Adaptable user interface models for evaluation tasks based on IMS-QTI E-Learning standard

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Abstract. Course material conversion from standard format to electronic format for E-Learning purposes have been the object of a lot of work during the previous years. A number of XML based E-Learming standards as LOM, SCORM and IMS-QTI have been designed to facilitate course material conversion and exchange on servers over the Web. Often, the emphasis is placed on course materiel presentation (E-Learning) while the evaluation (E-Evaluation) aspect is neglected. This paper will try to develop the last issue by proposing a theoretical GOMS derived model allowing evaluation tasks conversion into evaluation objects coded in IMS-QTI standard. This model will consider evaluation process adaptability allowing the user interface to adjust itself to the multimedia components of the evaluation tasks. An E-Evaluation software will be also designed with adaptive testing capabilities in mind allowing the questions of the evaluation tasks to be shown in accordance to the user's previous answers.

Keywords: E-Learning, E-Evaluation, adaptable interfaces model; assessment tasks; computerized adaptive testing; computerized assisted learning; computerized assisted evaluation; learning objects; computer interface standards; XML; GOMS model

1 Introduction

Traditional methods of education in classrooms that are only using blackboards, books, slides and course notes now seems no longer valid for higher education as stated by Andrews & Haythorntwaite [4].

Higher education institutions now needs to reach more students and to have a worldwide reach. They must have a very flexible course schedule to accommodate students that are working, workers needing professional development, scholars needing continuing education and foreign students living far from the campus. Many colleges and universities wants to consolidate their presence on the net and their course accessible worldwide via the Internet. In accordance with these previous statements, some prestigious universities as the Massachussets Institute of

Technology (MIT) had all their courses and support material converted to electronic format and placed on Internet servers. For example, MIT courses, resources, databases and professors are instantly accessible to anyone having access Internet.

Computerized assisted learning supported by the Internet needs a complete revision of teaching, learning (E-Learning) and evaluation (E-Evaluation) methods with its underlying epistemology.

This paper will explore E-Evaluation theory and especially evaluation tasks conversion into electronic format on web servers. Another side of our research is the user interface development of Internet based evaluation task presentation software. Our research will lead to the construction of a theoretical model inspired by the GOMS model able to formalize evaluation tasks conversion into XML[89] based electronic format. The model will also define parameters for the multimedia elements contained into the evaluation tasks and their adaptive presentation according to the user's previous feedback.

2 Background

This project has three phases. The first is the development of an E-Learning application with adaptive testing capabilities, the second is the implementation of QTI-IMS[42] sub-standards for item and user interface parameters modeling, and the final phase is the establishment of learning methods with formative evaluation capabilities.

The E-Learning application will be tested on subjects who are students in Quebec schools and members of the Canadian Army. The results will be collected through interviews and adaptive tests using the E-learning application.

2.1 Project client-server architecture

The application is based on a client/server architecture. Users access the application with their Web browser (ex.: Internet explorer). The application is hosted on a Web site on a server. It can be used for question data entry and has a question display engine for adaptive testing in accordance with item response theory. The inputted questions are converted into assessment items coded in QTI-IMS XML format and stored in the server database as shown in Figure 1.

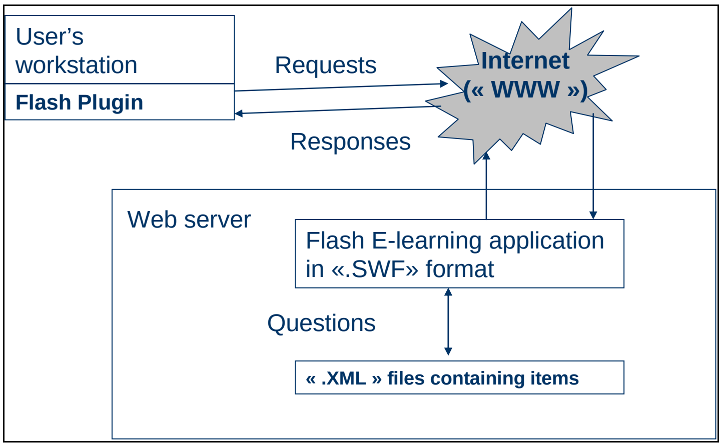

Fig. 1. Software architecture of CAMRI Laboratory's Flash adaptive testing application for reading and writing XML IMS-QTI standard files on local or user workstation mode[45].

