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HTML5 in Development of Assessment Tasks for e-Learning

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***Abstract* – The paper describes various types of assessment tasks that are used in e-learning environments and studies the use of HTML5 in the development of user interface elements for e-learning systems. Popular existing practices of HTML5 user interface design are examined, and some examples relevant to e-learning environments are provided.**

***Keywords* – Assessment, assessment task types, e-learning, HTML5, Internet technologies.**

I. Introduction

Learner knowledge assessment has been and still is in the focus of research for many teachers and information technology specialists. For the last thirty years, the research has been evolving, building upon individual examples and samples, generalizing upon cases for special areas of knowledge and competence, elaborating formal models, mathematical methods for data analysis, offering a variety of strategies for assessment and evaluation of learner's knowledge and skills [1]–[9]. Assessment tasks play an important role in e-learning, being not only an instrument to measure learner's mastery of a topic, but also a source of information for adaptation of e-learning course to a student, a mechanism to develop skills and competencies, and a way to transform static courses into interactive and engaging experience.

A lot of efforts were put to classify assessment tasks, identify their components, and suggest a common model for exchange of assessment descriptions, content and results [8]–[12]. Some types of assessment tasks have become a common practice supported by e-learning authoring system, whereas others remain for individual programming. Taking into account that interactions based on assessment mechanisms have become a core feature for modern e-learning, the quality of implementation of the assessment tasks is essential. Therefore, the developers of the e-learning courses and tests have to consider not only pedagogical and methodical requirements to content, kind and type of assessments but also be able to select proper methods and technologies for their realization.

In this article, the implementation of assessment tasks using modern Internet technologies, such as HTML5, is considered.

II. Assessment Task and Its Characteristics

In a general case, every computer-based assessment consists of a content part – a question or description of a task to be performed, and an executive part, which is responsible for input and analysis of an answer to the question or a result of the performed task [9]. There are many ways to present a content part of the assessment. Many e-learning authoring tools allow for using images (picture, chart, scheme), audio or video fragments to present an assessment task to the student.

To prepare assessments it is necessary to pay attention to the supposed form of their presentation on the screen; however, it is more important to define the types of interactions related to the assessment tasks. The most popular are the following groups:

- "Menu" tasks;
- Open tasks;
- "Compatibility" tasks;
- "Sequence" tasks.

"Menu" type tasks (another name is "closed type") require a choice of one or a few correct answers from a set (list) of offered variants when a student is ready to answer. Multiple choice questions with a single correct answer are still widely used in the computer-based learning. However, this type of tasks has two substantial drawbacks: random selection of correct answer and involuntary memorization of wrong answers included in the list of offered variants. Therefore, from the point of didactics it is not recommended to use this type of tasks.

Open type questions require an input of answer by the student as a number, a word, a phrase etc. This type of task reduces the chances of random guessing of a correct answer to a minimum. It is often used to check the knowledge of names, formulas, vocabulary, some facts or properties, signs, data etc.

Working on a "compatibility" task, a student has to form a correct answer by putting the elements of one set in accordance with the elements of another set. It may be the task of matching, such as to identify a proper translation of a term or its definition, or a classification task, when a number of "classes' is less than a number of elements. Using this type of tasks it is possible to check associative knowledge, i.e., knowledge about connection of form and content, essence and facts, relations between various objects, properties, and laws.

In those cases, when it is necessary to set a correct sequence of actions or words in a sentence or definition, a "sequence" type of tasks is used. A student is required to construct the answer by sequencing elements of a proposed set.

Complex tasks, requiring several steps to reach a solution, can be used to assess student's knowledge. These tasks are implemented as a combination of several simple tasks to

enable cognitive independence during the search of a solution. Complex tasks are used to evaluate student's ability to apply the acquired knowledge to solving difficult tasks, such as, modeling of processes.

Every type of task requires a certain cognitive activity of a student to perform the task and a specific interaction to enter the answer. The interactions can be divided into three basic types: choice, input, and construction. Combining types and forms of answers it is possible to distinguish the following types of answers [12]:

1. Choice of one or a few answers from several options (menu);
2. Input of an integer, a real number or a few numbers (calculation);
3. Input of one or a few words (word);
4. Input of a sentence or expression (phrase);
5. Input of a formula (formula);
6. Choice or input of correct answers and correspond variants (compatibility);
7. Identification of a place on a graphic, picture, or photo ("hot" spots);
8. Choice of correct answers and their position within a certain sequence (sequence);
9. Choice of a word or a paragraph from the text (hypertext);
10. Input of an answer depending on the task heard (sound).

