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Scientists‘ Night: An Event Not Only for Children

The University of Ostrava is one of the coordinators of the nationwide, science-popularizing event called Scientists’ Night, which enables the visitors to learn more about the inspirational science environment. This year’s event took place on October 5th, 2018 under the title “100 Years of Czech Science”. Results from the past one hundred years can be seen in the field of Information and communication technologies in education. That is why the Department of Information and Communication Technologies had its own stand at this year’s event – “From an inkwell to a tablet”. The purpose of this activity was to present the evolution of school tools – from a goose quill pen to the latest tools such as a tablet, augmented reality or the Sphero and Bee-Bot robots. During this time traveling, both children and parents were constantly being reminded not only of how beneficial these new gadgets were, but also of the importance of digital literacy and the development of computational thinking, especially in the context of Industry 4.0, etc.

The visitors found the stand interesting, as can be seen in the following pictures:

The presented technology has unlimited uses and it is up to the teacher how they decide to use it. Such events, as well as your scientific findings published in the ICTE Journal, can change teachers' approach or at least inspire them. I hope that you will find articles in this issue of the ICTE Journal inspirational and that we will continue to positively influence the ICT-based education process together.

Tomas Javorcik

Executive Editor

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GAME-CONSTRUCTION STUDENTS EXPERIENCES OF EDUCATIONAL GAMES - GAMING OUTCOMES AND LEARNING OUTCOMES

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ABSTRACT

Game-based learning has been a rapidly expanding field in the 21th century, with research reports praising the motivational effects and learning outcomes of games. At the same time there have been doubts on the learning outcomes of even the most seriously designed learning games. The generation that today enrols for university programmes is in general a gaming generation, and game construction students are often so called hard core gamers. What are the game construction students' experiences of educational games, and what are their perceived learning outcomes?

This study is based on student essays on gaming habits and game-based learning outcomes, written by students taking a course on game-based learning. Essays from four course batches have been thematically analysed to answer the two research questions. Findings show that students have a rich experience of various kinds of games, but that they do not make any clear distinction between games developed for educational purposes, and other games. Students also perceive that there are cognitive, behavioural as well as affective learning outcomes from both standard entertainment games, and more serious learning games.

KEYWORDS

Game-based learning, GBL, Educational games, Serious games, Learning by gaming.

1 INTRODUCTION

Game-based learning (GBL) has been a hyped and emerging field in the 21th century. There have been several research reports on the strong learning potential of GBL, with the condition that games are carefully designed (Gee, 2007; Ebner & Holzinger, 2007; Torrente et al., 2010; Reinhardt & Sykes 2014; Wiggins, 2016). Another trend during the last decades is the 'myth dispellers', where the most ambitious dispellers analysis and discards around 50 myths at the same time (Lilienfeld et al., 2011; Jarrett, 2014). In the field of GBL and serious games, one published and quoted dispeller is Jeanne Farrington (2011).

In her quite shallow analysis serious games and simulations are seen as a 'research myth', with the recommendation to not invest in serious games development. The paper that can be found at ResearchGate, is hardly a methodical research study, and something written for a web column with the ambition to "… look at a recent entry in a series of 'serial myths'." (Farrington, 2011). Her column is mainly an analysis and a discussion of a study carried out by Sitzmann (2011), combined with material from blogs, other web resources and a few research papers. However, the article is published in several research repositories and part of the ongoing GBL debate.

A recent and more thorough analysis of the learning potential of GBL is the literature study conducted by Vlachopoulos & Makri (2017). The aim of their study was to discuss the impact of learning games and simulations with regard to achieving specific learning objectives. Three learning outcome categories were found for games integrated in educational settings, cognitive, behavioural, and affective, with 123 articles providing either empirical results or claiming meta-analytic evidence (Vlachopoulos & Makri, 2017). However, as suggested by Vlachopoulos & Makri, there is a need of further research and university instructors should take a more active role in the design and implementation of GBL in higher education.

Games and simulations are today widely integrated in higher education curricula, and there also exist many university programmes on game construction. Today, people are playing lots of digital games in general (Juul, 2010), and game construction students in particular (Mozelius, 2014). Most of these students have played different types of digital games since early childhood and spent considerable amounts of time in front of game screens. What are their perception of educational games, educational resources or so called Shavian reversals?

1.1 Aim

The aim of the study is to analyse and discuss students' perception of GBL and what they see as useful learning outcomes.

1.2 Research questions

Important research questions to answer in this study are:

1. What are game-construction students' experiences of educational games?
2. What are students perceived learning outcomes from playing educational games, categorised as cognitive, behavioural and affective?

2 GAME-BASED LEARNING

GBL has been a rapidly growing research field in the 21st century with studies indicating promising results in various educational contexts (Tobias, Fletcher & Wind, 2014). It would not be correct to classify GBL as a standalone didactic strategy, it should rather a concept that can and should be combined with other instructional design. GBL can today be seen as an integrated part of different educational concepts and built on various types of games and almost any initiative that combines gaming and education can be considered as GBL (Moreno-Ger et al. 2008).

Another related trend is gamification, which compared to gaming and playing, is more about gaming than playing since there are rules to follow. Gamification has been broadly defined as *"the use of game design elements in non-game contexts"* (Deterding et al., 2011), and more specifically defined for educational purposes as *"using game-based mechanics, aesthetics, and game-thinking to engage people, motivate action, promote learning and solve problems."* (Kapp, 2012, p. 10). A gamified system is designed to look and feel like a game but it does not go all the way (Olsson et al., 2015). Considering the students group taking a university programme on game construction, GBL was the natural choice since the curriculum is closely aligned to the idea of constructing games. Considering the essays, students' experiences of games are much richer than their experiences of gamification.

2.1 Educational games and serious games

GBL is in this article seen as *transmedial*, and not as in other studies exclusively as digital so called DGBL (Van Eck, 2006). Game ideas can be implemented in several ways, and analogue strategy games have been used in educational settings for thousands of years. Furthermore, this study does not make any clear distinction between commercial-of-the shelf (COTS) games and educational games. However, educational games can widely be defined as *"games that are designed to teach someone something*" (Moreno-Ger et al. 2008).

The term Serious Games origins from the book 'Serious Games', where serious gaming refers to analogue board games and card games (Abt, 1987). Later the term was adopted by the Serious Games Initiative to refer to digital GBL and simulations (Marsh, 2011). With the fast technological and artistic development in the field of GBL it has been hard to define exactly what a serious game is. What seems like a good idea is to instead view serious games as the continuum presented by Tim Marsh (2011).

Figure 1. The serious games continuum (Marsh, 2011)

The games in the leftmost third are the traditional ones defined by Salen and Zimmerman (2003) as " . . . *a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome"*, but with the extension that they should include a training and learning dimension. In the middle section games have less of traditional game characteristics and are more of digital media environments but still with entertaining game-like environment with a purpose to explore and learn. Finally, in the rightmost third the continuum encapsulates digital media environments with minimal to no traditional game mechanics with serious games mainly as interactive simulations. (Marsh, 2011)

2.2 Shavian reversals

The term Shavian reversal was coined in article by Seymour Papert (1998) where he criticises the contemporary *"mating of education and entertainment"*. In an online dictionary that explains e-learning terminology Shavian reversals has been defined as*: "A type of game in which the game and content are rarely integrated, which Seymour Papert calls Shavian Reversals, a term from genetics in which an offspring has inherited the worst characteristics of both parents"* (E-learning Terminology, 2010).

This definition is correct in the sense that the term was coined by Seymour Papert, but the origin is not from genetics and based on a story featuring George Bernard Shaw and a famous beautiful woman. In the story the woman speculates about what a magnificent child they might have together if the child got her looks and Shaw's brain. According to the story Shaw's quick reply was*: "But what if the child had my looks and your brains?"* (Papert, 1998). The story is probably not true and a similar meeting has also been described between Albert Einstein and a chorus girl (Quote Investigator, 2013).

However, the term has been frequently used and discussed in GBL research (Peirce, Conlan & Wade, 2008; Charsky, 2010; Söbke, Bröker, & Kornadt, 2013). The phenomenon has sometimes been blamed on academicians who, in their game development process, have had little or no understanding of the art, science, and culture of game design (Van Eck, 2007). Despite the fact that much has happened in the design of educational and serious games since 1998 (Wechselberger, 2008), the term is still around in GBL discussions (Kronenberg, 2016; Wiemeyer & Tremper, 2017).

3 INFORMANTS AND METHODS FOR DATA COLLECTION

Data in study has been collected from four batches of students taking a university course on Game-based learning where the author is the course developer and the subject matter expert. Students have written essays on games, gaming habits and study habits. Essays were submitted in Moodle discussion fora where students also have posted their comments on two other submitted essays. Before writing the essay students have read suggested research papers on GBL to get familiar with concepts and learning theories that later should be discussed and related to in the essays. Students that did not find the suggested articles interesting have been free to choose their own GBL articles with concepts relevant to their essays. In all four course batches there have been a majority of male students and relatively few females, in the 2016 course batch there were 6 female and 27 male students.