2.2 Evaluation tasks data entry and display engine

An evaluation task containing multiple choice questions suitable to be converted into XML format is shown in Figure 2.The question data entry interface is shown in Figure 3. The actual stage of development only allows the data entry of multiple choice questions.

The application is able to generate items in IMS-QTI format and to store the items in its database. The application is also able to perform the reverse operation and retrieve items from its database, parse the XML and display the question as shown in Figure 4.

The bulk of the project remains to be done and consists of the completion of the E-Learning application, the implementation of IMS-QTI sub-standards and the accompanying learning methods.

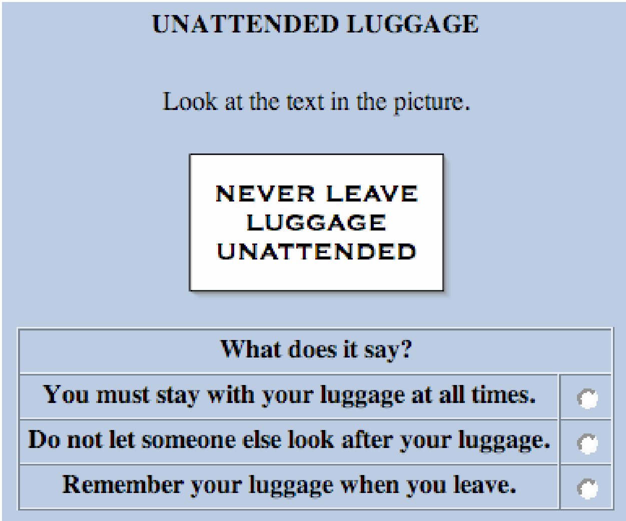

Fig. 2. Simple IMS-QTI item representing a multiple choice question (www.imsglobal.org) [42].

Fig. 3. Item (Question) data entry interface of CAMRI Laboratory's Flash adaptive testing application [45]

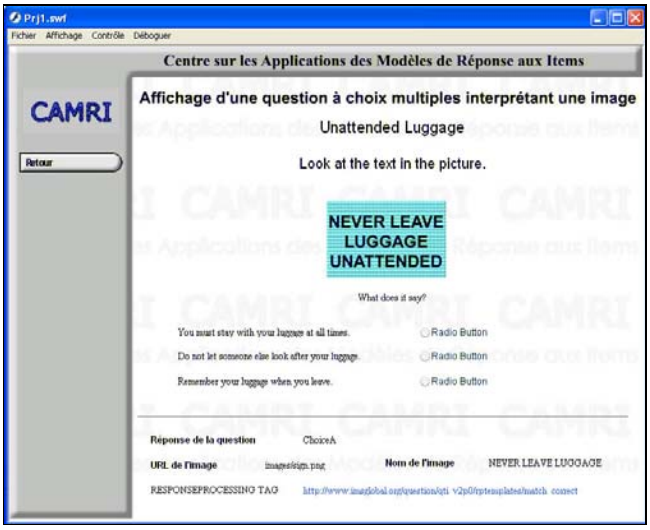

Fig. 4. IMS-QTI item displayed in the flash application [45]

2.3 The IMS-QTI sub-standard for interface parameters

Our QTI-IMS sub-standard will be similar to the Mozilla XML user interface language (XUL) project (http://www.mozilla.org/projects/xul/) [90]. Due to the multiple uses of XML in defining interface and item parameters, the interface parameter characterization sub-standard could not be simply formatted in XML, like XUL, because our standard has to model evaluation objects in IMS-QTI format. We have decided to implement an IMS-QTI sub-standard for interfaces that will be similar to XUL but modeled on the IMS-QTI standard. The main concern is that the interface be able to adjust itself to a sequence of questions in evaluation tasks where different multimedia elements have to be displayed at each question as large images or full screen movies or video clips.