A study run in 2007 [12], which covered about 70 computer-based applications for learner knowledge assessment, detected the most typical type of tasks and answers used in assessments. It was found that the "menu" type of tasks was used in 50% of cases (open type – 38%, other – 12%), and the most popular types of answers were "choice" (32%) and input of one word (17%).

In next section, we shortly describe HTML5 in a context of modern Internet technologies and justify the choice of it for the implementation of e-learning content and knowledge assessments tasks in particular.

III. Modern Internet Technologies

For years, e-learning developers have tried to reproduce functionality, which used to be available on a local computer only (specifically, analysis of user interactions) in on-line applications. During the last few years, the so-called Rich Internet Application (RIA) [13] based on asynchronous communication has allowed limiting the amount of data communicated between a server and a client and enhance the usability of web applications.

A serious advance in web development has been achieved by the HTML5 – a technology, which can make on-line applications quicker, simplify their development and make them more user-friendly. A combination of HTML5 and CSS3 is competitive to Flash-based implementations for many tasks. Moreover, HTML5 is the only language, which works well on many modern mobile operating systems, such as Android, iOS, Windows Mobile, Blackberry and WebOS [14], comparing to their native programming languages.

According to research performed by company Chitika, to May 25, 2010, 46% of Internet users all over the world already used web-browsers supporting HTML5 [15]. By the end of 2014, open tests of HTML5 support demonstrated 68% to 92% successful features tests passed for desktop browsers and 67–88% for mobile devices with Chrome and Opera among the leaders in both categories [16].

Although a complete specification of HTML5 is not finalized and, according to W3C, is due in 2022 only, most modern web-browsers already support many features described in the published parts of the specification. Modular structure of the specification facilitates partial implementation of the HTML5 features, which in turn allows web-browser producers to improve HTML5 support and, thus, to promote this technology with every browser version update contributing to its popularity.

This technology can provide important advantages for e-learning developers, simplifying development of interactions, and, in particular, knowledge assessment tasks. Taking into account growing use of online resources through mobile devices, and the fact that mobile sales have recently overtaken desktop or notebook sales, HTML5 for mobile devices has become a driving force for e-learning [17]–[19].

Further in this article HTML5 features are considered for creation of different types of assessments in e-learning, and some examples of implementations are described for specific cases of learner knowledge evaluation.

IV. Examples of HTML5 Technology Use

We cannot underestimate benefits that HTML5 technology can provide in the area of e-learning. Below you can see a list of examples related to different areas of e-learning, which demonstrate the advantages of HTML5 use in accordance with specification available at the moment of preparing this paper [20].

Example 1: Foreign Language Learning

In computer-assisted language learning, it is critical to offer activities to practice the acquired skills [21]. Assessment tasks are used for this purpose to provide immediate feedback to the student. Due to the importance of communication skills, besides reading and writing, a student should practice listening comprehension. Audio fragments may differ in size – from a word to a speech, so sometimes the audio should be available in an on-line mode, without download. In some assessments, a student has to choose among several audio fragments for the best response or pick up a proper term to complete a sentence which requires convenient placement of audio element on a page. Using HTML5 tag <audio> it is possible to insert a built-in audio player next to a word on a web-page which is also useful for online vocabularies.

To describe options for audio file reproduction, HTML5 provides a tag <audio>, which is displayed on a web-page as a small audio player which is able to reproduce mp3, .wav and .ogg files. The attributes listed in Table I are intended for the description of controls visualization, as well as playback options.

TABLE I

TAG <AUDIO> ATTRIBUTES

Attribute	Description
controls	Shows or hides the buttons of display control
auto play	Begins playback after visualization by a browser
Loop	Repeats audio file playback
Src	URL of audio-file
preload	Variants of values for file loading before playback: none: not to buffer file at advance metadata: to load metadata from a file auto: to load a complete file before playback

Example of the use:

```
<audio src="lecture-02-04-part3.mp3" controls
autoplay></audio>
```

As representation of control elements is not defined in W3C specification, the browsers display audio controls differently (Fig. 1). To the moment of standard acceptance, the developers of browsers promise to add the possibility of control elements stylizing by CSS- styles.

