# APPROACH TO THE CREATION OF A MICROLEARNING COURSE IN CODING WEB PAGES WITHIN THE LMS ENVIRONMENT

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***Abstract:*** *For the creation of an e-Learning MicroLearning (ML) course "Creation of Webpages" we chose our ML concept slightly adjusted to needs of the subject matter. The paper describes the creation principles with examples and transformation scheme from the "classic" e-Learning design. Because of the nature of learning HTML and PHP coding, the course was extended by interactive coding exercises with prepared HTML code fragments. The created e-learning course also makes use of interactive microcontent units. The aim of this approach is to engage more active participation of student in the course and let them test coding directly within the LMS.*

**Keywords:** MicroLearning, e-Learning, Web Pages, coding, LMS.

## INTRODUCTION

Today's world is changing quite fast and educational institutions have to react and keep pace. But they also have a responsibility to evaluate and carefully select what to implement as a new approach or tool. We would like to present evolutional approach to e-Learning, not an extremely revolutionary one.

If we say that today's world is changing fast, we mean society, its people and technology (services) that influence them. The Internet connection in mobile devices is nowadays quite common, mainly young people are in almost non-stop contact with their peers and the whole world. For younger generations internet connectivity, Web and social networks are services that they use on an everyday basis. In this world, complex study materials have to compete with interesting, obtained in small doses, available information that is almost always more appealing or interesting.

The classic approach to e-learning generally has the potential to attract students but many times is not flexible enough to follow up-to-date trends. It was some time ago that Nielsen defined the term "microcontent" (Nielsen, 1998) and this trend was later followed by the massive success of social networks. Social network Twitter (www.twitter.com) even explicitly restricts the maximum length of posts (at first limited to 140 characters, later extended to 280). We may find signs of "compression" in communication not only on the Web but also from lengthy book stories to movies, then shorter situation comedies, then maybe to comedians' short sketches. On the Internet, "classic" articles were accompanied by (usually) shorter (and less formal) blog posts. Poe (Poe, 2011) speaks about the fact that short is what is connected with the Internet. Later emerged microblogs (around the year 2005), later best-known service working in a microblog-way became Twitter (founded 2006). The social network Facebook and its success was yet another step in the arrival of short content.

## 1. MICROLEARNING AND THEORETICAL BASE

### 1.1 Microblogging, MicroLearning and microcontent

In the Czech Republic, microblogging became for a short time a trend, several web-based services were established but eventually maybe for lack of authors or attention of readers were closed. Twitter can be definitely considered as successor - web service that created social network which makes use of short posts and interconnection of users and their messages.

In 1998 Nielsen (Nielsen, 1998) coined the term "microcontent", meant headings (describing macrocontent) rather than the main content itself, though. Microblogging (first called *tumblelogs* in 2005) is connected with short pieces of text. There have been some examples of making use of it in education (Ahmad Kharman Shah, Latif Shabgahi, & Cox, 2016; Costa, Beham, Reinhardt, & Sillaots, 2008; Hauptmann & Gerlach, 2010). Alike ML, it is connected with informal learning (Ebner, Lienhardt, Rohs, & Meyer, 2010). It was Hug (Hug, 2005) who connected short text with the term MicroLearning and defined its main attributes. Lindner (Lindner, 2007) used the term "microcontent" and connected it with short pieces of content, in conjunction with Web 2.0. What he points out is the fact that microcontent is loosely connected, can be permanently changing, rearranging. In fact, many features can be found on the Web. Microcontent is also being connected with a rise of possibilities for masses to publish on the Internet (Buchem, Ilona & Hamelmann, 2010). If we look at microcontent as a part of the  subject matter, the connection with learning objects (McGreal, 2004; Wiley, 2002) is obvious. They are also connected with granularity (McGreal, 2004) and are meant to be (re)used. The difference is that microcontent, in connection with ML is called a microcontent unit (MCU), aims to be focused on rather small parts of subject matter and in our view should, on the whole, make an e-learning (ML) course.

## 1.2  In search of a better way of learning

Although almost all educators agree that the learner should be in the centre of instructional efforts, many study materials are being prepared in a teacher-centred manner. We see it for instance in long textual materials that are easier to be prepared, cover more of the curriculum in a shorter time and making them accessible is to a wide extent also easier. Even though the student-centred approach shows better results (Freeman, Haak, & Wenderoth, 2011).

