

New Moodle plugin for IMS Question and Test Interoperability specification (QTI)

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ABSTRACT

In the ESF project "StudiPortal Brandenburg", eight Brandenburg universities, colleges and the Brandenburg Study Orientation Network are working together on the development of a portal for study orientation, preparation and support. An important part of the project is to store questions from different systems in a question exchange database and make it accessible for all project partners. Since there is currently no well-functioning option for this, we decided to develop an extension for integration into our question exchange platform. For this purpose, a new Moodle plugin was developed at BTU Cottbus - Senftenberg that converts questions from the QTI 2.1 standard into Moodle XML and vice versa. The aim was to convert as many question types as possible free of loss. For this purpose, questions from various systems that work with the QTI standard were made available and tested for the possibility of lossless conversion. The result is the prototype of a plugin that can convert eight different question types. In this article we present the first prototype of the plugin.

Keywords: Question Exchange, Online Self-Assessment Tools, IMS QTI transformation, Moodle Plugin, Interface

1. INTRODUCTION

With the increasing use of different LMS and e-examination systems at universities and schools, it is necessary to use a standardized data format for the exchange of assessments (questions) between the different systems. For this purpose, a standardized data format (IMS QTI) defined by the IMS Global Learning Consortium has been developed since 2012 specifically for the design of online materials. Online questions and answers, quizzes, multiple-choice tests can be created in all standardized programs and used and modified as desired. Therefore, it is possible to exchange tests and quizzes between different applications. IMS has published a wide range of interoperability standards for learning technologies, which are available under a royalty-free license. [1] (Figure 1)

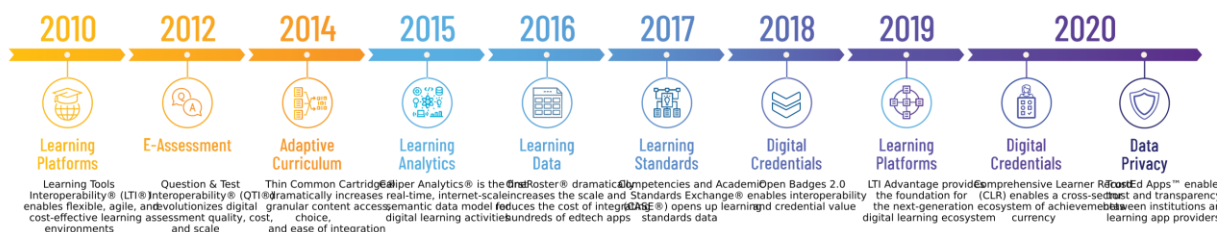


Figure 1. IMS timeline [2]

In order to import questions from Questionmark Perception (QMP, QTI 1.2), an external tool was implemented in a previous project at the BTU [3] which cannot be integrated into Moodle without major adaptations. In [4] the approach for converting QMP (QML) to Moodle XML for our question exchange platform using a Moodle plugin was presented.

We researched other possible extensions we could use and tested them as much as possible for our purposes before the development. There are few plugins in the Moodle community [5] that realize the QTI import. Unfortunately, these plugins are now outdated and no longer maintained. For example, the Questionmark QML Importer (Alpha) [6] was maintained until 2018 and implements the now obsolete QTI 1.2 standard. In our tests with various multiple-choice questions in the QTI 1.2 standard, none of these questions could be imported without errors with the help of this plugin. Another example is the moodle-qformat_imsqti21plugin [7], which implements the QTI 2.1 standard but has not been maintained for 6 years. As we tested this plugin with QTI 2.1 standard questions, neither the import nor the export of Moodle QML to QTI 2.1 worked. These preliminary considerations led us to the decision to develop a new Moodle plugin for our purposes. The plugin should be designed in such a way that it can easily be extended with new question types, that both import and export of questions is possible and that in the future further new versions of the QTI standard can be implemented based on this plugin.