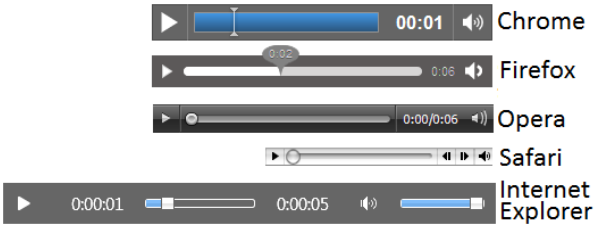

Fig. 1. Visualization of tag <audio> control elements by web-browsers.

Example 2: Video Course on Any Topic

One of the popular ways of e-learning content production at present is recording a video for the whole course, a lecture or a short video fragment on a specific topic. There are libraries of video content; some commercial companies are specialized on providing and distribution of video courses (for example, Lynda.com). Within on-line courses, preview of video files is often provided by Adobe Flash technology, which requires installation of additional software (the so-called plugin) on a user's computer. As plugins may be forbidden on the office computers for security reasons, and Flash does not work on iOS-based devices, HTML5 happens to be a convenient way to enable video for e-learning. The tag <video> has some attributes that coincide by semantics to the corresponding attributes of the tag <audio>, namely, controls, auto play, loop, src and preload. Additional tag attributes specify the size of a frame for video and a picture to be shown before the video begins, as is specified in Table II:

TABLE II

TAG <VIDEO> ATTRIBUTES

Attribute	Description
width	Width of a video fragment
height	Height of a video fragment
poster	Address of a picture that will be shown before the playback of a video file

It is not indicated in a current version of the standard, what codecs (programs able to execute transformation of data or signal) browsers have to support; therefore, implementation of its support differs depending on the developer. All modern web-browsers can reproduce video at least in two formats – Ogg Theora and VP8. Support of H.264 codec in some browsers is under discussion in connection with the policy of licensing, but when needed, it can be set as a separate package [20], [21].

Example 3: Tasks of Geography, Logistics, Tactics

In some cases, several tasks have to be solved within a certain context or environment, so conditions and limitations of the task may be visualized and user actions cause changes in the environment. A typical example is a task from a serious game in a military training: to find a way to avoid evacuation of a strategic object and to secure the area around it having limited military resources. The situation is illustrated by an HTML5 game (Fig. 2).

Fig. 2. Example of tactical location of battle units in HTML5 game "Pirates Love Daisies".

For this and similar purposes, an HTML5 tag <canvas> will be suitable. The tag sets a certain location on a web-page, within which a user interaction with objects inside can occur. It is possible to create valuable tools for various types of tasks, for example, a graphics editor, as company Mudcu did (Fig. 3). Usually the implementation is based on HTML5, CSS3 and JavaScript technologies.

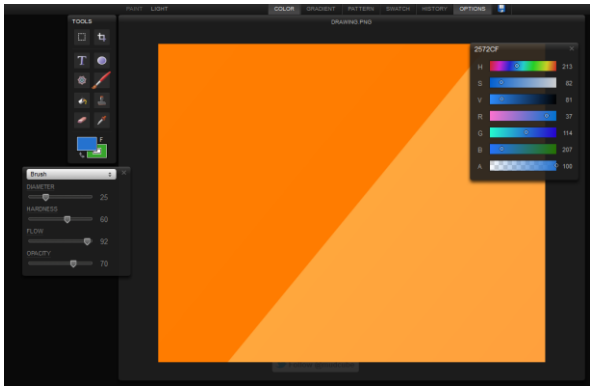

Fig. 3. Web-browser Sketchpad developed on the basis of HTML5, CSS3, JavaScript.

Tag <canvas> does not provide a possibility to draw graphic elements by its attributes, so JavaScript is used for this purpose. There are several groups of actions to interact with and modify an element:

- Color and style help set colors of frames and filling, determine style of lines, shadows and other features;
- A set of basic graphic elements allows for drawing lines, curves, quadrangles, ovals and arcs. Also there is possibility of verification if a point belongs to the current context;
- Transformations give an opportunity to modify already existing elements by stretching, turning, moving or transforming a graphic element using the matrix of transformations;
- Text – determines size and font type of a text;
- Pictures and work with pixels – loading of external pictures in the object of canvas and removal of pixels area model from it;
- Composition – a possibility to set global transparency for the pictures, style of the ceiling and interaction between the layers, i.e., to determine sequence of layers.