The interface will have to adjust itself to the presentation of a full screen multimedia object through managing its content area and window size. The applications will be able to expand the content area and close some less relevant windows, icons or menus for full screen multimedia presentations.

The standard will also be able to control the display mode and the position of menus, buttons, backgrounds and toolbars. It will also determine all the text in the interface to modify its size, color, font and position.

Some examples of a QTI-IMS sub-standard characterization for interface parameters are shown below:

- Menus

```
<MenuParameter positionX="100" positionY="200"
type="DropDown" />
```

- Backgrounds

```
<BackGroundParameter src="bckdir/bck.png"
positionX="100" positionY="200" Animated="No" />
```

- Buttons

```
<Button positionX="100" positionY="200"
type="Rectangle" caption="E-mail" Animated="Yes">
```

- Windows

```
<windows positionLeft="100" positionTop="100"
positionRight="600" positionBottom="700" >
```

- Video

```
<video positionLeft="100" positionTop="100"
positionRight="600" positionBottom="700" src=
"president.mpeg" >
```

- Image

```
<image positionLeft="100" positionTop="700"
positionRight="100" positionBottom="700" src=
"img1.jpg" >
```

- Graphics animations

```
<graphicsAnimation positionX="100" positionY="200"
src="anim/anim1.jpg"/>
```

2.4 The IMS-QTI sub-standard for item parameters

The project will study the E-learning standard IMS-QTI in detail because it already contains question banks and item modeling parameters. Our goal is to enhance the IMS-QTI standard by developing a sub-standard for item parameter modeling.

As presented before in this paper, the three item parameters associated with item response theory are discrimination (a), difficulty (b) and pseudo-guessing (c) parameters. One must also consider the subject ability represented by θ and the conditional probability associated with item i as represented by Pi [84].

As a numerical example, if Pi = .11, θ = .25, a = .3, b = .4 and c = .5, the new proposed QTI-IMS modeling for item parameters would be:

<ItemParameter P=”0.11” Theta = “0.25 a=”0.3” b=”0.4” c=”0.5”/>

Or when all the parameters are in multiple XML structures:

```
<PItemParameter>0.11</PItemParameter>

<ThetaItemParameter>0.25</ThetaItemParameter>

<AItemParameter>0.3</AItemParameter>

<BItemParameter>0.4</BItemParameter>

<CItemParameter>0.5</CItemParameter>
```

2.5 Inclusion of the IMS-QTI sub standard in XML item definition

Once the sub-standards will be defined, they will be included in the IMS-QTI standard XML formatted items. As stated, the item response theory parameters sub-standards will be included in the items with the interface parameters sub-standards allowing the interface to adapt to the multimedia elements. The following code shows a multiple choice question with an image named “sign.png” in a 400 x 400 pixel windows at 100 pixels from the upper left corner.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Thie example adapted from the PET Handbook, copyright University
of Cambridge ESOL Examinations -->
<assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_v2p0
imsqti_v2p0.xsd"
    identifier="choice"  title="Unattended  Luggage"  adaptive="false"
timeDependent="false">
    <responseDeclaration  identifier="RESPONSE"  cardinality="single"
baseType="identifier">
        <correctResponse>
            <value>ChoiceA</value>
        </correctResponse>
    </responseDeclaration>
    <outcomeDeclaration    identifier="SCORE"    cardinality="single"
baseType="integer">
        <defaultValue>
            <value>0</value>
        </defaultValue>
    </outcomeDeclaration>
   <itemParameter P=”0.15” Theta = “0.25  a=”0.3” b=”0.4” c=”0.5”/>
   <windows  positionLeft=“100”  positionTop=“500”  positionRight=“100”
positionBottom=“500” >
    <itemBody>
```