All students are following a Bachelor's programme on Game construction and they are to be classified as digital gaming natives with extensive and sophisticated gaming habits (Mozelius et al., 2016).Students are digital gaming natives in the sense that almost all have started playing digital games as young as four to five years old. Non-gaming students have been rare and below 1% of the participants in the four student batches. The vast majority of the students also have all-embracing gaming habits and are, like so called hardcore gamers (Juul, 2010), playing in long and extensive game-sessions. (Mozelius et al., 2016) It seems realistic to assume that these student have high demands both considering gameplay and considering game design.

Data collected from the first three course batches have earlier been presented as conference papers (Mozelius, 2014; Mozelius et al., 2015; Mozelius et al., 2016) after content analysis of student essays and discussions at seminars. In this study earlier data has been reanalysed as a complement to the data gathered in the essays from 2016 version of the course. The earlier content analysis has now been replaced with a thematic analysis to find themes that can be useful when answering the two research questions. In contrast to the earlier content analyses where the frequency of found patterns are essential, the thematic analyses has had a focus on identifying themes that can be part of the answers to the research questions. The analyses has been conducted in six steps as recommended by Braun & Clarke (2006): Step 1) Get familiar with data, Step 2) Generate preliminary codes, 3) Identify relevant themes, 4) Review found themes, 5) Define and name the themes, 6) Write up and present.

To answer the first research question an inductive analysis was conducted with a focus on the data collected in the 2016 course batch. Here students' essays were written to answer the question: *What are your experiences of playing educational games?* To answer the second research question a deductive analysis was carried out with the three learning outcomes categories presented by Vlachopoulos & Makri (2017), as predefined analysis criteria. Students' perceived learning outcomes have been categorised and presented as cognitive, behavioural and affective. Essays in the 2013, 2014 and 2015 course versions have been written to answer the following questions:

- What are your experiences of playing games and have this has led to knowledge acquisition, new skills or learning stimulating effects? (Mozelius, 2014)
- What are your earlier gaming experiences and has the gaming led to any knowledge or skills that can be transferred and used in other contexts? (Mozelius et al., 2015)
- What are your gaming habits and how might excessive gaming disturbed your school studies or social activities? (Mozelius et al., 2016)

4. FINDINGS AND DISCUSSIONS

Found themes have been grouped separately try to answer the research questions one by one. Findings for research question 1 are separately presented and discussed under 4.1 and findings for research question 2 can be found under 4.2.

4.1 Students experiences of educational games

Findings in the essays from the 2016 batch strengthens the earlier findings that students have wide-ranging and extensive gaming habits, and that most students started to play games at an early age and often together with their parents (Mozelius, 2014; Mozelius et al., 2016). The excessive gaming and students' preference for long gaming sessions also is according to the idea of hard core gamers playing all kind of games and in long gaming sessions (Juul, 2010).

Many students write about memories of educational games on Mathematics from primary school, where some frequently played games were 'Matteraketen /Math rocket ', 'Flygande start / Flying start', 'Chefrens pyramid' and 'Cheops pyramid', which all are Swedish designed educational games, developed on purpose for school use in mathematical contexts. One female student remembers that she played Flygande start both in school and outside school and that *"It didn't really feel like a learning game, and I played it mainly because it was fun"*. Most of the Math games have been played in school, but a male students tells that *"My parents bought me the Math game 'Den flygande mattan / The flying carpet' to combine my strong game passion with something useful"*. There are different opinions about the learning outcomes, but students seem to agree on that the various Math games have increased their general motivation for Mathematics.

There are also reports on Swedish produced games with historical content that students have been playing them without viewing them as educational. One male student recalls "That 'Svea Rike' is an educational game wasn't anything I reflected on". Svea Rike that originally was an analogue board game on Swedish History in various eras, was never intended to be an educational game, the idea was rather to create a game for persons with a passion for History. With or without a passion for History, in one of the essays a student claims that "This game that doesn't have high immersion was, at least for me, a good way to learn History. As I remember, I was never interested or motivated for History classes, but this game gave me some motivation". Games on History can be hard to classify, but they are in general praised in the essays. Examples of well-designed COTS games where students say that they have learnt about History are: 'Age of Empires' and 'Civilization'. In Age of Empires every level is introduced with a History lesson where details to a high degree are correct.

That the essay writers have not made any clear distinction between educational games and other games is a found pattern for more types of games than the ones on History. Two other games that several students have hard to classify are 'Sim City' and 'Backpacker'. Most discussed in a long thread of its own is Backpacker, which also was one of the games that evoked a lot of nostalgia. A female student writes that "Backpacker has changed my opinion and made me see educational games as something enjoyable, where you also can learn something". She also brings up *"What I see as the difference between Backpacker and 'chocolate covered broccoli-games' is that the mini-games are well integrated with the rest of the gameplay"*. Some more critical comments on the games' learning outcomes are *"For every job you try you learn a little bit of everything, about mushroom picking, about how a radio works or how a newspaper is made, but all together rather superficial"* and *"Like many other kids I played a lot of Backpacker, but how about knowledge retention? I don't know if any important knowledge remains today"*. Two other students comments that the important lesson learnt in Backpacker is that, *"abroad without money you call your parents for more"*.

It is two students in the 2016 batch that write that they have little experience of educational games. One of them writes that he finds educational games *"to be uninteresting with simple game mechanics and poor graphical design"* but also *"... many educational games are boring seen as games, but in my opinion they can be a way to make education more interactive"*. The other student mentions a passion for mobile apps where you can learn to program. A game genre that he describes as *"A grey zone between casual games and educational games"*. Casual, both in the sense of how casual games are defined with the possibility to play in short sessions and pause before the next session (Juul, 2010), and in the sense of casual games having a simplified gameplay. Examples given of this game genre are 'Code Avengers' and 'Learn

JavaScript for Android ', quiz based games with questions on code syntax and basic programming techniques. Another game for learning to program and improve computational thinking is 'Human Resource Machine', which is described in an essay as *"A kind of visual programming where you should make your avatar to correctly execute instructions"*. Another student wrote that *"More of problem solving than to wrestle with messy syntax"*. A surprising finding was that many students brought up their experiences of 'The typing of the Dead', a learning game to improve the keyboard typing speed.

Image 1. The Typing of the Dead

The game is a remake of the light gun game 'The House of the Dead 2 ', where the ray guns are replaced by computer keyboards. In 'House of the Dead 2' the main characters are carrying ray guns, in 'Typing of the Dead ' the main characters are waking around with computer keyboards attached to a 'Dream Cast console'.

A student writes that *"My main experience from educational games are the many hours that I've played 'The Typing of the Dead'"* and he also mentioned that *"I definitely have to thank 'The Typing of the Dead' for my ability to type fast and correct on a keyboard, and unlike many other games that are designed for learning, this is a genuinely entertaining game worth playing merely for the sake of entertainment"*. Several students also mention that the competition factor in the gameplay contributes to the thrill. This also starts a discussion on games and competition, where some students claim that they find it exciting to compete, while others write that they dislike competition in gaming.

An interesting reflection in one of the comments is a male students' view of "older digital games", defined as games from the 20th century, as problem-based learning. He writes that *"... to read the manual was a way to learn more English, and to be able to install the game required knowledge about how an operating system and file structures are organised"*. Problem-based learning is a didactic strategy that preferably can be combined with GBL and also natural part of constructionism (Papert & Harel, 1991). Another male student writes about newer network games that *"I've definitely learnt much English and quite a lot of technology related to network communication by playing games"*.

Finally, an interesting question in an essay was *"Take car simulations as an example, if it's possible to learn to drive a car entirely in a simulation (a game), wouldn't it be possible to transfer skills in other areas as well?"*. This bridges over to the next section on learning outcomes and if knowledge can be transferred and reused to other contexts. The question is based on earlier course discussions about two German racing game enthusiasts that won the Bathurst 12-hour race. The real world Bathurst race is one of the toughest endurance races in the world and the worlds' car racing expertise was stunned when the 2015 competition was won by two persons that have learnt to drive by playing video games (news.com.au., 2015).

4.2 Students' perceived learning outcomes

Essays from all four student batches have been analysed with found learning outcomes categorised as cognitive, behavioural, and affective. Cognitive outcomes are in this study defined as knowledge and skills acquisition that are transferable to other contexts, like language skills learnt in a game reused in real world conversations. Behavioural outcomes are defined as in the study by Ranchhod et al. (2014) as relational and teamwork skills, including concepts such as collaboration, interaction, team dynamics and leadership skills. Finally, affective outcomes are defined as how players' motivation and engagement are affected by playing games, and how games directly or indirectly can stimulate learning. An example of learning stimulation is the concept of tangential learning, with the meaning of joyful gaming stimulating further studies after playing the game (Portnow & Floyd, 2008).