With the decision to focus efforts to maximize learners' gain, the test delivered before instruction (Grimaldi & Karpicke, 2012) shows interesting results. Applied are pre-tests that enhance subsequent encoding (Wissman, Rawson, & Pyc, 2011). The question is how is subject matter (as a whole) step by step being transferred to the mind of a student. A temporary structure that is by the time being extended and adjusted would be understandable. As to course structure, previous results show that active engagement of students makes them more skilled learners (Freeman et al., 2011). That is one of the motives that moved us to make use of (and enhance little bit) what is today called ML.

ML is usually being connected with a change in the way people communicate and in the way they can access all sorts of information (Bolka & Langreiter, 2006; Lindner, 2007) that the Internet offers. What we see as similarly important is the learning theory's perspective. There exists Miller's Magical Number (7+2) (Miller, 1956) or number four plus one (4+1) (Mathy & Feldman, 2012) that says that learners' short-time memory and capacity is limited. Following these findings, we can create an e-learning course that suits better students' current needs.

## 2.  CREATING A MICROLEARNING COURSE IN AN E-LEARNING WAY

Most approaches to ML are mobile-based ML (P. A. Bruck, Motiwalla, Simons, Foerster, & Jonker, 2015; Peter A. Bruck, Motiwalla, & Foerster, 2012; Cates, Barron, & Ruddiman, 2017; Gabrielli, Kimani, & Catarci, 2006; Gassler, Hug, & Glahn, 2004; Göschlberger & Bruck, 2017; Jahnke, Lee, Pham, He, & Austin, 2019; Nikou & Economides, 2018). We also understand the indisputable need to support mobile devices and the benefits it brings. Because of the use of LMS Moodle as the main e-learning tool (at our University) – well known to students – we decided to create an ML course in this environment. LMS Moodle with a well-chosen template is responsive, so it meets the need for support for mobile devices. Because of the nature of some content types (e.g. interactive videos) they are not best viewed on devices with too small (narrow) screens. The solution is to use a mobile device in landscape mode.

In addition to Hug's (Hug, 2005) ML parameters, we added emphasis on interactivity, multimediality, and integrated quiz questions. The potential

of LMS Moodle in the use of interactive content are quite limited, so we made use of H5P (www.h5p.org; based on HTML5 and JavaScript) that adds several interactive educational content types. In a variety of H5P content types, we mostly used "Course presentation", "Interactive video" and "Quiz" (that supports almost any of supported testing tasks). We set a limit that one MCU should be around 5-7 minutes long. If the content length is not easily measurable (e.g. text, images), the time needed for its completion should be similar. Another applied constraint was connected with a number of terms. If they were important for the course we limited them to approximately 5-7 per MCU.

## 2.1 Structure of the topics of the MicroLearning course in dynamic web pages' basics and use of MCUs

The course consists of eleven topics that cover the creation of dynamic webpages (Introduction to web pages, HTML, HTML and CSS, CSS positioning, JavaScript, Basics of PHP, PHP and Forms, PHP and MySQL, Saving Form data to DB using PHP, PHP Functions, Form Validation). The structure of each topic consists of compulsory parts set by the university regulation, among them are learning outcomes, keywords, study materials, (optionally) examples, summary, control questions for students' self-evaluation and a test. MCUs themselves are then inserted in the study materials section. Generally, one unit looks like a normal Moodle-like e-Learning course. But the main difference lies in the used smallest parts – MCUs. They were placed in the course using Moodle's activity content type (H5P activity specifically).

The results of the research we have recently finished showed that students did better in the factual knowledge test (Polasek & Javorcik, 2019) if they used the ML course in comparison with the "classic" e-Learning. The difference was statistically significant. Taking this into account we decided to utilize the gained experience and create a similarly based ML course for the subject dynamic web pages' basics. Each unit consists of mainly MCUs (on average 10 per unit) – besides summaries of e.g. protocol commands, etc. – and at the end of each unit with a summary quiz. For the creation of MCUs, we employed the below mentioned H5P content types.

### 2.1.1 Interactive videos

In the beginning, as an introduction into a given topic, it is suitable to make use of video, which, by combining images, animations and various sketches, makes learning less limited by mere textual information. The intention is to grasp the learner's attention and employ as many senses as possible. Because video (animation) creation is a lengthy process, good sources of videos are public video services like YouTube. Unfortunately, because of the language barrier (most of our students prefer Czech to English), the use of Czech subtitles is then a must.