Example 4: Test/Questionnaire Type Tasks

Most e-learning objects (courses, modules, lessons) have some kind of test tasks, which are intended either for self-check of understanding the learning material or for assurance that the level of student's knowledge is sufficient to proceed. Usually simple tests to check understanding are represented by multiple choice questions (selection from a list of options). Sometimes, a student needs to enter an answer into a field, as in cloze exercises in foreign language learning. It is possible to implement this kind of tests without HTML5, but the use of this technology facilitates the development process, and also improves usability of the produced code and extends functionality.

Input of information is processed by tag <input>, which is represented as an empty field on a web-page. In order to specify to the user what should be entered in a certain field, initially a temporary text is added in the field by JavaScipt, which disappears upon clicking within the field by a cursor. In HTML5 a separate attribute of tag <input> – placeholder – is used for this purpose.

In case of tests that are restricted in time to be finished, it is important that a user can focus on a test itself and not on manipulation of the cursor to be able to enter the next answer. For this purpose, the tag <input> has an attribute autofocus that enables positioning of a cursor to the required field when loading the page so that the user could immediately begin to enter the answer.

In a code of a page to specify a text-prompt in <input>-field one can use the following HTML- code:

```
<label for="first_name">First Name</label> :
<input id="first_name" placeholder="First name goes
here">
```

This fragment not only causes the appearance of the text-prompt "First name goes here" in the Input field, but also an input field next to the label "First Name" becomes available for typing. Fig. 4 shows a visual representation of a simple Input field – text-prompt. In browsers that support this feature, the color of prompt is bright grey by default. In outdated web-browsers, the input field remains empty, but basic functionality remains the same.

Fig. 4. Input field with the use of text-prompt.

Attribute of tag <input> is responsible for support of filling the obligatory fields. It may be useful when a student performs a large test and a complete form is sent to a server so no changes may be done afterwards. In this case a web-browser will remind the user that he forgot to fill in the mandatory field, before allowing him to send a complete test to a server (Fig. 5).

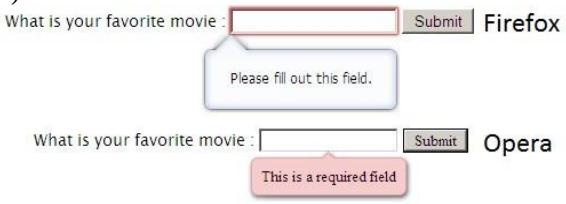

Fig. 5. Feedback to a user who forgot to fill in an obligatory field.

Attribute of tag <input> – data list provides a list of possible values, which could be scrolled by pressing a key "up" or "down". Each symbol entered in the input field is used to filter the listed values for potential relevance. This attribute can be useful as a sophisticated variant of spell-checking when the answer has to be typed. A complete list is downloaded in advance and a search for relevance is performed locally without connection to a server. Such filters are often used in online forms, for instance, to accelerate selection of a country from a long list (Fig. 6).

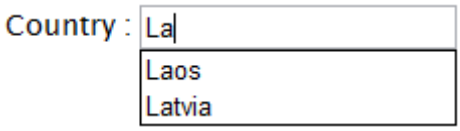

Fig. 6. Automatic filtration of countries by first letters of entered name.

Some attributes of a tag <input>, i.e., e-mail, website, and phone, are very helpful for mobile devices, indicating a set of symbols and expressions used in the input. An appropriate keyboard layout is selected and displayed to the user as shown below (Fig. 7).

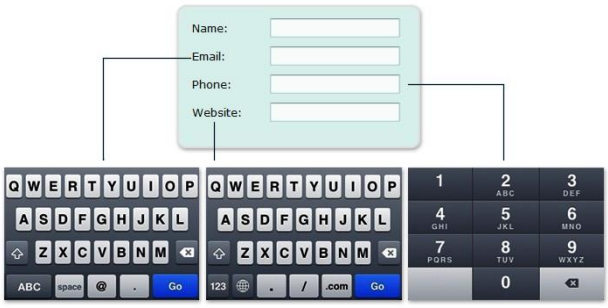

Fig. 7. Automatic change of keyboard layouts depending on a field type in Safari, Apple iOS.