Cognitive learning outcomes

The least surprising, but most obvious finding is that both educational games and COTS games can improve players' language skills. What is most mentioned in the essays are about improved speaking skills where a male student wrote that *"I had, of course, earlier learned English at school but mostly not by free will and mainly by reading and writing. In a World of Warcraft guild, I had for the first time the opportunity to speak English voluntarily in a relaxed environment with people that have English as their mother tongue. This has later been useful for communication with locals on holidays to New York, Croatia and London"*.

Two other students claim that *"My overall gaming has had a huge impact on my English skills, they have clearly improved without any thoughts on how to learn …"* and *"The most obvious example of what I learned was English, which also was confirmed by my teachers in school. They recognised a difference in the national test results between students who played digital games and the ones who didn't"*. There are also other essays where students posit that their English improved English proficiency also includes grammar and writing skills *"In tandem with my school activities online sessions in Battle.net accelerated my learning of English in primary school and during my 9th year in school I took a Cambridge certificate that affirms speaking as well as writing skills"*.

English is the by far most practiced language but a female student remembered that *"In primary school I played educational games with exercises in English and Spanish, and even if I might have been too young to write in foreign languages I managed to build phrases by listening and image association in the games"*. Furthermore a male student stated *"I would welcome a feature that, not only writes out the English names of the involved items, but also in Arabic and French…"*. Players' improved language proficiency from playing games have been reported in other research studies, where one of them is del Blanco, Marchiori & Fernández-Manjón (2011).

Much can be argued about the importance of keyboard typing skills, but essays from all four course batches brings up the fascinating game 'Typing of the Dead '. Several students claim that their typing skills definitely have improved during hours of enjoyable gaming "The Typing of the Dead ' is a game where you have to type a lot of words that appears on the screen to avoid the zombies. If you manage to type the word the zombie that tries to catch you get killed. Playing this game has made me a very fast writer, where I'm always sure where the keys are placed on the keyboard and I never have to look at the keyboard". Another male student describes the game and the learning outcomes as *"This game works like an excellent tool to improve something that is valuable today, the ability to type real fast on a computer keyboard. Since there*

are several monsters appearing at the same time you have to constantly focus on the screen, not to miss the words and phrases you should enter. The trick to speed up your typing pace is to stop looking at the keyboard and you learn a superfast automatic way of typing". Whatever the opinions on zombies and keyboard typing the learning outcomes seem to be obvious.

Regarding games a bit to the right in the serious games continuum (Marsh, 2011) several student essays have mentioned the Sweden developed Bonnier's Car School / Bonniers Bilskola, a gamified version of the theoretical test for the Swedish driving licence. Both male and female students find the game useful and one student writes that*, "... this game definitely helped me without ever giving me the feeling of studying when I switched on the computer"*. To get a Swedish driving licence is an expensive process and that a well-designed serious game can facilitate: *"Bonniers trafikskola was an efficient tool where I could learn and test what I've learned in a multi-media environment instead of only reading the theory book. My clearest memories are of the images depicting various traffic situations from where you should tell how the cars should act and interact. I also learned about the different parts of a car and its engine"*.

Serious games and simulations seem to be where learning outcomes are easiest to prove with examples brought up in the essays. One example is the earlier mentioned German gamers that participated in the real world Bathurst race (news.com.au., 2015). Another example involving simulators mentioned in an essay is the case of the infamous 'Swedish fake pilot'. Without any pilot licence, except for a home-made one, he worked as a pilot for several international airline companies during 13 years. How to fly passenger planes was something he learnt during night sessions with SAS owned flight simulators at the Arlanda airport in Sweden. (Daily Mail Online, 2010) The Scandinavian airline company SAS is just one of many airline companies that use simulators in their pilot training with a cost of hundreds of Euro per hour (Scandinavian Aviation Academy, 2017).

Behavioural learning outcomes

Two types of games where strong emotions are involved are 'First-person shooter games' (FPSs) and 'Massively Multiplayer Online Role-Playing Games' (MMORPGs). The two most frequently played are 'Counter Strike' (FPS) and 'World of Warcraft' (MMORPGs), where both games have high status and at the same time with a risk for addictive gaming (Mozelius et al., 2016). Several students bring up learning outcomes from FPSs and MMORPGs, a male student stated that "I've definitely learnt most from COTS in my gaming life. World of Warcraft has for me been like a long exercise on talking and writing English, collaborating with other people and problem solving". Another male student posits that *"I've played World of Warcraft for a long time and most of the time you collaborate in groups … , what I've learnt from this is to collaborate and to get info from multiple sources"*.

Several essays in all four student batches have brought up the idea of improved communication skills and improved social skills as an outcome from playing online games, a male student in the first course batch claimed that "…the virtual world has its own values where you have to create contacts and build a social life just like in real life". A female Counter Strike (CS) player from the same course batch wrote "CS functioned a bit like any other social media with chats where people chatted about all kind of things and not only CS related topics". There also exist several testimonies about improved leadership skills from playing MMORPGs, where a male student from the last course batch *posited "By playing World of Warcraft with people from many different countries I've also developed my leadership skills, when I've been leading raids with 24 other gamers"*.

Except from the female Counter Strike player, the worlds of FPSs and MMORPGs seem to be strongly male dominated. A more girly game with behavioural learning outcomes seems to be 'The Sims', where the virtual characters can get sad, moody and even depressed when they are isolated without communications with other 'Sims'. Another female student see 'The Sims' as a way to improved strategic skills that later have been useful in daily life situations. Two games that seems to be played by mostly boys are the football based 'FIFA Manager' and the ice-hockey game 'NHL'. A male student described his experience of NHK 13 as "*Except from playing against other persons you can play together with friends. In the beginning it*

was like a grey-zone where we didn't really understand each other. But the more we played on the smoother the collaboration. There is a certain feeling after a successful attack resulting in a beautiful goal".

An extraordinary example of how behavioural/cognitive learning outcomes can be transferred to other context was found in an essay where the student remembers that *"I've learnt to cope with stressful situations in computer games"* and *"... some years ago there was a sudden earthquake in Japan, and of course I got frightened and worried but I pulled myself together and remembered the training from a computer game. Get down under a table, cover your head, wait until the quake ceases and don't be close to windows"*. The same student also concludes his essay with the recommendation: *"Accordingly I would like to encourage everybody to play as much as you can, because you never now, it might one day save your life!"*.

Affective learning outcomes

A game mentioned in some essays is SIM City and a reflection from a male student was *"This is not a game that has a focus on teaching advanced city planning, but on the under hand it's built around that with certain aspects that you have to consider. Which can be stimulating and inspire you to learn more"*. Another student wrote *"This (SIM City) is a game that in a longer perspective can make you interested in city planning"* and *"It is because of Japanese games that I, in the future, want to be a game designer in Japan"*.

Other games described to have learning stimulating effects are 'Civilization' and 'Age of Empires', where both games touches upon the concept of tangential learning. The fundamental idea of tangential learning is that a game should introduce a theme or a technique to inspire learners to further self-studies (Portnow & Floyd, 2008). Instead of a traditional direct teaching and learning setup, a game could engage and stimulate learning by presenting abstract knowledge in an attractive and motivating context. Civilization is a game that has built-in 'Civilopedias' containing information about the civilizations that the player is related to in the gameplay. 'Age of Empires' has History lectures built-in between the various levels in the game.

Many students have played various types of Math games during their time in primary school and several essays mention the motivational effect. One male student has, just a few years ago worked as an assisting primary school teacher, in his essay he describes the situation some years ago as "Something I recognised in the school where I worked was that several kids had lost their joy and motivation, as early as 7-8 years old" and "… it was a fascinating experience that students that earlier didn't solve more than just a few assignments per lesson, now sat down after class and tried to get further on in the game". That Math games can increase students' motivation for Mathematics was also a finding in the study conducted by Gunter, Kenny & Vick (2008).

Why the Math games are motivating is hard to pinpoint, but two explanations found in the essays are that games visualise the problems and that the games are built around competition. Regarding visualisation a male student raised the question *"Why should it be better to solve assignments on a screen than in a paper book? "*. His own answer *was "An important reason is that in 'Chefren's Pyramid' the Math problems are visualised in a challenging way. And if you solve the problem you will be rewarded"*. 'Chefren's Pyramid' is also built around competition which a male student described as *"The external motivation is to compete with your classmates, which was an important motivation for me"*. But in another essay a female student recalls that *"... the competition can result in a backlash for students that are not that good at Mathematics and have a negative effect on bad losers (like me)"*.

Competition games or collaboration games, many essays mention the motivational effects. As early as in the 1980s Thomas Malone and Frank Leppard found that digital games could kick-start strong intrinsic motivation (Malone & Lepper, 1987). With the improved computer graphics and game design in the 21st century, it is realistic to assume that digital games today can create stronger states of intrinsic motivation than 30 years ago.