These videos are turned into interactive tools by enriching it with various interactive elements. One of the basic devices are bookmarks, that give students the opportunity to skip parts, get to a certain point that student finds important, etc. We found it good to mark the beginnings of the main parts of videos and enable viewers to navigate within them. Videos themselves are very good tools, but we think that because of the lack of structure their cognitive potential may not be fully employed. Bookmarks in fact virtually chop quite short videos (maximum 5-7 minutes) into even shorter parts – seconds long, that cover only one specific detail, one piece of information, etc. We also inserted into videos short texts, that point out the key topic of a given part, important fact or give headings to video parts. They also can be used to translate texts that are not covered by subtitles.

Within interactive videos other types of H5P objects can also be used, mainly various quiz questions and tasks. Suitable are multiple-choice questions, drag the words or fill the gaps kind of tasks. We placed them at the end of particular parts to reinforce key facts or at the end of a video for summary revision.
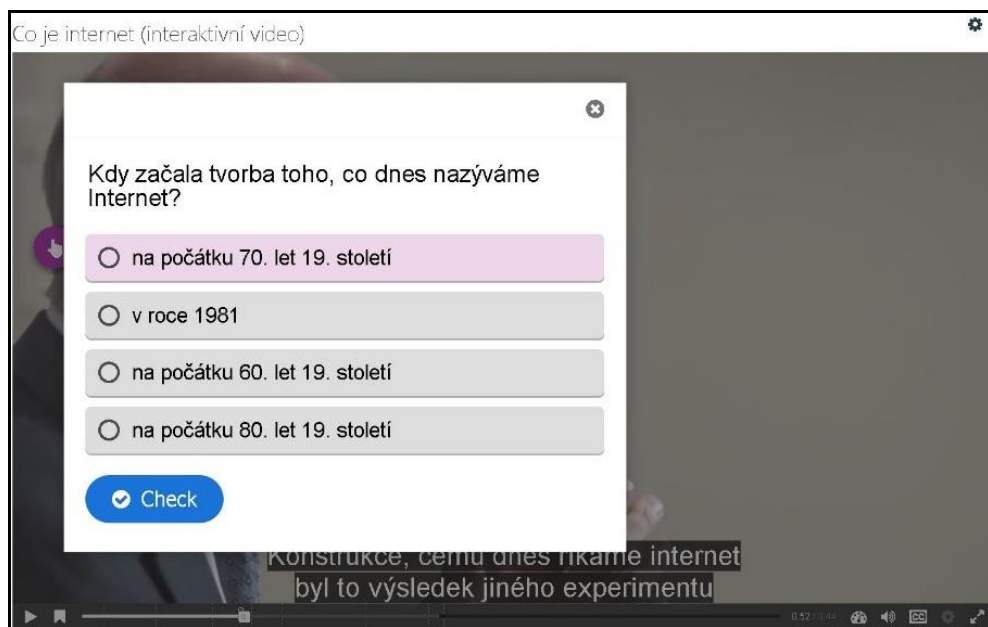


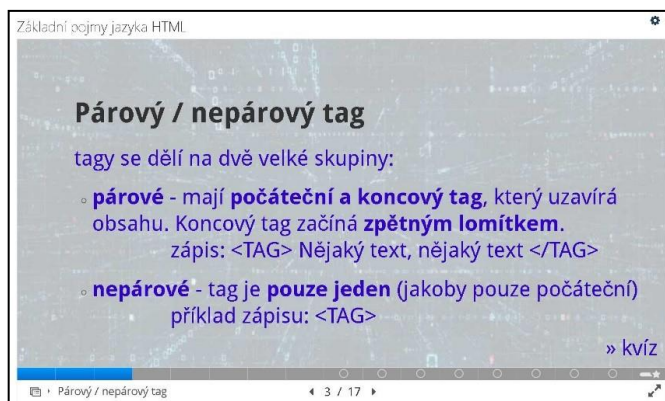**Figure 1. Interactive video with subtitles and displayed quiz question**
*Source: Own work*

**Figure 2. Interactive Course presentation as MCU with 7 terms and 8 quiz questions**
*Source: Own work*

### 2.1.2  Course presentation with interactive content

An interactive course presentation was used as the main content type for MCUs. Unfortunately, if used just as a frame for text delivery they do not meet their full potential. A simple use can be as follows – a linearly connected chain of slides with text. But if slides are properly interconnected by hyperlinks, then also non-linearity can be employed. The approach we chose is to create this MCU with a limited number of slides (approx. 3-4 excluding title slide), without links, or when consisting of more slides (5 or more) interconnecting appropriate parts (slide with linked quiz questions).

The supported content types for the course presentation MCUs are, besides text and again various quiz questions, also videos, images, audios, even interactive videos. When using Course presentations, we made use of text slides combined with quiz slides.