Attribute of tag <input> – range allows the user, by moving of slide, to choose a necessary value in specified limits. This element can be used in teaching tasks for children, when by motion of such slides it is possible to explain principles of simple arithmetic on graphic examples. As in the case with audio player management elements, different web-browsers represent this element of interface differently (Fig. 8).

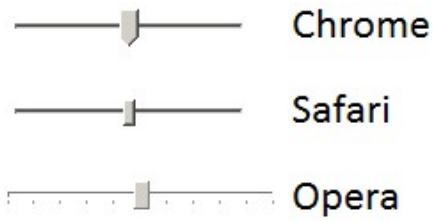

Fig. 8. Display of a "range" element in different browsers.

Attribute of tag <input> – number allows creating the fields, where one can enter only numerical values, as well as indicating for mobile devices, what type of keyboard has to be shown to the user (as in an example <input type="phone">). Apart from the basic functionality of input from a keyboard, there is a possibility to change the number by using additional buttons on the right side of input field (Fig. 9).

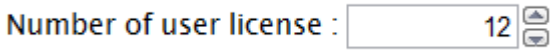

Fig. 9. "Number" type field display.

As second-rate attributes this sub-type of tag <input> can have parameters, which determine a font and other characteristics of an element (Table III):

TABLE III

ATTRIBUTES OF TAG <INPUT TYPE="NUMBER">

Attribute	Description
value	Value by default
min	Minimum value that may be entered
max	Maximum value that may be entered
step	Step of value increase

Attribute of tag <input> – date allows displaying a calendar from which a user can choose an arbitrary or a certain date, week or month. This parameter is useful for design of various history tests, when students need to demonstrate knowledge of dates of remarkable historic events.

Attribute of tag <input> – color allows for choosing the color manually from the suggested palette. Further, the hexadecimal value of the chosen color can be passed as a parameter for further processing. This parameter can be used in the programs for teaching little children to distinguish colors and to solve color tasks. Using this element a browser shows a small pull-down menu with basic colors; however, after pressing the button "Other…" the standard menu of color choice for an operating system appears, from which it is possible to select any color (Fig. 10).

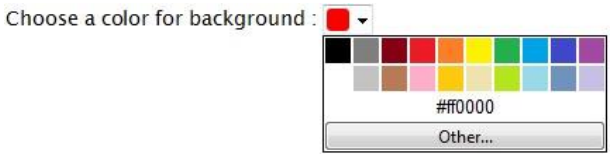

Fig. 10. Choice of color with use of Opera web-browser standard options.

As one can see from the examples discussed, the HTML5 features make it a powerful tool that is able to support most part of the assessment tasks, which are typically offered to the students in e-learning systems, and it once more proves the necessity to use this technology in the e-learning area.

V. CONCLUSION

HTML5 technology is a powerful instrument in hands of developers, which can enrich experience of an ordinary web-browser and any electronic learning system or teaching game. Besides, this technology facilitates the process of web-application development. Most of control elements for popular types of assessment tasks, which are often used in the e-learning area, may be represented by HTML5 features.

Leading IT companies all over the world, such as Apple, Google, Facebook, Twitter, and Microsoft, are actively exploring this technology. Even corporation Adobe reported about stopping of Adobe Flash technology support for mobile devices and operating systems on the basis of GNU/Linux and active participation in HTML5 development [22]. Advantages of early HTML5 support are obvious: they decrease the risks for time and money investments, which are necessary for future HTML5 transfer of web-applications and system supporting distance learning [23], [24].

Market share of mobile devices is growing every year and today all advantages of modern web-sites are available from a tablet PC, iPad, or smartphone, which makes these devices a good substitution for a desktop computer for distance learning. The reason is that these devices are permanently available to the user and could be used on the bus or train during commuting from the office, home, or university. Use of HTML5 guarantees that implemented interactions will work on most of the mobile platforms and, thus, mobile learning is one of the directions of e-learning area development [25], [26].

The topic of HTML5 use in e-learning systems will be further explored by the authors of this article.

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