5. CONCLUSION

One obvious finding is that the students do not have a clear distinction between educational games and other types of games, the first encounter with an educational game was in some essays described as by random. A student writes that *"I started playing it thinking that is was a regular Mario game, but it turned out to be an educational game"*. This can also be related to students' perceived learning outcomes, where students claim that they have learnt various things from various types of games, from COTS games and from different parts in the serious games continuum and that one student claims that *"Most gaming leads to some kind of learning"*. However, there have also been descriptions in the essays of games that could be classified as Shavian reversals, and some students have claimed that they are reluctant to educational games in general.

Considering the second research question there are several findings supporting the idea of cognitive learning outcomes from playing games. The cognitive learning outcomes that are most obvious are improved language skills, and according to the student essays this goes for most kind of games. That serious games, seriously combined with teaching and learning sessions, improves learners language skills have been shown earlier in other studies as well (Johnson, 2007). The findings from this study implies that this hols for other subjects as well.

There were also several testimonies on how games can motivate and engage players, which is an idea that was investigated as early as in the 1980s (Malone & Lepper, 1987). Today, three decades later, with a wide variety of digital games, there are strong reasons to assume that the affective learning outcomes are even stronger. There also exist research studies that indicates that well-designed and challenging games, can have a positive effect on learning outcomes both directly and indirectly via an increased engagement (Hamari et al., 2016).

Finally, it is hard to draw any conclusions on behavioural learning outcomes based on the data collection in this study, but students' perception is that playing FPSs and MMORPGs could improve social skills. There are also claims in some essays that collaborative gaming might strengthen students' leadership skills and the ability to handle stress. There would for several reasons be interesting to design and develop educational/serious games based on the MMORPG concept.

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PERSONALIZED E-COURSE IMPLEMENTATION IN UNIVERSITY ENVIRONMENT

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ABSTRACT

The paper deals with the issue of e-courses personalization in selected LMS. Even though this topic has been the subject of research for a longer time, more effective concepts of learning through e-courses are still being sought. Part of the contribution is a brief explanation of the terms personalization and adaptivity, which are often mistaken or regarded as equivalent in practice. An overview of the current issue provides to reader concrete solutions to a personalized approach to education through the LMS Moodle. For purposes of research, LMS Moodle is used, which fulfils the conditions for meeting the goal of the research problem. SWOT analysis has been selected as an auxiliary tool for implementing the personalized e-course in the university environment. Further, the paper deals with the principles of creating an e-learning course as well as with the proposal of a specific methodology and its implementation in LMS Moodle. The results and findings from the research conducted so far are also available. The conclusion of the contribution deals with the summary of the results and findings as well as the further tendency in this field.

KEYWORDS

E-learning, LMS Moodle, Adaptive hypermedia systems, Personalization, Educational process, SWOT analysis

1 INTRODUCTION

Since the integration of Information and Communication Technologies (ICT) into the educational process, new ways of use of these technologies in education have been sought. One of them was the e-learning that represented new era in education. With the increasing trend of lifelong learning supported by ICT, some roles and competences of the teacher are changing. According to Burianová & Turčáni (2016), the digital competences of the teachers represent a bridge between the traditional learning and e-learning. Progressively, the educational process is starting to focus on the personality of the learner and the teacher is getting into the role of a tutor. E-learning has become the part of education in today's times thanks to its diverse use, from its presentation of digital content till the so-called Learning Management Systems (LMS) (Kostolányová, 2012).

Nowadays, students no longer have to wait for a specific time and place to learn. They can use technology not only for formal but also informal learning that is directly applied to their lessons or at home, on any computer, notebook, tablet or smartphone connected to the Internet (Burianová, Turčáni, Balogh, & Mudrák, 2018).

The use of e-learning technologies affects the planning, learning, design, control, and assessment of the learning process and the provision of educational content. For example, blended learning education is based on this idea (Burianová, Turčáni, Balogh, & Mudrák, 2018). When designing and implementing an e-

course, it was chosen this form of education. The individual solutions are described in the methodical part of the paper.

At the beginning of creating a computer support in the form of e-courses created in virtual environment, they brought some disadvantages among the advantages. One of them was disrespecting the individual attributes of the learners. This disadvantage has already been pointed out by multiple authors. The most famous one is Peter Brusilovsky who has already written a few scientific publications. He called the approach "one size fits all". An example of the concept is publishing the same study materials for the e-course participants. In 2007, Brusilovsky was one of the editors of the book *The Adaptive Web, Methods and Strategies of Web Personalization* which sets the objective of mapping the current situation in adaptive systems. In the book, each author describes their own approach to the issue of adaptation (Brusilovsky & Millan, 2007).

The mass education in the class with the help of standard e-learning is not capable of fulfilling the individual needs of students. Some of them are kept hold and start to get bored and then there are those for who the speed is too high and cannot understand everything. Some students might like the study topic, but they might not be satisfied with the teacher's teaching style. By time, these students might show dislike for the teacher and the subject. As a consequence, this results in impaired learning results (Brusilovsky, 2003; Magdin & Turčáni, 2015).

The reasons mentioned above led to efforts to personalize the content of e-learning courses according to individual attributes of particular classes of users. To some extent, every student is determined by a set of his individual attributes. These attributes can be expectations, motivation, learning habits and styles, needs, etc. according to which students can be categorized into particular groups (Despotović-Zrakić, Marković, Bogdanović, Barać, & Krčo, 2012).

Nowadays, efforts are being given to design more efficient concepts that could possibly be used in applied adaptive learning systems. The goal is to use system tools that help to identify automatically the mentioned individual attributes of students. The more aspects would be taken into account the more precise personalization could be created. Before the implementation of the personalized course itself, the first was to analyse the given LMS Moodle and to create an e-course model with the help of simulation tool Petri nets (PN) (Mudrák, Turčáni, & Burianová, 2018). The acquired knowledge will be applied to achieve the main goal which is creating a personalized e-course and implementing it in the educational process.

2 PERSONALIZATION OF E-LEARNING

In scientific publications about personalized systems with adaptive potentials, there is a certain difference in opinions in the meaning of terms adaptability and personalization. It can also be caused by understanding them from various points of view. They are not used only in informatics which can be another reason for misunderstanding or various definitions by authors.

Authors, who deal with the adaptation of the user interface, distinguish between the concepts of adaptability and adaptivity. The main criterion is how the system customization is implemented. Adaptive systems dynamically change their features to constantly support the user in their activity, while adaptable systems only provide the user with various adaptation mechanisms for this change. Thus, dynamics can be considered one of the basic attributes of an adaptive system. According to Kostolányová (2012) an adaptive LMS monitors the behavior and characteristics of a student, stores this information and continually evaluates and updates the system. Based on the evaluation of this information according to Kapusta & Švec (2008) adaptive systems change their structure, functionality and interface to meet the different and changing needs of an individual or group.

Multiple authors indicate that system personalization represents supplying and providing personalized content to a particular user. In our opinion, the terms personalization and adaptability are closely related. Personalization is viewed as a problem solution how to provide the user with as much comfort as possible while working with the system. Bieliková & Návrat (2006) claim that besides providing individualized

information to the user, the objective of the personalization is to define which information is the most relevant for him and to present it to him in the most convenient way. Kostolányová & Šarmanová (2016) understand the term personalization as a solution adaptation for various problems, situations, environments, etc. to specific conditions and requirements of individuals.

According to Magdin & Tučáni (2015) education personalization is a way by which students learn with regard to their previous knowledge, skills and learning styles. Limongelli, Sciarrone, & Vaste (2011) state that personalization of the learning experience is closely related to the effectiveness of the learning process itself, as the personalized content is more easily assimilated by the learner who, as a result, is more strongly motivated.

According to Karagiannis & Satratzemi (2016), there are two approaches in personalized e-learning – static and dynamic. An example of a static approach is a specialized questionnaire at the beginning of the course where the student has to fill in order to find out his entry attributes (learning style, previous knowledge, motivation, etc.). According to this information, the course adapts in advance to the student, so it suits his needs. On the other hand, the dynamic approach is based on observation of user's activities in virtual learning environments (VLE) in real time. The system saves the data about the user into the database. Immediately after evaluation it adapts its content, user interface, etc. to the given user. Karagiannis & Satratzemi (2016) claim that better results are achieved with the second approach, because in the first one is dealing with the initial state of learners while the second deals with a specific state. Mudrák, Turčáni, & Burianová (2018) propose the combination of these approaches. In their opinion, with the static approach, it could be possible to find out information via diagnostic methods where this information would be hard to obtain. For new students it would enable to adapt the course right at the beginning. After receiving a sufficient amount of data about each user, there would be another adaptation with the dynamic approach.

The knowledge mentioned above would be summarized and an interrelationship would be described between personalization and adaptability. Adaptability of e-learning courses could be understood as means provided by the system that allows to collect and to save data about the user. Based on the information, it could enable a change of system elements leading to personalization.

