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USING XML AND THE IMS QTI STANDARD FOR THE DEVELOPMENT OF ASSESSMENT TOOLS

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Abstract. The paper deals with the issue of using the IMS Question and Test Interoperability standard for the development of assessment tools. This standard is based on XML (extensible Markup Language) and intended for description of tests at a structural level independent from the computer platform. According to this standard, questions and tests can be represented as plain text, which is marked-up with XML tags. The testing tool reads a test description in XML and parses it to translate into the format used internally in the system. This approach allows creating test descriptions that are highly interchangeable, readable, and reusable.

Introduction

The amount of learning resources and management systems increases steadily. In this situation a problem of co-operation and interoperability arises and becomes very important. The process of learning technology standardisation aims at creating specifications and guidelines for the description of learning material and scenarios so that different learning technology systems could interoperate and exchange learning content and other resources. An example of this activity is the development of educational metadata and brokerage for learning resources (Anido et al., 2002). There are several bodies engaged in standardisation, one of them is IMS - IMS Global Learning Consortium, Inc. It works on several specifications for on-line distributed learning and they are widely used for development of educational systems such as the ContentNet framework for the interoperability of educational content (Torres da Silva, Pereira de Lucena, & Fuks, 2001).

Most of standards are nowadays implemented with XML (extensible Markup Language). XML is a language for the description of the structure of documents independently from any output facilities. The use of XML involves marking up a document with text-based tags. This permits to use XML for the exchange of information between different systems, e.g. geographical information systems (Badard & Richard, 2001). XML is also used in the educational area. A number of projects are concerned with using XML for archiving and preservation of electronic thesis and dissertations (Dobratz, Schulz, Potter, & Strabala, 2001).

Computer-based assessment (CBA) has potential to be a versatile tool for educational purposes (Thelwall, 2000). CBA can be used in many ways for a range of assessments from

diagnostic tests in the beginning of studies to mid-term tests and final examinations. Peterson and Reider (2002) report in their study that test takers have overall positive opinion about CBA. However, they noted that their form of testing completely ignored written communication skills and free-form problem solving. Internet-based surveys and computer-based testing have a long history of research and they are earning growing popularity (Epstein & Klinkenberg, 2001). The proliferation of CBA poses the problem of interoperability between different assessment tools. Learning technology standards can be used to tackle this problem. This paper deals with the usage of the IMS Question and Test Interoperability specification (IMS QTI) for developing computer-based testing tools.

Use of the IMS QTI standard

In the present study we used IMS QTI to describe a test consisting of several questions of open-ended type. This work continues our previous research on designing tools for testing with open-ended questions, which showed that open-ended questions were more motivating for students and allowed us to organise learning and teaching more effectively (Tarassov & Tarassov, 2003).

The IMS Question and Test Interoperability specification is designed for the description of assessments at a structural level that is independent from the testing tools and computer platform (IMS, 2002). It includes basic structures for the representation of test and question data. According to this standard, questions are called 'items' and they include usual types, e.g. true/false, multiple choice, multiple response, fill in the blank, etc. Items are grouped into sections. Assessments (tests) are composed of one or more sections. IMS QTI defines XML tags for the description of each structural element of an item, section, and assessment.

The whole item representing a question is surrounded by the tag denoting the title and identifier of the item. For the question about rhomb, this tag looks like the following:

```
<item title = " rhomb" ident="Question2"> ... </item>
```

The description of the item includes three main parts. The first part is intended to give the instructions on how to present the question and possible responses. As soon as we choose a standard fill-in-blank question type, the student is expected to enter a line of free text: presentation label = "Question2">

```
<flow>
```

```
<material>
```

```
<mattext texttype = "text/plain">What rectangle has perpendicular diagonals?</mattext>
```

```
</material>
```

```

<response_str ident = "Question!" rcardinality = "Single" rtiming = "No">
  <render_fib fibtype = "String" prompt = "Box" maxchars = "40">
    </render_fib>
  </response_str>
</flow></presentation>