```
        <p>Look at the text in the picture.</p>
        <p>
            <img src="images/sign.png" alt="NEVER LEAVE LUGGAGE
UNATTENDED"/>
        </p>
        <choiceInteraction responseIdentifier="RESPONSE"
shuffle="false" maxChoices="1">
            <prompt>What does it say?</prompt>
            <simpleChoice identifier="ChoiceA">You must stay with
your luggage at all times.</simpleChoice>
            <simpleChoice identifier="ChoiceB">Do not let someone
else look after your luggage.</simpleChoice>
            <simpleChoice identifier="ChoiceC">Remember your luggage
when you leave.</simpleChoice>
        </choiceInteraction>
    </itemBody>
    <responseProcessing

template="http://www.imsglobal.org/question/qti_v2p0/rptemplates/matc
h_correct"/>
</assessmentItem>
```

The code shown at the bottom of this page shows the next question displayed after the question in the preceding code. The item parameters have changed to reflect the estimators of difficulty for this new question. Instead of a small image, this question is displaying a large 800 x 600 pixels video in a 900 x 1000 window. To control the video, a button assign for a manual start of the video by the student is displayed at coordinates X= 1000 pixels and Y = 1100 pixels.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Thie example adapted from the PET Handbook, copyright University
of Cambridge ESOL Examinations -->
<assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_v2p0
imsqti_v2p0.xsd"
    identifier="choice" title="Unattended Luggage" adaptive="false"
timeDependent="false">
    <responseDeclaration identifier="RESPONSE" cardinality="single"
baseType="identifier">
        <correctResponse>
            <value>ChoiceA</value>
        </correctResponse>
    </responseDeclaration>
    <outcomeDeclaration identifier="SCORE" cardinality="single"
baseType="integer">
        <defaultValue>
            <value>0</value>
        </defaultValue>
    </outcomeDeclaration>
   <itemParameter P=”0.45” Theta = “0.65  a=”0.7” b=”0.9” c=”0.33”/>
   <windows positionRight=“50” positionTop=“50” positionLeft=“950”
positionBottom=“1050” >
   <button positionX=“1000” positionY=“1100” type=“Rectangle”
caption=“Play” Animated=“No”>
<video positionLeft=“50” positionTop=“50” positionRight=“850”
positionBottom=“650” src= “president.mpeg” >
    <itemBody>
```

```
        <choiceInteraction              responseIdentifier="RESPONSE"
shuffle="false" maxChoices="1">
            <prompt>Which president of the United-States is shown in
the video?</prompt>
            <simpleChoice identifier="ChoiceA">Lincoln</simpleChoice>
            <simpleChoice identifier="ChoiceB">Carter</simpleChoice>
            <simpleChoice                identifier="ChoiceC">Clinton
</simpleChoice>
        </choiceInteraction>
    </itemBody>
    <responseProcessing

template="http://www.imsglobal.org/question/qti_v2p0/rptemplates/matc
h_correct"/>
</assessmentItem>
```

2.6 Related work

Recent years have seen the development of applications similar to our project, client-server E-Learning applications with question data entry interfaces and adaptive testing based question (item) display engines where items are stored in a database on a Web server. We will mention four applications in our field of development: SIETTE [20], QTIeditor [59], CosyQTI [43] and PersonFIT[74, 75]. The last three use the IMS-QTI standard for question encoding. Another interesting application of E-Learning is the RATH (Relational Adaptive Tutoring) system using the knowledge space theory[38, 39]. SIETTE and PersonFIT applications use an evaluation process based on item response theory but do not have self-configurable user interfaces.

A brief introduction to E-Learning standards can be found in Michel & Rouissi [55] and also in Dunand, Fernandes & Spang-Bovey [25]. Learning objectives and their relation to instructional design theory are defined in Wiley [88].