Personalization of education through VLE has been solved for several years. Two major directions of implementation are presented in this area. Some authors have chosen to create their own VLEs according to their specific requirements, and on the other hand, they have created plugins or changed properties of some open-source LMS modules, such as Moodle.

Limongelli, Sciarrone, & Vaste (2011) created an LS-Plan system that was integrated into LMS Moodle. The system automatically organizes study material based on student knowledge and learning styles. It uses a three-level approach to dynamic adaptation, which the authors describe in detail in the article.

Despotović-Zrakić, Marković, Bogdanović, Barać, & Krčo (2012) developed a method to create adaptive learning courses for distance education in Moodle. The courses are organized and adapted to three groups of students according to their learning styles. The authors used the model FSLSM leaving the sensing/intuitive dimension out. It is interesting that for this purpose only default functions of LMS Moodle were used.

Magdin & Turčáni (2015) modified the module book in LMS Moodle that provides advanced adaptive behavior of the original module and called it AdaptiveBook. The authors used the questionnaire ILS (Index of Learning Styles) to assign the appropriate learning style to every student.

Karagiannis & Satratzemi (2016) decided to create a hybrid dynamic user model based both on learner knowledge and behavior. They are using the static modeling, in which the learner must answer ILS and declare his/her objectives at the beginning of the course. Regarding dynamic modeling, data comprising the number of visits to each type of learning object and the duration of these visits, are used as input in a decision tree algorithm. Besides mining behavior data, dynamic modeling implies knowledge progress calculation.

Zounek, Juhaňák, Staudková, & Poláček (2016) implement education through LMS Moodle based on constructivist principles, project and group teaching methods. In the concrete, students are becoming the e-course makers themselves, and together with the teacher, they form one work team. Teachers are in the role of tutors or coaches of individual teams and provide students with feedback on their work.

Bradáč, Šimík, Kotyrba, & Volná (2017) identified the properties they considered to be key in personalizing VLE using the data they obtained. Based on the results of the questionnaire, which was attended by students of Applied Informatics, they developed a specific proposal of a personalized e-course in LMS Moodle. They decided to personalize the e-course's difficulty based on student's previous knowledge. For this purpose, they used a test activity that was based on the gradual complexity of questions where students could reach different levels of knowledge (beginner, intermediate and advanced). Further, the authors recommend continuous testing of students during the whole semester and, in case of deviations of the results, their transfer between the groups. They are of the opinion that it should be provided with different forms of study material to students, but there is no need to identify their learning styles. They leave students free to choose different forms of study materials.

3 METHODS

To determine the advantages and disadvantages of LMS used, the most appropriate method is to analyze its properties. For this purpose, we decided to use a strategic SWOT analysis to present these findings as strengths and weaknesses as well as external factors affecting the system in terms of possibilities and threats (Bakhouyi, Dehbi, Talea, & Batouta, 2016).

3.1 SWOT analysis of LMS Moodle

In the internal analysis, we consider the strengths and weaknesses of LMS Moodle in terms of implementation in the university environment, namely at The Department of Informatics (DI) UKF in Nitra. In the external environment, we identify opportunities and threats in all major areas of the organization (Grasseová, Dubec, & Řehák, 2012). The university environment and all elements that affect it will be considered the external factor which influences a successful implementation.

Based on the results of the SWOT analysis, our goal will be to eliminate the negative factors associated with the use of LMS Moodle, respectively, to reassess the suitability of its use at the DI. After the initial analysis, however, we did not find a more serious reason to persuade us to think about changing the LMS used. This SWOT analysis, as a sketch of the initial findings, is presented in the article *Analysis and Implementation of Adaptive Course in Moodle* (Mudrák, 2017). Its updated version, for the sake of clarity, is also shown in Figure 1.

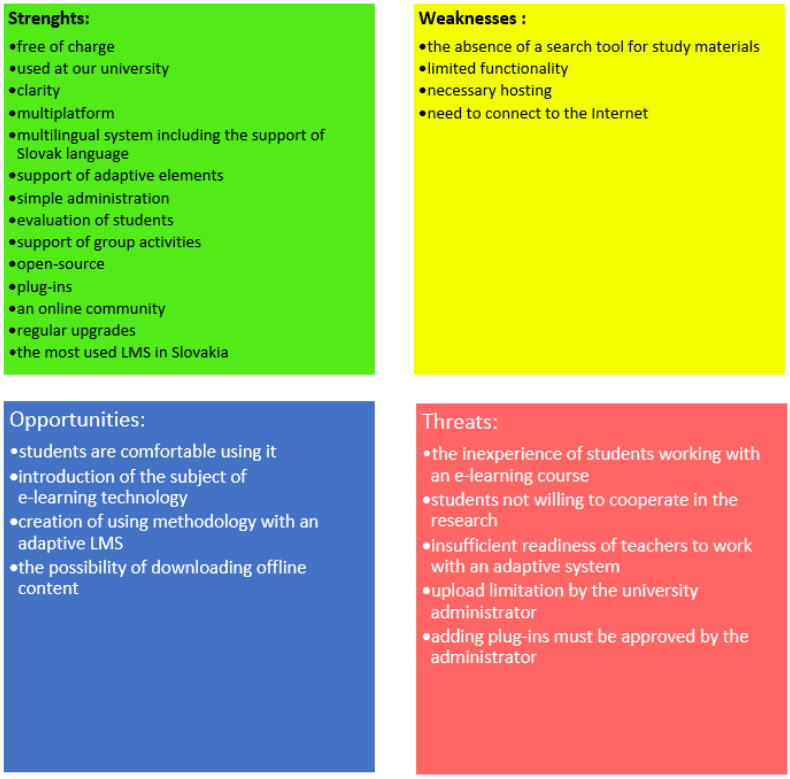

Figure 1 SWOT analysis of LMS Moodle in university environment

Apart from the fact that LMS Moodle is free, its use brings with it many other benefits. The most important criterion for us was the support of adaptive elements for personalizing the subject matter, which the system meets either by its predefined features or plug-ins that are available at https://moodle.org/plugins/. Since we are dealing with an open source platform, we can create new functionalities and implement them directly into the system under open license, specifically the GNU GPL. One of the weaknesses is considered the absence of a search engine, which would allow students to get a faster orientation in the study materials. The need to connect to the Internet is considered as a weakness because of that it may be to a certain extent restrictive, whether for course designers or students. However, students have the option of downloading some educational content and studying in offline form. The last weakness found is the need to establish hosting for the use of the system, which requires funding. However, this only applies if we want to create and manage our own LMS Moodle outside the university environment. The fact that our e-course is not created on our own server also brings with it certain limitations from the university side. These are next declared as threats. First is the rate of upload limitation, namely 128MB, which may be in some cases inadequate (especially when uploading larger projects or applications). The addition of plugins must be approved by the system administrator of the university, which may be restrictive, especially for course designers, in terms of research and innovation. The insufficient readiness of educators to deploy adaptive elements to the system is considered as the weakness too. At first, it will be necessary to confirm this claim by means of a questionnaire survey and a content analysis of the courses used at the university. In case of confirmation of the hypothesis mentioned above, the proposed methodology should also simplify this problem. University students often differ from each other by the attended secondary school. While most secondary schools in Slovakia use the form of e-learning, it is also through LMS Moodle (Tóthová, Šemeláková, & Hosťovecký, 2016). However, there are also schools that do not provide this form of education or use a different LMS. e would also like to verify this fact at the beginning of the winter semester about first-year students. The aim will be to find out whether students have experience with the use of LMS Moodle, respectively another LMS from the secondary school. If students are not working with this system, it is a possible solution in introducing a subject that will deal with using LMS Moodle, and which will teach students how to use effectively the e-learning environment as soon as they enter the university. Other

strengths and weaknesses of LMS Moodle, along with the possibilities and threats in its implementation, are presented in Figure 1.

In the present, the aim is to keep it up-to-date, especially for new findings. The next step will be to eliminate identified weaknesses through the strengths of the system and the opportunities offered by the university environment.

3.2 The methodology of e-course creation

The next step was to create an e-course structure and content based on adaptive possibilities and needs. For this purpose, modelling methods have been chosen that enabled to formalize the given problem. A visualization modelling system with the possibility of a simulation has been selected. For the indicated purposes, a modelling system with PN has emerged as the most appropriate. A specific model of student transition through the personalized e-course is presented in Mudrák (2017). To create a didactically effective e-course, it was essential to know the principles of its creation. When designing and creating a teaching with the support of e-learning, it was important to choose tools that would have actual didactic effect. The basic requirement was that the students would become active and creative working beings instead of receiving information in a passive way (Čapek, 2015). For the creator of the e-course, the educational objective should be determinative.