### 2.1.3  Quiz (Question set)

This H5P content type is suitable for revision at the end of a unit. In fact, it is a group of slides where each of them can contain a different type of quiz question or activity. We used this Question set as a quiz MCU at the end of each unit. Employed were multiple-choice questions, fill the gap for code completion, drag the text for placing extracted code parts (text parts) in the to the right places and true/false questions.

### 2.1.4 Try, Alter and Execute (TAE) exercises

These exercises are meant to be supportive for students to see HTML (CSS, PHP) code, and have the possibility of directly experimenting with it. TAEs do not follow strictly ML philosophy we adopted, but the maximum limit for the length of MCU (less than 15 minutes) is met (Lindner, 2007). TAE exercises consist of two windows where the first shows a code and the second is used for code rendering after pressing the button "Run code".



**Figure 3. TAE exercise example, Headings, Paragraph and horizontal line in HTML**
*Source: Own work*

TAE exercises have set task(s) that students should try and debug with a given code. Mostly they are focused on practicing/applying prepared code in a different context and after that, with Moodle Assignment they have to hand in their completed task to the teacher.

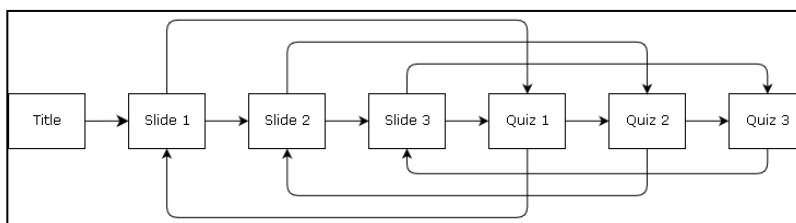### 2.2 Creation and design of MicroLearning Units (MCU)



**Figure 4. General model of a MCU with three content slides and three quiz slides**
*Source: Own work*

Each MCU was created in similar design, just with adjustments according to above mentioned H5P content types (interactive videos, interactive course presentations, Question sets) used for their creation.

For purpose of planning and creating MCU, we always took a unit's content and from the beginning to end started to divide it by restraint of the number of possibly used terms for one MCU, but also taking into account logical groups within the given unit (e.g. keep HTML page structure tags within MCU). If the size of a logical group produced too long MCU, two were created instead. The possibility of connecting MCUs among each other would bring easier navigation for students. Unfortunately, LMS Moodle doesn't offer permalinks for activities, so for keeping all links valid even after exporting/importing of the course we didn't use links to interconnect them.
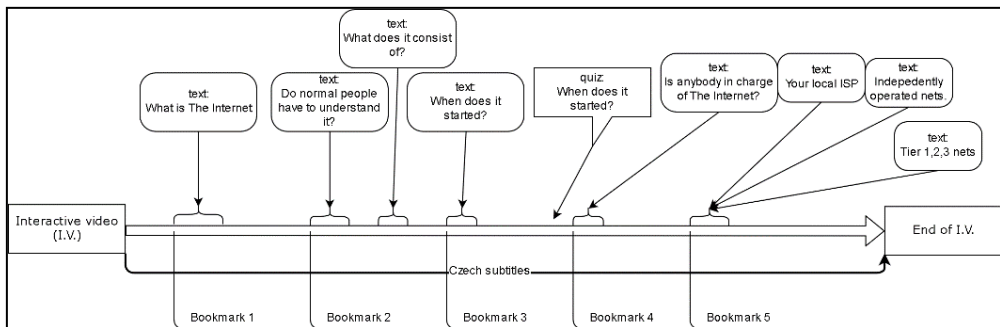


**Figure 5. Example of added texts, quizzes in an interactive video**
*Source: Own work*

Creating interactive videos was a bit different. The first and usually most important quality of a video that was searched for was its length in minutes. We set the limit to approx. 7 minutes for introductory videos and approx. 12 to 20 minutes for coding examples. Next were marked the main parts by Bookmarks and added labels where needed throughout a video. Lastly quiz questions were added and at the end a short quiz for revision.

## 2.2.1 Application of quiz questions within MCU

It's a matter of question where to place and how often to apply quiz questions for reinforcement within MCUs. Some findings show that post-instruction testing improves delayed retention learning (Haynie, 1994; Ramraje, 2011), so we employed a similar approach to the use of MCUs. Basically, one way is to use a quiz question immediately after presenting a piece of information, the second way is to postpone a quiz question after one, two or three other slides. Postponing a quiz question can roughly copy measures used against the effect of forgetting (forgetting curve) (Averell & Heathcote, 2011; Fisher & Radvansky, 2018) as used for instance in Anki application (apps.ankiweb.net). Another

possibility was to apply a quiz question(s) at the end of MCU, which we mostly used.