A constructivist distance learning approach states that distance learning applications should include evaluation functionalities that allow students to assess their knowledge in a formative evaluation context [10]. Distance learning implementations in the academic curriculum should be one element of learning methodology and should consider distance learning application's potential to adapt to student knowledge level, personality and grade.

Many formal E-learning standards are now in use: Dublin Core Metadata Initiative (http://www.dublincore.org), IEEE LTSC LOM (http://ieeeltsc.org), IMS-QTI (http://www.imsglobal.org), AICC/CMI (http://www.aicc.org) and ADL/SCORM (http://www.adlnet.org). Dublin Core, SCORM, LOM and AICC/CMI E-Learning standards do not have the item modeling capacities for evaluation that IMS-QTI has. Nonetheless, while the IMS-QTI standard is able to model some types of assessment items, it still presents two main weaknesses for which a solution is proposed in this paper. The first weakness of the IMS-QTI standard is that it does not model item parameters according to different item response theory models. The second weakness of the IMS-QTI standard is that it does not model user interface display parameters such as backgrounds, buttons, menus, font type, etc. Despite these weaknesses, we believe that the IMS-QTI standard is the most appropriate one designed so far to consider assessment tasks and this is why we are proposing an IMS-QTI sub-standard in this paper.

Related work has been done by Gerbé, Raynauld & Beaulieu [33] in a project called “Sac d’école électonique” (electronic schoolbag) developed at the Maison des technologies de formation et d’apprentissage Roland-Giguère (MATI) (http://www.matimtl.ca). The goal of the project was to define an XML E-learning standard for learning and evaluation situations in the context of the competency based approach. The Gerbé, Raynauld & Beaulieu project models learning and evaluation situations according to the LOM based Normetic (http://www.normetic.org) standard, instead of the IMS-QTI standard. The project models learning and evaluation situation parameters as general attributes of the situation (title, author, abstract, standard to attain and grade), disciplines (literature, science, etc.), training subjects (academic, entrepreneurship, etc.), development bases (homework, project, etc.), concepts, competencies, evaluation criteria, teaching techniques, and the learning activities of the situation. Even if the LOM based Normetic standard approach has good general classification functionalities, it fails to take account of the quantitative parameters of computerized adaptive testing and item response theory with sufficient precision.

3 Theoretical framework

We will introduce in this chapter basic theoretical concepts regarding this research, especially computerized adaptive testing (CAT), learning and testing objects, evaluation tasks, XML-based E-Learning standards and GOMS model.

3.1 Adaptive testing using item response theory

The adaptive testing process could be done without a computer by a human examiner choosing questions to be answered by the examinee (the student) according to the answers given by the examinee to the selected questions. Computerized adaptive testing follows a similar process but the difference is that the examiner is replaced by a computer that processes the answer given by the examinee to choose the next question according to statistical estimators selected by item response theory.

A formal definition of adaptive testing could be a test question selection and display process in which test questions named “items” are selected one by one from a question bank to be shown to the student according to the validity of the answers of the previously administered questions. If the answers given by the student are mostly incorrect, easier questions will be selected. In the opposite case, if the answers are mostly correct, harder questions will be selected from the question database. The question selection and administration process adapts themselves to the examinee by tailoring a unique exam to a specific student, giving rise to the term “adaptive testing” as shown in Table 1[86, 77, 63].

Table 1 Algorithm of adaptive test based on Item response theory

Rule	Action
Starting instruction	Submit an item (a question of the test) with difficulty level in accordance with the student profile (personality, knowledge level, etc.).
Looping condition	Submit an item with difficulty level near the skill level provisional proficiency estimate.
Stopping rule	Stop the test: When some predetermined number of items has been administered Or: When the skill level provisional proficiency estimate indicates a predetermined type of error/There is an occurrence of skill level provisional proficiency estimate predetermined type of error Or: When no further items could influence the estimation of the student skill level