The design, the creation or the construction of teaching is called instructional design (ID). According to Zounek, Juhaňák, Staudková, & Poláček (2016) ID includes:

- tools (ID process, theories and models, digital technology, etc.)
- participants (of teaching, management, ID team, etc.),
- environment (school, LMS, etc.).

ID model represents a systematic arrangement of teaching that had an objective to support the processes of teaching. ID should be based on theories and principles of learning and it should describe each phase of teaching operations.

When creating an e-course with the use of any model, it was necessary to take into account the didactic principles that were laid down for the teaching process in accordance to educational objectives and the content. A precise formulation of educational objectives of the e-course simplified the choice of study content, didactic methods and improves the organization of teaching. When creating an e-course, two approaches arose regarding the course's organization, e.g. teacher-directed learning or learner-oriented learning. Zounek, Juhaňák, Staudková, & Poláček (2016) introduced a suggestion of particular phases of e-course creation from both views while they gave specific examples of system and tool use. In their publication, they dealt with:

- defining objectives,
- e-course scheduling,
- teaching and learning processes,
- evaluation of achieved results.

Mudrák, Turčáni, & Burianová (2018) describe the principles, requirements, and teaching strategies for creating a personalized e-course. They claim that an appropriately created course has set the objectives in advance even before the creative process. The objectives and the tasks should cover the content of the course and should be relevant to the study program. The objectives were formulated briefly and clearly pointing out the process of evaluation. It was important that the students knew about the objectives, and they have been provided. LMS Moodle provided a wide range of tools for the purpose, such as Wiki, Forum,

the option of mass information via e-mail, or a separate tool to define the goals of the e-course that can be find in Administration – Grade administration – Outcomes.

The time management of the course was convenient to design on the bases of the stated objectives. Among other things, entry knowledge, the size of the group, the difficulty, the character of the subject or content, methods would have been projected and implied into the timetable. The content would have given a precise picture about the course arrangement. The organization of the course, its graphic arrangement and structure would have been invariable during the whole course. For the purpose of the time management of the course, LMS Moodle provided pre-set functions *Calendar*, *Upcoming events*, *Completion tracking*, and also *Access restriction*.

LMS systems offered multiple options of student evaluation whether in a formative or summative way. LMS Moodle itself provided ways of evaluating students via activities such as *Quiz*, *Assignment*, *Workshop*, etc.

The e-course evaluation required knowing each participant's opinion about the way the teaching course worked. That is the reason why the e-course needed the option of teacher assessment or more precisely the teaching process and the e-course itself by students. Tools such as *Feedback*, *Survey* and *Forum* could be used in LMS Moodle for this purpose. *Feedback* could serve as a self-reflection of the teacher, it could lead to correction of the e-course or the teaching process itself (Mudrák, Turčáni, & Burianová, 2018).

3.3 Research methodology

The decision was made for a survey that was used as the education personalization tool. It has been applied in subjects Logic Systems (LS) and Computer Architecture (CA). When creating the tool, the following procedure took place:

- setting the objectives,
- the choice of research file,
- the specification of variables,
- the construction of the content part of the survey,
- data collection,
- computer data processing,
- data reading,
- results and conclusion of the survey.

The goal of the designed survey was to gain specific information about each student. The research sample included students of the first and second year studying at the Department of Informatics at CPU in Nitra taking the subjects Applied Informatics (AI) and Teacher Training of Academic Subjects (TTAS) with a combination of informatics. To create a survey, tools provided by LMS Moodle were used.

The subjects LS and AP took place every week in a form of a lecture and seminars. One experimental group and one control group have been created. The students in the control group had unlimited access to all materials during the whole semester, and they also studied in the original e-course. The students in experimental group studied in the proposed methodology and modification of the original e-course.

On the introduction lesson, the students were given a survey and a pre-test. The objective of the second one was to find out the students learning styles. For this purpose, the survey ILS has been used. According to the results of the ILS, the individual students were recommended to study materials and activities that most

correlated with their learning style. The goal of the pre-test was to find out information about new students highlighting their entry knowledge. For this, *Quiz* activity has been used the LMS Moodle environment.

The hypothesis No. 1 (H1) was set: *"There is no statistically significant difference in entry knowledge between the control and experimental group of students."*

Furthermore, it was an assumption that post-test results depend on the type of course used. Specific hypothesis No. 2 (H2) was set: *"The created personalized e-course has a more prominent effect on student learning efficiency as classic (non-personalized) e-courses."*

Confirmation of the H2 would mean that, in case of better results of the experimental groups in the post-test, which will verify the acquired knowledge of the students at the end of the e-course, compared to the control group, were the results of the application of the proposed e-course.

In order to be able to create an as efficient e-course as possible, it was needed to identify the flaws of the hitherto used e-course in the subject LS. A sample of students was provided. The students of the control group studied the standard way, e.g. that they had the unlimited and voluntary access to all materials and activities. In the experimental group of students few options were used such as conditional access, activity performance, feedback via Lesson and Quizzes to control the teaching with LMS Moodle. Both groups studied in a form of a blended learning. Students of the experimental group were provided with a survey created in LMS Moodle. The goal of the survey was to obtain an overview and basic information about the students that participated in the e-course. The results were exported into a spreadsheet of Microsoft Excel where the results were processed.

As the second survey, the students filled in the Felder-Soloman ILS survey. The results were interpreted in the course and were processed in a form of chart and diagram as well. There were efforts to find other standardized survey that would suit the need of the research, however it was unsuccessful.

The next subject of interest was to observe the study results of students in the e-course and to find out the differences between the control and the experimental group.

The results of the students were also compared based on the type of attended secondary school. There was set the hypothesis No. 3 (H3): *"Attended secondary school has an impact on entry knowledge of Applied Informatics (AI) students."*

4 RESULTS

The pilot experiment has been divided into three phases. In the first one, surveys have been used as diagnostic tools. In the second phase, a pre-test in a paper form has been applied in the control and the experimental group where the content included some key questions regarding the subject LS. The observation of student activity in the e-course was a part of the second phase, and system tools of LMS Moodle were used. The third phase represented the end of the subject with an exam which was considered to be the post-test.

From the processed data, it has found that some students tended to "cheat" in such a way that in the first attempt the *Test* was only "guessed" to find the right answers through the feedback. In the second attempt, these responses were already written off, because the questions were repeated in the test and only their order was changed.

Part of the Test's evaluation was also a feedback that referred students to a particular location in the e-course or website, in the case of an incorrect answer. Student attitudes towards this kind of feedback compared to the classical (correct/incorrect or revealing the correct answer) were identified by the interview method, and it was received positive feedback.

These findings confirm that it is necessary to change the e-course test methodology in the following way:

- not to give correct answers in the feedback, but motivate the student to look for them by referring to the study material, which contains the given knowledge,
- to create the query database from which questions will be randomly generated for each Test activity,
- to create sufficiently reliable questions (open answers, multiple choice, sufficient count of answers, etc.)
- limited number of attempts, or time constraints.

Another subject of interest was the comparison of the groups in terms of activity and attended secondary school. In the first case, it was found that students who were more conscientious with the course activities achieved better results both in the pre-test and in post-test. Specifically, the Test activity was used to help students to verify and fix their knowledge. This comparison can be seen in Table 1. Of course, these results could have been affected by many other factors, but we are still convinced that student e-course activity affects his / her achievements.

Table 1 Comparison of student results in relation to activity

Activity	Average pre-test results:	Average post-test results:	overall average
Below average	3,250	2,058	2,513
Above average	2,600	1,661	2,123

The total activity of the students was also observed during the whole semester. It is presented in Figure 2. The observation of the activities and conditional activities were used in the first month of teaching in the semester. During this period, at least a double of activities was observed compared to the period after the credit week where the conditional activities have not been used. Another finding was that the majority of students started to show more activities in the e-course immediately before the important events such as credits and exams.

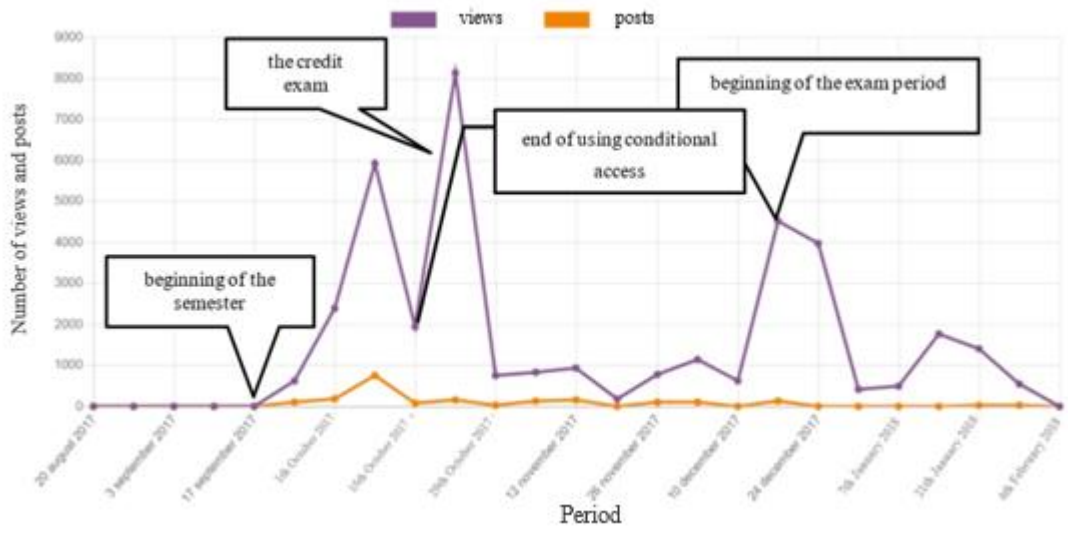

Figure 2 The total activity of students in the course during the Winter Semester

The average values of both groups (control and experimental) are processed in Table 2. Students in the control group in both cases reached a worse average by 0.2 compared to the experimental group. However, it should be noted that the experimental group consisted of a larger number of students.

