Primary E-learning from the Perspective of the Revised Bloom's Taxonomy

Marie Hubalovska

Abstract—The paper deals with possibility of implementation of the LMS (Learning Management System) Moodle and e-learning to education in Primary School in Upice, Czech Republic.

The theoretical part of the paper describes creation of e-learning exercise in author system Hot Potatoes and the implementation of the exercises to LMS Moodle. Furthermore the paper highlights the theory of the Revised Bloom's taxonomy of educational objectives.

The paper presents the results of the research – analysis and classification of the e-learning Hot Potatoes exercises in terms of the Revised Bloom's taxonomy of educational objectives.

Then the results of the analysis are compared with success rates of pupil achievement in given exercises.

Keywords—E-learning, primary e-learning, Hot Potatoes, Moodle, Bloom's taxonomy.

I. INTRODUCTION

Development of information and communication technologies bring to all areas of human life large changes. In connection with this development raises new demands to knowledge, skills and characteristics should be equipped the members of such society. The goals of education formulate requirements and ideas that define competencies the individual who lives in this period should acquire. Requirements for the contemporary people are changing. People of the 21st century should be digitally educated to be able to compete in the labor market and to be competitive on an international scale. Digital education involves both the use of digital technologies in the educational process and also develops knowledge and skills in information technology. The aim of the current government documents, such as digital education strategy for 2020 in the Czech Republic is the development of digital literacy [1] and [2].

Current students perceive digital technology as integral part of life. They seamlessly use the latest technologies for different activities. Pupils, however, these technologies are used primarily as toys. Activities such as playing games, watching movies, viewing pictures and photos, listen to music, use of social networks are predominant (see e.g. pilot study

Marie Hubalovska is Ph.D. student at University of Hradec Kralove, Department of informatics, Faculty of Science, Hradec Kralove 500 38, Rokitanskeho 62, Czech republic, marie.hubalovska@uhk.cz. She works as assistant at Faculty of Education, University of Hradec Kralove from 2014. She is responsible for using of information and communication technologies in primary education.

provided in Elementary school in Upice [3]). A very small percentage of students uses these technologies for getting information, therefore, for learning.

School or teachers are tasked to teach pupils to use digital technology not only for entertainment but also for active learning. It is important to teach pupils to work with information. That means - to learn how to search for information, evaluate their veracity, to learn them to process the information and use it in life. Another way of using digital technology is to provide pupils with educational programs and materials mediated by these technologies. The *learning management system (LMS)* should be used by students not only at school but also for preparation of students at home. For these purposes are used e-learning courses. E-learning began to use the first at universities and gradually the e-learning is transferred to all stages of education up to primary level [4].

II. THEORETICAL BACKGROUND

A. Using of LMS Moodle

One of the most widespread LMS in the Czech Republic is Moodle. The idea and development of the courses is given by the principles of social constructivism and constructivism. The idea implies from these theories is to create educational content from the perspective of the learner and actively involved the learner to education [5]. Moodle is a system for full-time, combined and distance learning. The Moodle conveys e-learning courses via a web browser. All educational institutions should be connected to the Internet currently. Moodle uses current website and server technologies. With Moodle can work well, "common" user who does not have special computer skills [5]. Moodle allows you to create educational content, manage content, save the results already fulfilled courses. The courses can be directly created in Moodle, insert ready-made courses created with other authoring tools. Moodle enables communication through discussion forums, news, chat, polls and blogs. Moodle allows to insert comments and questionnaires. Moodle can be used for testing of knowledge by questions, exercises and tests. Moodle allows monitor the activity and progress of the pupil or student. There are other interesting features of the Moodle that are not the subject of this paper.

B. E-learning Courses Created in Author System Hot Potatoes

Project entitled "*Computer-aided preparation for teaching*" was realized in primary school in Upice in the years 2012 – 2015. Within the project teachers of elementary schools created e-learning exercise in an interactive author system *Hot Potatoes*.

The materials and exercises are created and implemented directly by teacher. The material and exercises are entered into the school e-learning environment LMS Moodle. During this project will be created 6600 materials and exercises for pupils from 1st to 9th grade of elementary school in subject the Czech language, Mathematics, English language and Science. Involvement of such amount of e-learning materials in learning process represents a major shift toward the use of information technology at the elementary school.