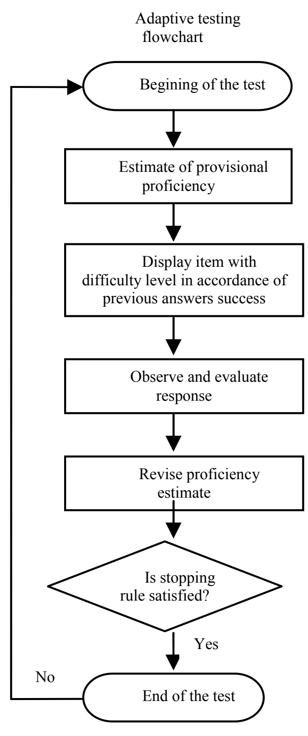

Fig. 5. Adaptive testing algorithm using item response theory [84, 63]

3.2 Learning objects

Learning objects are sharable and reusable electronic entities (data structures) used for learning. These entities are always available at any time and not stored only on the Internet. They are usually stored in data repositories controlled by their administrators or developers. Learning objects can be entire courses or component elements such as audio/video clips, images or graphic animation [11, 69, 78].

3.3 Testing objects or evaluation objects (Items)

An item is a set of digitized interactions (that could be void),, with all the attendant support material, that can be analyzed with a set of rules permitting the conversion of a candidate's answer into evaluation results. Item size could vary from a single question composed of text and one input field to an entire multiple question exam with instructions and multimedia support material [55].

3.4 Evaluation tasks' definition

The previous sections allowed us to distinguish amongst a myriad of expressions related to knowledge construction, such as "situation-problems," "evaluation situations" and evaluation tasks. As shown in Figure 2, situation-problems include evaluation situations that could have one or many evaluation tasks.

Scallon [69] states that situation-problems include every complex project allowing the student to draw upon resources. The expression "situation problem" comes from written problems in the field of mathematics

Evaluation situations include evaluation tasks and ask students to solve complex problems [26]. They can also allow assessment of students' knowledge and skill level and support the retroactive regulation process [11].

The preceding sections allow us to define evaluation tasks synthesizing previous definitions: an evaluation task could be all types of tasks involving questions or problems to analyse [81]. These tasks are generally used to assess various skills or knowledge in many situations [78, 26, 46].

3.5 Computer standards

A standard in defined by the dictionary of computing [41] as: "A publicly available definition of a hardware or software component, resulting from international, national, or industrial agreement" and also "A product, usually hardware, that conforms to such a definition."

The goal of the present research project is to define two formal language XML-based computer standards. The first provides a formal definition of user interface characterization parameters and the second defines item parameters of item response theory. These two computer standards are designed using the XML based E-learning standard IMS-QTI because this standard can model evaluation objects.

3.6 The XML computer standard

The XML acronym stands for eXtensible Markup Language. It is a tag-based language similar to HTML Web page definition language. The difference between HTML and XML is that, for XML, the tags are defined by the programmer, unlike HTML which has fixed tags. The XML language is especially designed to format file data to store information on Web server databases. E-learning standards like LOM, SCORM and IMS-QTI are built around this language to format course material data into learning objects and evaluation objects.

3.7 The IMS-QTI evaluation standard

The IMS-QTI standard allows for the packaging (encapsulation) of course sections or teaching points ("learning objects ") into small XML ("eXtensible Markup Language") modules as shown in Figure 3.

Many E-learning formal standards are now in use: Dublin Core/DCMI(http://www.dublincore.org), IEEE LTSC LOM (http://ieeeltsc.org), IMS-QTI (http://www.imsglobal.org), AICC/CMI (http://www.aicc.org), and ADL/SCORM (http://www.adlnet.org)

Dublin Core, SCORM, LOM and CMI standards are especially designed to automate and model course material (learning objects). These standards don't include formalism and item modeling parameters for testing (learning evaluation).
The IMS-QTI standard does not currently allow online adaptive testing based on item response theory (IRT).