Table 2 Average results from pre-test and post-test experimental and control group

AVG pre-test		AVG post-test	
control	**experimental**	**control**	**experimental**
3,0	2,8	2,0	1,8

In the next case, the hypothesis H3 was confirmed. Students graduating from secondary schools of electrotechnical engineering had better results from the pre-test compared to students from other secondary schools. Surprisingly, they showed worse results at post-tests (Table 3). Comparison of results is also shown in Figure 3 and Figure 4.

Table 3 Average results from pre-test and post-test experimental and control group

Comparison of student results in relation to completed school		
School	Pre-test	Post-test
SOŠ Electrotechnical engineering	2,300	1,767
Other schools	2,717	1,630

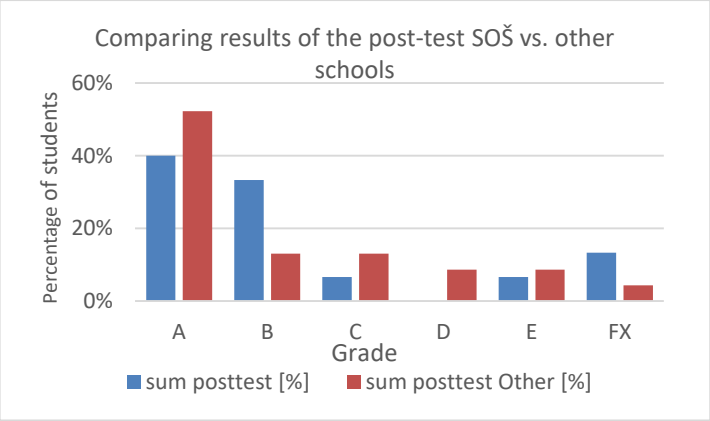

Figure 3 Comparing students results in the post-test from SOŠ vs. other schools

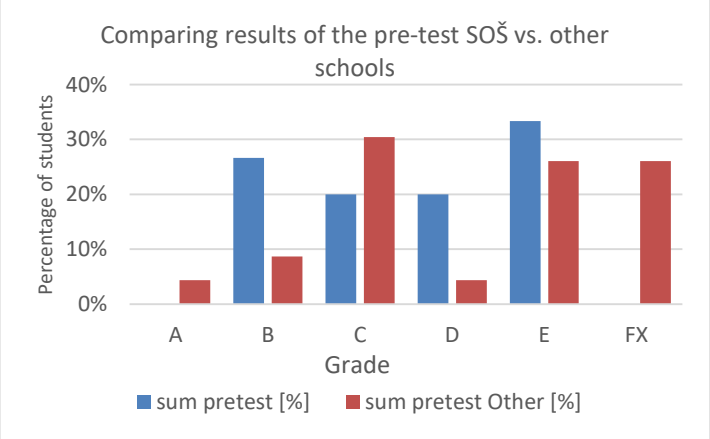

Figure 4 Comparing students results in the pre-test from SOŠ vs. other schools

Finally, the overall success of students in the post-test from both experimental and control group has been compared to a group of students studying the subject until 2015. The results of these students were obtained from the Academic Information System (AIS). Content and methodology of the subject haven't changed

during last years. The sample of students from AIS included the study results of 919 students and we considered it equivalent to the control sample. Specifically, the grade percentage of each group has been compared. The experimental group alone had a decreasing trend towards worse evaluation. The control group and the sample data from AIS had a slight correlation among the results. The results are shown in Table 4 and Figure 5 for better clearness.

Table 4 Comparison of experimental, control and AIS group results

Students success rate by 2015 in percentage (AIS)					
A	B	C	D	E	FX
23,39%	11,64%	17,19%	15,67%	22,31%	9,79%
Students success rate of the experimental group in percentage					
A	B	C	D	E	FX
40,91%	18,18%	13,64%	9,09%	9,09%	9,09%
Students success rate of the control group in percentage					
A	B	C	D	E	FX
21,05%	5,26%	42,11%	0,00%	31,58%	0,00%

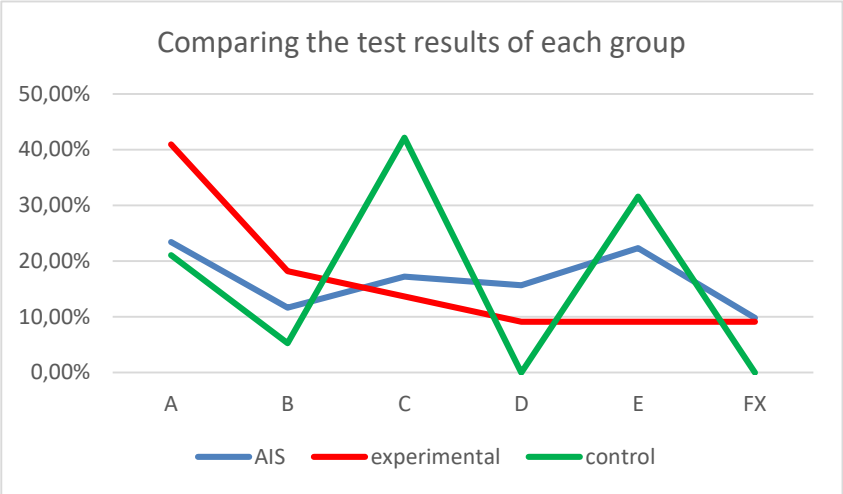

Figure 5 Comparing the test results of each group

The findings might represent that the quality of the achieved results students from the subject LS studying in this type of e-course might be on a right track.

CONCLUSION

Although the issue has been solved at an international level for a long time, in practice we are constantly confronted with insufficient personalization of education for students with characteristic features. On this basis, it is necessary to analyze more closely the status of the student, the level of his / her knowledge on the subject, as well as the individual parts of the educational process. For this purpose, e-courses were selected for KI UKF, which were subjected to a thorough analysis to identify their shortcomings. Using some parts of the proposed methodology, it was able to compare the impact of individual activities on the learning and outcomes of the students from the subjects.

Regarding the impact of used methodology on students, it was reflected in a student's activity during the semester. This fact also affected the results of students from the subject. Among other things, the assumptions about the diversity of students were confirmed, specifically their initial knowledge, which is more strongly influenced by the secondary school.

In the future, the aim will be to replace all identified e-course shortcomings with more effective methodical concepts. It has been described some of them in this article. The focus will be on using Moodle's adaptive

capabilities and using the appropriate e-course structure using personalization capabilities. Applying of the proposed methodology is being expected not only the increased effectiveness of the educational process but also achieving better results in terms of knowledge.

The presented and described issue deal with individual activities accompanying the students in the given subjects and is part of a research project within the UGA grant agency. The results of the project will be published as scientific articles at international conferences and journals registered in the SCOPUS and WoS databases in the following period. The proposed e-course will be fully implemented in the school year 2018/2019 at the beginning of the winter semester. The obtained data from questionnaires, pretests, post-tests will be processed and evaluated to improve education in the given field.

ACKNOWLEDGEMENTS

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SUSTAINABILITY OF U-CALL

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ABSTRACT

This paper shows that the flexibility of time as a potential of Computer Assisted Language Learning (CALL) proves the sustainability of its latest stage – Ubiquitous CALL. Firstly, the ideas of the Third Millennium Pedagogy are combined with the ethical and philosophical principles of sustainable education. One of the descriptors of the sustainable education – its durability is then compared with the principle of time flexibility in e-learning. On this theoretical base, the ideas of Ubiquitous Learning in general and Ubiquitous CALL (U-CALL) in particular are developed. Two comparable cases of the research aimed at the time flexibility of e-learning in foreign language education are described. The former one was conducted in 2016, the later in 2008. Similar results in time flexibility prove that e-learning in language education can be omnipresent, fulfilling the demands on Ubiquitous CALL. The durability of time flexibility proven by the real-life examples indicates the sustainability of U-CALL.