Hot Potatoes author system is based on templates [6]. The templates help to create interactive exercises with any practically programming experience. The tool, despite its simplicity, allows the author's creativity in developing of e-learning courses. Images, photographs, video and audio can be uploaded to the courses. Hot Potatoes can be converted to HTML and published on the Internet. Hot Potatoes program works under Windows, Linux and Mac OS.

Hot Potatoes has 5 modules (JQuiz, JCross, JCloze, JMatch, JMix), each of which is used for creation a particular types of exercises [6]. Exercises can be placed on the website in html format. The interactive exercises are evaluated automatically by computer. The exercises can be printed as worksheet. These exercises may be single or assembled in blocks of inter-related tasks aimed at studying or practicing certain subject of matter. The advantage is that the study material can be not only placed on the website, but students can also save it storage medium, or the material can be available on computers in classrooms without access to the Internet.

Exercises created in Hot Potatoes program provides pupils with rich feedback. In addition to providing evaluation whether the answer was right or wrong, the student (pupil) indicates the percentage of success rate was of his job. During the work a student (pupil) has possibility of help in form of uncover the first and other letters of the correct answers or the pupil can use other additional equipment – e.g. the word help. All the auxiliaries used tools are counted in the percentage assessment of the success pupil's work.

1) Module JQuiz

The first module of Hot Potatoes *JQuiz* offers several types of templates:

- Select one correct answer;
- Select multiple correct answers;
- Finishing writing short answers;
- Mixed response brief and select one correct answer.

Example of template of development environment of *JQuiz*

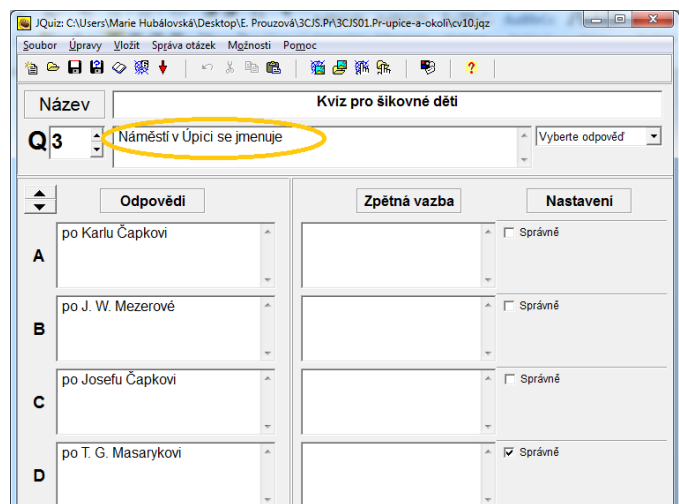module is shown on Figure1. Example of resulting exercise window of *JQuiz* module is shown on Figure 2.

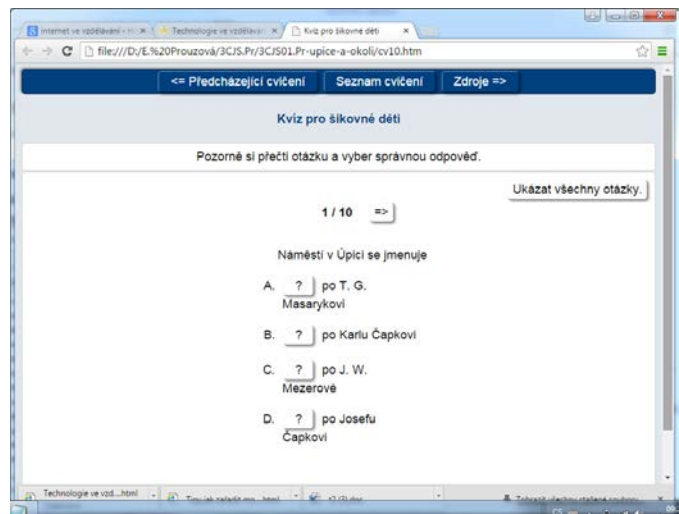Fig. 1   Example of template of development environment of *JQuiz*.

Fig. 2   Example of resulting exercise window of *JQuiz*.

2) Module JCloze

Module *JCloze* allows creation of two basic types of exercise:

- Choose the correct answer from a drop-down menu;
- Adding the correct answer into an empty editing window;

3) Module JCross

Module *JCross* allows create simple crossword puzzles.