To solve this problem, this project aims to improve the IMS-QTI standard with the formal implementation of two sub-standards: characterization of interfaces and characterization of item parameters according to item response theory.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Thie example adapted from the PET Handbook, copyright University
of Cambridge ESOL Examinations -->
<assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_v2p0
imsqti_v2p0.xsd"
```

```
    identifier="choice"  title="Unattended  Luggage"  adaptive="false"
timeDependent="false">
    <responseDeclaration  identifier="RESPONSE"  cardinality="single"
baseType="identifier">
        <correctResponse>
            <value>ChoiceA</value>
        </correctResponse>
    </responseDeclaration>
    <outcomeDeclaration    identifier="SCORE"    cardinality="single"
baseType="integer">
        <defaultValue>
            <value>0</value>
        </defaultValue>
    </outcomeDeclaration>
    <itemBody>
        <p>Look at the text in the picture.</p>
        <p>
            <img  src="images/sign.png"  alt="NEVER  LEAVE  LUGGAGE
UNATTENDED"/>
        </p>
        <choiceInteraction              responseIdentifier="RESPONSE"
shuffle="false" maxChoices="1">
            <prompt>What does it say?</prompt>
            <simpleChoice  identifier="ChoiceA">You  must  stay  with
your luggage at all times.</simpleChoice>
            <simpleChoice  identifier="ChoiceB">Do  not  let  someone
else look after your luggage.</simpleChoice>
            <simpleChoice  identifier="ChoiceC">Remember  your  luggage
when you leave.</simpleChoice>
        </choiceInteraction>
    </itemBody>
    <responseProcessing

template="http://www.imsglobal.org/question/qti_v2p0/rptemplates/matc
h_correct"/>
</assessmentItem>
```

3.8 The GOMS model

The GOMS name is an acronym for Goals, Operators, Methods and Selection rules. A GOMS model is a representation of knowledge described by a list of methods used to perform a task or accomplish a goal. The methods include the appropriate instructions, steps or operations. The appropriate methods are choosen by the selection rules [17].

3.9 NGOMSL

The acronym NGOMSL stands for Natural GOMS Language. It’s a natural language representation and a procedure for GOMS models construction [17].

4 Research topic

The aim of our research is to develop the E-Evaluation field and make the evaluation process more accurate.

The studied problematic is the evaluation tasks conversion in electronic format to be stored on Web servers. One of the problems of evaluation tasks conversion is that the teacher, professor or subject matter expert that is the author of the evaluation task may not be an expert in the computer science field and XML E-Learning format.

A model should be provided to the teacher to allow him to be able to convert his evaluation tasks in standard format into electronic format.

The aim of the model will take the evaluation tasks into iterating stages converting evaluation tasks from text format supported by multimedia into XML based IMS-QTI E-Learning format. The proposed model will be an extension of the GOMS model that could be learned by any teachers or instructor of any disciplines.

The teacher will convert his evaluation tasks into a GOMS derived model that could be easily and automatically converted onto XML-based electronic format by the E-Learning Web server system administrator.

5 Methodology and preliminary results

This project will conduct a theoretical research for the evaluation tasks conversion into XML based IMS QTI E-learning format using a GOMS model extension.

An online evaluation tasks presentation software will be programmed in Macromedia Flash based ActionScript3 language using Research-Development (R&D) methods.

The evaluation tasks will be finally evaluated by users to see of this kind of software will be suitable. The results will be compiled and interpreted using qualitative methods.

The evaluation task described in figure 2 could be initially stated in pseudocode instructions to be later converted into a GOMS extension model:

```
Evaluation task title: Unattended luggage

Evaluation task instructions: Look at the text in the
picture

Evaluation task multimedia element: Picture, PNG
format, size 200 X 200, URL sign.png

Evaluation task question: What does it say?