```

The second part describes how to process the response and assign a score to it. The response processing includes comparison of the student's answer to the correct one. If the answer is correct, then one point is added to the score:

```

<resprocessing>
  <outcomes>
    <decvar varname = "FIBSCORE" vartype = "Integer" defaultval = "0"/>
  </outcomes>
  <rescondition title = "Right">
    <qtcomment>Scoring for the correct answer.</qtcommem>
    <conditionvar>
      <varequal respident = "Question!" case = "Yes">rhom</varequal>
    </conditionvar>
    <setvar action = "Add" varname = "FIBSCORE">l</setvar>
    <displayfeedback feedbacktype = "Response" linkrefid = "Right"/>
  </rescondition> ... </resprocessing>

```

The third part contains the feedback information to be shown to the test taker. In the case of answering correctly, the student is presented with the one-word feedback 'Right':

```

<itemfeedback ident = "Right" view = "Candidate">
  <flow_mat>
    <material>
      <mattext texttype = "text/plain">Right.</mattext>
    </material>
  </flow_mat>
</itemfeedback>

```

All other questions are described in the similar manner and packed into an object bank that can be read and interpreted by any assessment system implementing the IMS QTI specification.

Processing XML documents

The implementation of the testing tool is based on our architecture of the system for assessment on a local network (Tarasov & Kyurshunov, 2003). The architecture consists of a test database, a web server module, and a client module. The database stores a collection of questions and tests, and assessment results. The web server module contains servlets intended for retrieving tests from the database and entering test results into it. The client module includes an applet presenting questions to students and processing their answers.

To process XML documents we used JAXP - Java API for XML processing (Sun, 2002). JAXP includes the Simple API for XML (SAX) providing event-based means for parsing XML documents. First, an XML document describing a test is retrieved from the test database. Then, the servlet invokes the SAX parser. When a particular XML tag describing the structure of the test is encountered, the parser calls our methods contained in the servlet. These methods translate the test written in XML into the format used internally in our system. This processing of XML-based test descriptions is shown in Figure 1. Finally, the applet runs the test, collects student responses, and reports results.

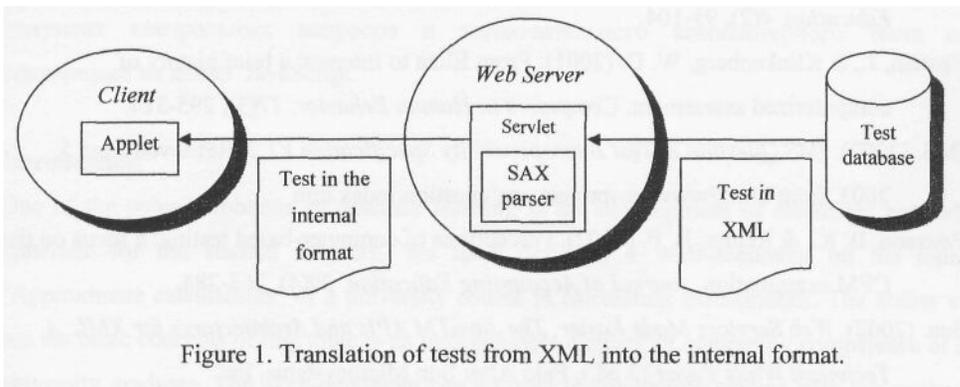


Figure 1. Translation of tests from XML into the internal format.

Conclusions

This study was concerned with using the IMS QTI standard for construction of the CBA tool. Standards and XML make it possible to create flexible and cooperating testing tools. Application of a standard specification to describing tests allows creating learning content that can be interchangeable between diverse learning technology systems. Employment of XML tags for markup of the structure of a test permits to make the test equally readable for both machines and human beings. Using IMS QTI and XML increases the level of reusability of tests. Though, there are certain disadvantages of using standards. Wordiness of XML, which is used in most standards, implies the growth of time needed for preparation of tests and space needed for storage of tests or time needed for transmitting tests over the network.

Additionally, assessment systems must include specific modules for translation and interpretation of tests written in XML.

In future work we are going to expand the use of IMS QTI to describe assessment results and to grade test takers. Experiments with different types of questions are also planned.

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