Not to limit students in a way they are going to use quiz questions in MCUs we inserted links that are connecting "theoretical slides" with corresponding quiz questions at the end of MCU. Also, backlinks were set. Within interactive videos we weren't mostly inserting links as screen of videos is mostly occupied by text, graphics, text labels, test buttons and subtitles and yet another element could make it too chaotic. Even though videos can be set to stop and show a quiz question we usually made it voluntary to undergo in-video quiz questions not to interrupt viewers' experience.

## CONCLUSION

The main reason for creating a new ML e-learning course was to offer to students (undergraduate IT teachers) a newer active way to study (for some) a not very interesting subject. For course creation, we chose the university's standard e-learning platform LMS Moodle with the use of H5P activities to add more needed interactive content forms.

The creation of a similarly founded ML course without the use of H5P would be possible but would limit interactivity and because of limited possibilities of interconnecting activities in LMS Moodle it would be also too fragmented and in the end, the course structure would be too complicated and disorganized. Also even though the environment of H5P is quite user-friendly, at least basic knowledge of HTML and its colours is needed, which restricts use of this tool to less IT skilled course creators.

From a general point of view, we see the benefits of ML (MCUs) that by creating small chunks, it offers a way for students to create their own study path and makes it easier for them to grasp particular parts of the whole. This is similar to the way we browse on the Internet and learn as we work – look up what is needed at a certain moment. Siemens (Siemens, 2007) sees knowledge in a distributed manner, the form similar also to the Web. This way we may connect ML with connectivism (Goldie, 2016). Important in this context is to carefully prepare the learning path by preparing MCU as step by step parts that self-contained though they are – they create students' mental image of a whole. The main course structure is still kept by LMS's course structure. This is different to the approach of the first ML system KnowledgePulse (Göschlberger & Bruck, 2017) or flashcards (Julie Phelps & Altabbakh, 2018) (that are also perceived as a kind of ML (Edge, Fitchett, Whitney, & Landay, 2012)) but focused on the particular micro-parts rather than on the whole. One of the negatives being mentioned in connection with ML is that it may lead to mere aggregation of isolated facts (Hug, 2012). By connecting LMS structure and logical division of subject matter (ideally interconnected in hypertext manner) we hope to address it.

Our approach to ML course is closer to the traditional e-learning course, which is a little bit different from many ML approaches of recent days (Jahnke et al., 2019). Because the creation of a new learning environment is time demanding and costly, we find the use of a classic LMS ~~as~~ the best way. By connecting the attractive form of the subject matter presentation with the possibility of testing code snippets (TAE) and creating new knowledge and skills directly within LMS, it opens the possibility for improvement of students' motivation and a higher rate of interest. Hopefully, also a higher rate of gained factual knowledge and learning satisfaction is met. TAE exercises are not totally novel as on the Web there can be found similar code testing sites. But incorporating TAEs into the course opens the possibility of studying, testing and developing coding knowledge and skills without the use of outside services that may stop operating, change service policy, etc. We also find it important that the use of a well-known LMS environment doesn't create new potential barriers for students to get used to it.

By creating a MCU with selected H5P modules we found out that there are almost unlimited possibilities in the approach to MCU design. Because of that, we created a basic model and limits that help create the MCU in the same way. At the same time because H5P modules offer a lot of feasible solutions we see possibility for further alterations and experiments. Even though the creation of a MCU is time demanding we see the benefit in the fact that the student is always tested (is given that possibility) after finishing even quite a small step. That gives the prospect of better-founded comprehension.

We intend to test the created course in comparison to the previously used one to find out if it helps students achieve higher score in factual knowledge or improves the approach to the subject matter and learning satisfaction. The topic could be further developed by creating TAE also for PHP hosted locally within the same web server as LMS. So far we solve PHP TAEs by using a third party online service. Finding a feasible way to interconnect various MCUs is a distant goal that deserves solving. Another possible way for development is better support for mobile devices as TAEs are unfortunately so far better when used rather on a computer. Further research can also focus on the issue of reinforcement quiz questions placement – if it is better to place them after each slide, delayed or at the end of the MCU.

ML is seen by many nowadays as a possible trend and we hope that making use of ML with an added value brings the prospect of improvements.


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