Evaluation task choice A: You must stay with your
luggage at all time
```

```
Evaluation task choice B: Do not let someone else look
after your luggage

Evaluation task choice C: Remember your luggage when
you leave

Evaluation task answer: Choice A
```

The teacher will now use his pseudocode to create a GOMS extension model stating the goals, operators, methods and selection rules of the evaluation task.

5.1 Goals

The following goals could be stated according to the evaluation task description:

```
Display: Unattended luggage

Display: Look at the text in the picture

Play multimedia: Picture, PNG format, size 200 X 200,
URL sign.png

Display: What does it say?

Display: You must stay with your luggage at all time

Display: Do not let someone else look after your
luggage

Display: Remember your luggage when you leave
```

5.2 Operators

The following operators could be stated according to the evaluation task description:

```
Answer multiple choice question

Evaluate user’s answer
```

5.3 Methods

The following methods could be stated according to the evaluation task description:

```
Step 1. <Display> Unattended luggage

Step 2. <Display> Look at the text in the picture

Step 3. <Play multimedia> Picture, PNG format, size 200
X 200, URL sign.png

Step 4. <Display> What does it say?

Step 5. <Display> You must stay with your luggage at
all time

Step 6. <Display> Do not let someone else look after
your luggage

Step 7. <Display> Remember your luggage when you leave

Step 8. <Compare anwer> Choice A
```

5.4 Selection rules

The following selection rules could be stated according to the evaluation task description:

```
If <(Picture.x < 400) and (Picture.y < 400)> then use
<Play multimedia> Picture, PNG format, size 200 X 200,
URL sign.png else use <display> Never leave luggage
unattended
```

```
If <UserResponse == ChoiceA> then use <CorrectAnswers =
CorrectAnswers + 1> else use <WrongAnswers =
WrongAnswers + 1>
```

5.5 User model automatic translation

The user result of the GOMS derived evaluation task conversion model can now be converted manually or by a computer algorithm in the following IMS QTI XML based E-learning standard.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Thie example adapted from the PET Handbook, copyright University
of Cambridge ESOL Examinations -->
<assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_v2p0
imsqti_v2p0.xsd"
    identifier="choice" title="Unattended Luggage" adaptive="false"
timeDependent="false">
    <responseDeclaration identifier="RESPONSE" cardinality="single"
baseType="identifier">
        <correctResponse>
            <value>ChoiceA</value>
        </correctResponse>
    </responseDeclaration>
    <outcomeDeclaration identifier="SCORE" cardinality="single"
baseType="integer">
        <defaultValue>
            <value>0</value>
        </defaultValue>
    </outcomeDeclaration>
    <itemBody>
        <p>Look at the text in the picture.</p>
        <p>
            <img src="images/sign.png" alt="NEVER LEAVE LUGGAGE
UNATTENDED"/>
        </p>
        <choiceInteraction responseIdentifier="RESPONSE"
shuffle="false" maxChoices="1">
            <prompt>What does it say?</prompt>
            <simpleChoice identifier="ChoiceA">You must stay with
your luggage at all times.</simpleChoice>
            <simpleChoice identifier="ChoiceB">Do not let someone
else look after your luggage.</simpleChoice>
            <simpleChoice identifier="ChoiceC">Remember your luggage
when you leave.</simpleChoice>
        </choiceInteraction>
    </itemBody>
    <responseProcessing

template="http://www.imsglobal.org/question/qti_v2p0/rptemplates/matc
h_correct"/>
</assessmentItem>
```

6 Conclusion

Actual learning institutions are converting their course and evaluation material from standard format into electronic format on Web servers using XML-Based E-Learning format. A large amount of work have been done on course material conversion but sometimes the evaluation aspect of online courses had been neglected.

This project will develop theoretical model based on GOMS that will enable teachers to optimize the conversion of evaluation tasks in electronic format. The teachers will only have to learn a simple model allowing them to draw a model of an evaluation tasks. The model will produce simple algorithmic language statements that the educational Web server database administrator will process to convert the statements into XML-based E-Learning standard format like IMS-QTI.

Similar models could be also used to convert course material into XML based E-Learning standards. This last issue could be an interesting extension to our work.

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