4) Module JMix

Exercise module *JMix* enables creating series, sequences, sentences, etc. and is suitable for the sort of words, images, etc. according to the regulation.

There are two types of exercises according to the way of

work with exercise:

- Type "*Click*";
- Type "*Drag and Drop*".

5) *Module JMatch*

Exercise module *JMatch* enables creation of assignment exercises. There are two types of exercises:

- Type "Drag and Drop" – the pairing the answers form left / right columns;
- Type "Select from menu" – selection of the correct answer from the drop down menu (list).

All Hot Potatoes exercises was implemented to school LMS Moodle. The implementation enables records of approaches, records of pupil's results (Hot Potatoes has no tool for such recording).

Within the project there was created the exercises for subjects Czech language, Mathematics, English and Science for pupils from the first up to nine class of the elementary school. All Hot Potatoes exercises have been created in accordance with the school curriculum and educational objectives.

C. Bloom's Taxonomy of Educational Objectives

School curriculum is formed on the basis of the Framework education program for primary schools [7]. The program defines not only the content, but also educational objectives and competencies, which the pupil should achieve. Objectives include knowledge, practical skills, values and attitudes.

Hierarchically structured classification of learning objectives is known as taxonomy. Clearly defined and organized structure of educational goals is known as Bloom's taxonomy [8]. The Revised Bloom's taxonomy will be used in the paper.

Bloom's taxonomy is classification model of educational objectives, hierarchically organized according to the difficulty of exercises from the simplest (memorial adoption) to the most difficult (evaluation assessment). The table of the Revised Bloom's taxonomy was used for evaluation of above mentioned e-learning Hot Potatoes materials [8] – see Table 1.

Table 1   Table of Revised Bloom's taxonomy of educational objectives.

	COGNITIVE PROCESS					
KNOWLEDGE	1. Remember	2. Understand	3. Apply	4. Analyze	5. Rate	6. Create
A. Factual k.						
B. Conceptual k.						
C. Procedural k.						
D. Metacognitive k.						

III. RESEARCH

How we already mentioned above the project "Computer-aided preparation of pupils for learning" was realized at a primary school in Upice. Within the project there were created about six thousands of e-learning exercises in the subjects Czech language, Mathematics, English and Science. The author system Hot Potatoes was used for creation of the exercise. The exercise were created by the teachers of the school.

The research investigation presented below in the paper analyses the e-learning Hot Potatoes exercises in terms of the Revised Bloom's taxonomy of educational objectives.

Then the results of the analysis was compared with *success rates of pupil achievement* in given exercises (the success rates of pupil achievement are stored in Moodle, so it is very easy to use these statistics for the research).

A. Result of the Research

The Revised Bloom's taxonomy have been applied to *Exercise 1* and *Exercise 8* of subject *Science* on the topic of *Water* for the *third class* in the paper.

The topic "*Water*" is divided to ten exercises. Some of the exercises include more sub-questions.

1) *Exercise 1*

Exercise 1 consists of eight sub-questions. The sub-questions concerns of test of knowledge of basic terms of topic "*Water*".

The exercise is created by *JQuiz* module of author system Hot Potatoes.

For example the first window (sub-question) (see Fig. 3) is as follows:

- Task of the exercise: "*Read the question carefully and choose the correct answer*".
- The question (red sentence) is: "*Where is the most amount of fresh water on Earth?*".
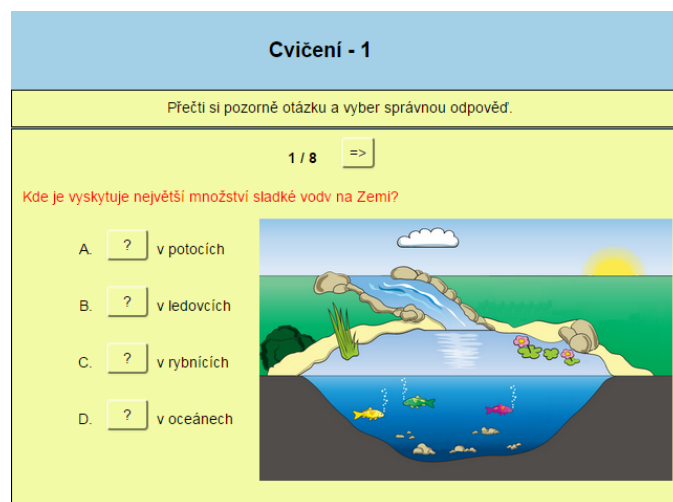- The offered reply are: "*In streams*", "*In glaciers*", "*In ponds*", "*In the oceans*".