2. DEVELOPMENT

2.1 Preliminary consideration of data transformation (mapping)

When mapping data from one format to another, it must be ensured, that the target format is valid after conversion. Validity in this case means, that a system implementing this format can use it without restriction. The XML structure of the questions resulting from the QTI format may not contain any errors and must be complete in terms of both content and logic, so that the questions in the target system still function exactly as the creator of the questions intended. During implementation, it is important to check whether:

- the data is complete
- the question retains its original meaning
- the question can be answered in the target system
- the resulting XML format has a valid form

2.2 QTI and Moodle XML

Basically, both formats serve the same purpose: they are used as individual questions for online assessments or entire quizzes (collections of questions) and allow porting between different systems. From a logical point of view, the basic structure of questions can be summarized system-wide into 3 main blocks and 6 sub-blocks. They consist of the main blocks Task, Answer and Feedback with the sub-blocks Question Text and Media, Interaction and Score and finally Notes and Evaluation. (Figure 2)

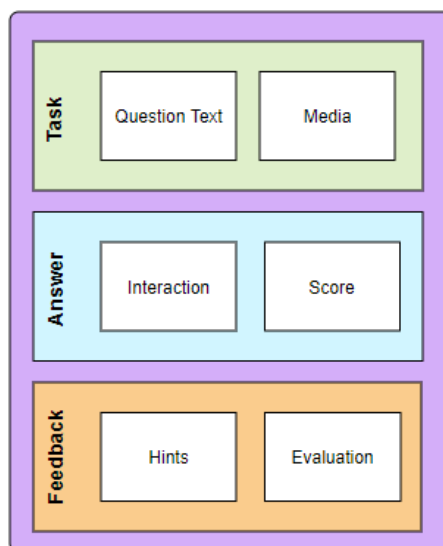


Figure 2. basic structure of questions [8]

The QTI and Moodle XML data types offer, of course, many more properties for questions than the modules listed above. They can contain their own IDs or names and be associated with higher-level question collections. How the interaction looks when answering the question and which other properties play an important role depends on the respective system. For this purpose, we will list the question types of the QTI 2.1 format and compare them with Moodle XML. The next two sections describe the special features of converting question types, using the QTI question types Choice Interaction and Graphic Gap Match as examples. This procedure can be transferred to all other question types we implemented and was practically implemented in the plugin for the other seven question types. The mapping process is clearly illustrated using the Altova MapForce 2019 (Basic) tool. (Figure 3 and Figure 4)

2.3 Choice Interaction

The QTI question type choice interaction corresponds to a multiple-choice question in Moodle, where the user can select one or several predefined answer options. The interaction is marked with tag "choiceInteraction". Within this tag there is a "simpleChoice" for each choice option. (Figure 3)

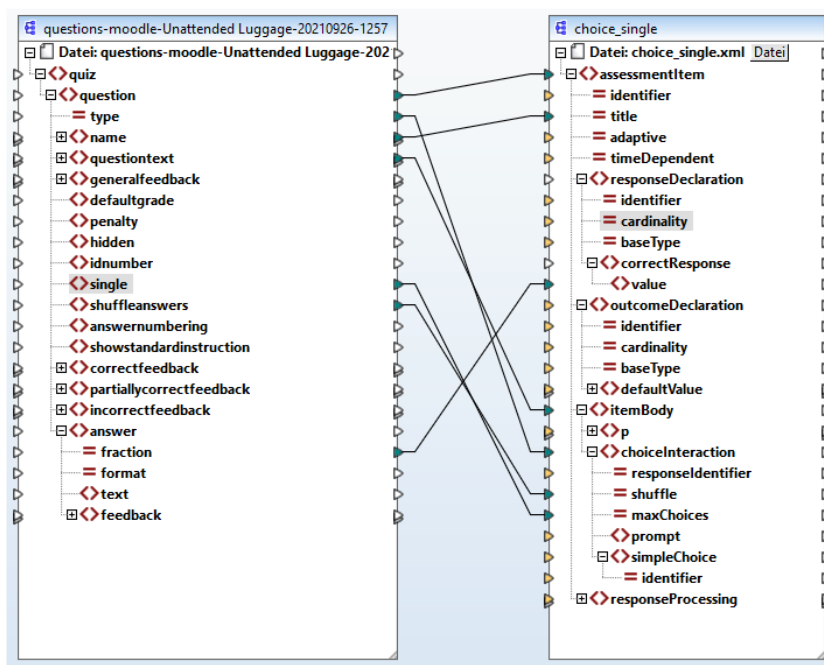


Figure 3. example mapping single choice to moodle xml [8]

Like with the multiple choice from Moodle, the attribute "shuffle" can be used to show a random order of the displayed selection options. Which answer is correct is noted in "correctResponse". On Moodle, the attribute "fraction" in the "answer" tag marks the correct answer. The attribute "maxChoices" in "choiceInteraction" indicates how many answers you can choose. If the value is 1, the question is of the single choice type. If the value is 0, you can choose any number of answers, which corresponds to the function of a multiple choice question. Despite the very different structure of the two types of questions, they are almost unrestrictedly convertible into each other due to their identical function. Some data, such as the format of the texts, must of course be added, but this does not change the content of the question itself. In QTI there is an attribute "fixed" in the tag "simpleChoice", which makes it possible to have an answer which appears always at the same place despite the attribute "shuffle". Such an option does not exist in Moodle.

