into a stable and comprehensive format for describing online learning content. Assessments for a variety of purposes, including tests, evaluations, and surveys.

8. Conclusion and Future Work

In this paper, we proposed the MINE Assessment Metadata to support e-learning operation. The assessment metadata strengthen SCORM assessment metadata. Also it offers an interaction to students and teachers.

The MINE SCORM Metadata:

1. Cognition level
2. Question style
3. Average Time
4. Answer
5. Subject
6. Test Time
7. Item Difficulty Index
8. Item Discrimination Index
9. Distraction
10. Instructional Sensitivity Index

These elements are designed for simple but effective for learner analysis and teaching quality. Assessment often is treated only as test. We let assessment as a direct in learning and teaching. The analysis result could tell the teacher if the teaching is valid. Students could realize what the key point in the course is and what loses in their learning progress. The e-learning system could analysis the assessment result, provide supplement test, and deliver the proper learning content to students. For future work, we could focus on the following aspects:

1. Knowledge map establishment

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2. Auto questioning for teachers
3. Interaction for assessment and multimedia assessment

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