Fig. 3   Example of e-learning window: Class: 3; Subject: Science; Topic: Water; Exercise 1.

In order the pupils answered correctly, they have to **use factual knowledge** and **understand knowledge**.

The exercise was classified according to the Revised Bloom's taxonomy as follows – see Table 2:

Table 2 Table of Revised Bloom's taxonomy – classification of Exercise 1.

	COGNITIVE PROCESS					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Rate	6. Create
KNOWLEDGE						
A. Factual k.		X				
B. Conceptual k.						
C. Procedural k.						
D. Metacognitive k.						

Above mentioned exercise was attended by **47 pupils**. Their **success rates of achievement was 82%**.

2) Exercise 8

Exercise 8 has no sub-questions.

The exercise is created by *JCross* module of author system Hot Potatoes. The exercise has form of simple crossword puzzles (see Fig. 4). The exercise concerns of properties of water.

For window is as follows:

- Task of the exercise: "*Fill the letters to crossword puzzles and solve it.*".
- The questions are:
  1. "*Flakes of frozen water are ...*";
  2. "*The taste of sea water is...*";
  3. "*Water tank for electricity production is ...*";
  4. "*Frozen water is ...*";
  5. "*Large water stream is ...*";
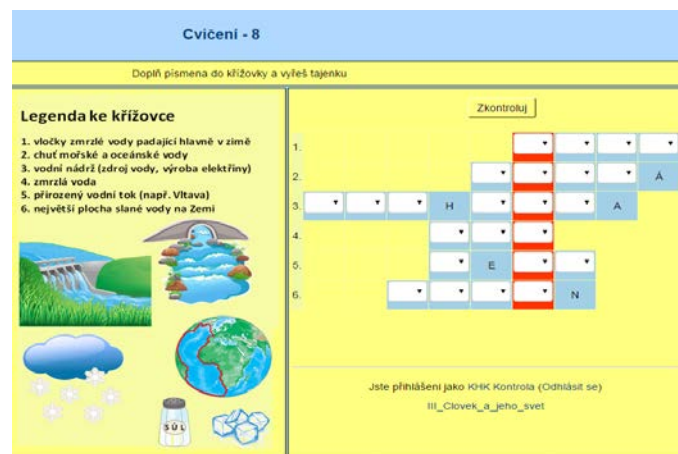 6. "*The largest area of the salt water on the Earth is ...*"

Fig. 4   Example of e-learning window: Class: 3; Subject: Science; Topic: Water; Exercise 8.

In order the pupils answered correctly, they have to **use conceptual knowledge** and **apply knowledge**.

The exercise was classified according to the Revised Bloom's taxonomy as follows – see Table 3:

Table 3 Table of Revised Bloom's taxonomy – classification of Exercise 8.

	COGNITIVE PROCESS					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Rate	6. Create
KNOWLEDGE						
A. Factual k.						
B. Conceptual k.			X			
C. Procedural k.						
D. Metacognitive k.						

Above mentioned exercise was attended by **42 pupils**. Their **success rates of achievement was 72%**.

IV. CONCLUSION

The main goal of the research determine the effect of difficulty of educational goals defined by the Revised Bloom's taxonomy to success rate of pupil's achievement.

The paper presents sub result of the research – Bloom's analysis of two exercises and its comparison with the pupil's achievement. I was found, that with increasing difficulty of the educational goals the pupil's achievement declines.

But the declines of the pupil's achievement is not significant. It can be probably caused by active use of e-learning at primary education.

To confirm this assumption, the next steps of the research will be realized – other e-learning exercises created in author system Hot Potatoes will be analyzed and statistically compared with success rates of pupil's achievement.

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Marie Hubalovska was born in Trutnov, Czech Republic in 1972, she obtained master degree in Education of primary school in 1994 and master of degree in Education of special pedagogy and logopedy in 1995, both in Faculty of Pedagogics, Charles University in Prague, Czech Republic. She works at Faculty of Education, University of Hradec Kralove. She is Ph.D. student at University of Hradec Kralove, Department of Informatics, Faculty of Science, Hradec Kralove. She is responsible for using of ICT in primary education.