2.4 Graphic Gap Match

The Graphic Gap Match question type can be equated with Moodle's Drag and Drop question type. With this question type, a background picture is given, onto which the coordinates are placed. Each zone has an associated answer. (Figure 4)

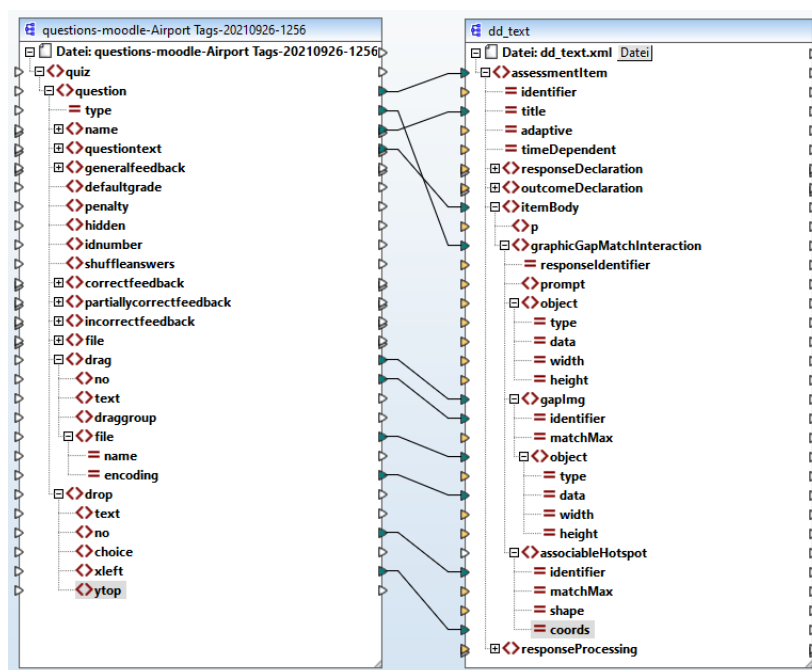


Figure 4. example mapping graphic gap match to moodle xml drag and drop [8]

The tag "gapImage" from QTI corresponds to the tag "drag" from Moodle XML. In "object", an image file is specified which is a possible answer to the question. The image is described in detail in QTI, as the exact data type and the size of the image in pixels must be specified. The drop zones are represented in QTI with the tag "associableHotspot". The hotspot can have a shape, which is determined by the attribute "shape". Depending on the shape the coordinates change. If it is a rectangle ("rect"), four coordinates in pixels must be specified to represent it. If it is a circle, its center must be specified by means of x- and y-coordinates, as well as its radius. However, in Moodle there are always only two coordinates for the drop zone. The point defined by "xleft" and "ytop" tells Moodle where the upper left corner of the drop zone should be. The shape of the drop zone is defined by the dimensions of the drop image itself, which is included in the "file" tag.

3. TEST

To test the plugin, questions were taken from the QTI 2.1 documentation [9] and imported into Moodle. To do this, we first installed the developed plugin on our current Moodle 3.9.9+ test system (Figure 5) and tested the import and export with the various question types of the standard QTI 2.1.

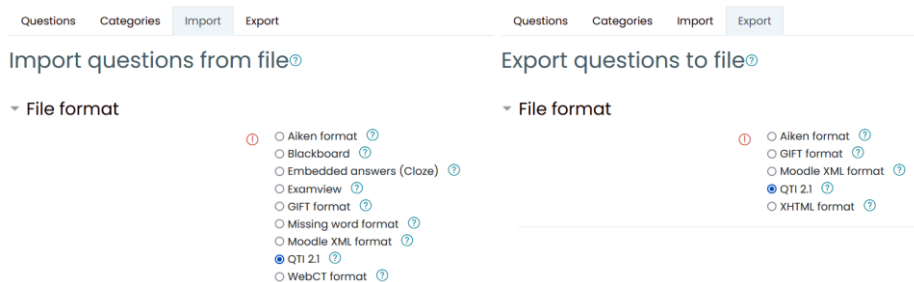


Figure 5. QTI 2.1 Import and Export Moodle 3.9.9+

All QTI 2.1 questions of the eight question types: multiple-choice, single-choice, true or false, short answer, associate, match, drag and drop and cloze could be successfully transferred to Moodle. (Figure 5)

Question	Actions	Created by
<input type="checkbox"/> Question name / ID number		First name / Surname / Date
<input type="checkbox"/> + Airport Tags	Edit ▾	Admin User 11 October 2021, 2:32 PM
<input type="checkbox"/> Writing a Postcard	Edit ▾	Admin User 11 October 2021, 2:30 PM
<input type="checkbox"/> Grand Prix of Bahrain	Edit ▾	Admin User 11 October 2021, 2:30 PM
<input type="checkbox"/> Richard III (Take 1)	Edit ▾	Admin User 11 October 2021, 2:30 PM
<input type="checkbox"/> Richard III (Take 2)	Edit ▾	Admin User 11 October 2021, 2:30 PM
<input type="checkbox"/> Composition of Water	Edit ▾	Admin User 11 October 2021, 2:30 PM
<input type="checkbox"/> Composition of Water	Edit ▾	Admin User 11 October 2021, 2:30 PM
<input type="checkbox"/> Unattended Luggage	Edit ▾	Admin User 11 October 2021, 2:30 PM

Figure 6. imported questions different question types questionbank Moodle 3.9.9+

We also tested the ability to import several questions at the same time and with media. For this purpose, the questions and pictures were packed into a zip file and imported together. After the import, the questions work exactly as intended. As an example, an imported drag and drop question with background image is shown here (Airport Tags). (Figure 6) With the drag and drop, the drop zones are slightly shifted, and this is due to the fact that the original background image was available and a screenshot was used instead.

Question 1

Not yet answered

Marked out of 1.00

The International Air Transport Association assigns three-letter codes to identify airports worldwide. For example, London Heathrow has code LHR. Some of the labels on the following diagram are missing: can you identify the correct three-letter codes for the unlabelled airports?

Figure 7. imported drag and drop onto image questions with media

4. SUMMARY AND OUTLOOK

In this paper we presented our newly developed Moodle plugin and shown that the import and export of IMS QTI questions is possible using a current Moodle system. Our tests showed that it is possible to import and export a selection of eight standard QTI 2.1 questions to Moodle without data loss. However, exporting is more difficult. Although we were able to export the questions from Moodle to the IMS QTI 2.1 standard without errors, we were yet unable to test the exported questions in special target systems such as Questionmark Perception or LPLUS. In this case it might be

necessary to implement a separate validator. This and the publication of the plugin for the public in the Moodle community will be a task for future developments.

5. ACKNOWLEDGEMENT

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REFERENCES

- [1] Imsproject.org, IMS: IMS Question, < <http://www.imsproject.org/question/index.html>> (8 September 2021).
- [2] Imsproject.org, IMS: About IMS, < <http://www.imsproject.org/aboutims.html>> (8 September 2021).
- [3] Paul, C., Masterthesis: "Java Konvertierungstool QML Moodle XML", BTU Cottbus - Senftenberg (2020).
- [4] Kutzner T., Meißner M., Nesterow I., Rojas P., and Freytag A., " Concept of a cross-university question exchange platform with Moodle LMS," InnoEducaTIC 2020, 225-234 (2020).
- [5] moodle.org, Moodle: Plugins, < <https://moodle.org/plugins>> (8 September 2021).
- [6] moodle.org, Question formats: Questionmark QML Importer, < https://moodle.org/plugins/qformat_qml> (8 September 2021).
- [7] github.com, Github: qformat_imsqti, < https://github.com/jmvedrine/moodle-qformat_imsqti21> (8 September 2021).
- [8] Nesterow, I., Masterthesis: "Datenmapping von Online-Assessment-Tests", BTU Cottbus - Senftenberg (2021).
- [9] imsproject.org,IMS:Question&Test,<https://www.imsproject.org/question/quiv2p1/imsqti_imply2p1.html#section10003> (8 September 2021).