KEYWORDS

Time flexibility, Third Millennium Pedagogy, Sustainable education, Durability, Ubiquitous CALL.

.1 INTRODUCTION

Foreign language pedagogy has always been an important part of education. In our modern globalized world, learning foreign languages is becoming more and more important not only for work, but also in private lives of all people, the fact which shows the necessity of making learning available for anybody, anytime and anywhere. This goal can be reached with the help of technologies. Computer Assisted Language Learning is entering its new stage fulfilling the needs of learners by being as omnipresent as its technological tools.

The ideas of the Third Millennium Pedagogy combined with the principles of sustainability of education show us the road to the world where learning will be a part of everyday life of all people. With the examples of using e-learning and/or blended learning environment, this paper proves sustainability of Computer Assisted Language Learning (CALL) in its latest stage – Ubiquitous CALL.

2 SUSTAINABILITY OF EDUCATION

The sustainability of education should be the main goal of educators within the framework of the so-called New Millennium Pedagogy. As stated by Sterling (2008), it is necessary to find an alternative to the educational practice of the past:

...we need an educational culture and practice adequate and appropriate to the volatile, densely interconnected, and dangerously vulnerable world that we have created. Instead of educational thinking and practice that tacitly assumes that the future is some kind of linear extension of the past, we need what I call an anticipative education, recognising the new conditions and discontinuities which face present generations, let alone future ones... (p. 64).

Sterling as the "father" of the term "sustainable education" (which is used by him to distinguish "education **for** sustainable development" from "sustainability **of** education") develops the idea of "changing the educational culture" (Sterling, 2001) on the basis of the ideas of those educators who were aware of the fact that the Third Millennium will need a change in educational paradigm.

Townsend, Clarke, & Ainscow (1999) predicted the change in thinking about the schools in the Third Millennium. Their ideas compared Second Millennium Schools and Third Millennium Schools. According to them, the education in the Third Millennium will be (among other characteristics):

- offered by different sources in time-unlimited interval;
- accessible on the basis of abilities and interests of students;
- controlled by the learner.

Sterling (2008) characterizes sustainable education by its four descriptors (p. 65):

> *Sustaining: it helps sustain people, communities and ecosystems;*
> *Tenable: it is ethically defensible, working with integrity, justice, respect and inclusiveness;*
> *Healthy: it is itself a viable system, embodying and nurturing healthy relationships and emergence at different system levels;*
> *Durable: it works well enough in practice to be able to keep doing it.*

The application of Sterling's ethical and philosophical principles in the theory of the Third Millennium Schools offered by Townsend, Clarke, & Ainscow leads us to the contemplations on e-learning, which, if properly used, may be a sustainable contribution to educational attainments.

Sterling's principles in the theory of the Third Millennium Schools

The application of Sterling's ethical and philosophical principles in the theory of the Third Millennium Schools offered by Townsend, Clarke, & Ainscow leads us to the contemplations on e-learning, which, if properly used, may be a sustainable contribution to educational attainments.

Basic principles of e-learning were described by Khan (2006). Khan considers e-learning to be "...an innovative approach for delivering well-designed, learner-centered, interactive and facilitated learning environment to anyone, anyplace, anytime by utilizing the attributes and resources of various digital technologies [...] suited for open, flexible and distributed learning environment." (p. 3). The learning environment offered by e-learning can be also described as a sustainable one, when viewed from the perspectives of the above-mentioned principles.

Stepanyan, Littlejon & Margaryan (2013) propose the term "sustainability" as a "useful umbrella concept because it helps bring together diverse terminology and various strategies addressing a range of interrelated issues in the area of e-learning." (p. 91). In the results of their scoping review, they state that in the concept of sustainability "[r]egardless of the variations of the definitions of the term, there appears to be a common foundation: a property of the continuity over time." (p.94). Time and space flexibility is one of the most important benefits of e-learning students can profit from (*cf.* Frankl & Bitter, 2012).

The space in which e-learning is happening is as flexible as its time framework – students can access their e-learning environment from any place with an internet connection, by any device (a notebook, a mobile phone, a tablet). According to Howard (2015), learning in the "afterschool spaces" is more challenging and entertaining than learning in formal school setting. The term "afterschool spaces" was introduced by Prensky (2012), who claimed that the afterschool world is for the young people more attractive than the traditional school environment. We do not have to agree with this idea without any doubts. In fact, both spaces should be equal, since learning at school should be as attractive as its informal equivalent.

This interpretation of sustainability in e-learning provides us with a solid base for further development of these ideas towards the concept of Ubiquitous Learning (U-learning).

3 UBIQUITOUS LEARNING (U-LEARNING)

The term U-learning was introduced by Wheeler (2009), who applied the idea of ubiquitous computing (pervasive computing) in the educational environment:

U-learning will rely heavily on access to devices and tools that enable and support learning in any context, whether mobile or static, anywhere 24/7, and in a manner that is seamless and unobtrusive. It will also need to be 'intelligent' according to the strictest interpretation of the ubiquitous model, so that it can predict changing contexts and user needs as they occur. The key tools of U-learning will be mobile phones, laptops and other portable wireless devices."(Wheeler, 2009, para 2).

Veselá (2012) connected these ideas with Computer Assisted Language Learning, and consequently introduced a new stage of CALL – Ubiquitous CALL (U-CALL). Its basic features are briefly described in the Table 1.

Table 1 Ubiquitous CALL

Technology	*PC's, mobile devices, Internet, multimedia, social media*
Role and use of computers	*Integral part of learning*
	Authentic and purposeful multimedial communication
	Networked collaboration
Applied linguistics	*Constructivism and connectivism*
Role of learners	*Autonomous part of global network*
Role of teachers	*Challenger, motivator, navigator*
Learning objectives	*Accuracy, fluency, agency and co-efficiency*

Adapted from Veselá, 2012

Since this paper is focused on just one characteristic of U-CALL – its omnipresence, which is closely connected with the durability of sustainable education, the description of the first two lines of the Table 1 follows.

As a rule, technological innovations enter the field of education relatively shortly after their production. It is believed (Norman, n.d.) that one of the first books printed by Guttenberg in Minz (the exact date is unknown) was *Ars Minor*, a schoolbook on Latin Grammar written by Aelius Donatus. The first public film screening using the Lumière brothers' 'cinematograph' in 1895 was followed by the first educational film 10 years later (Educational Films, n.d.). Other technological developments that entered the field of education include the television, the tape recorder, and so on. In 1953, IBM introduced the first mass produced computer (the IBM 701) to the public, and in the 1960's the history of Computer Assisted Instruction (CAI) began (Computer Help, 2012). Moreover, the same tendency can be traced even nowadays. As soon as the cellular phone became part of everyday life – M-learning (mobile learning) was introduced by technology-friendly teachers. Palmtops, iPods, e-book readers – all these innovations are already used in education and many more will follow. In U-learning all kinds of mobile and/or stationary devices with Internet connection can be used for teaching/learning purposes.

With the massive influx of social networks in our lives, the exploitation of their potential in education rises. According to the Centre for Learning & Performance Technologies (2015), which has been publishing the list of top 100 tools for learning for the last nine years, the 2015 Top Tools are (for the purposes of this paper the first twenty entries are selected):

Twitter	PowerPoint	Skype
YouTube	Dropbox	Evernote
Google Search	Facebook	Prezi
Google Docs/Drive	WordPress	Wikipedia

Pinterest	iPad and Apps	PowToon
LinkedIn	Kahoot	Slideshare
Moodle	Blogger	

When compared with the list from the year 2007, a fast move upwards of the social networks is clear. The first ten in the year 2007 were (Hart, 2007):

Firefox	Gmail
delicio.us	Google Reader
Skype	Blogger
Google Search	Word
PowerPoint	
Wordpress	

All of the above-mentioned technologies can be (and are) used in CALL.

Hanson (n.d.) envisions the future of computers, which will make technologies even more omnipresent than it is now. He predicts computer potential equivalent to the human brain, with a global network, self-editing software, instant data transfer, laptops built in desks, computers that never crash, holographic touch screen computers, computers that can turn into the size of a small sticky note, virtual reality, Internet-connection implant, holographic messages, and many other technologies connected with Artificial Intelligence, Robotics, Electronics, and Science on one hand, but also with Home and Society on the other. We are convinced that the technologies he predicts to appear in the near future will be usable in language pedagogy within the frame of learning which will be sustainably omnipresent. Together with new technologies, new challenges for teachers and learners arise. The main question is not whether we should or should not use technologies in education, but whether we, teachers and our learners alike, are prepared for using them despite the fact that today we can hardly imagine what in the not too distant future can be taken for granted.

4 CASE STUDY RESEARCH

Time and space flexibility of U-CALL, as the recent stage of CALL, is strongly supported by 'ubiquitous technologies'. This feature can be illustrated by the research conducted by Puschenreiterová (2016), who in her dissertation analysed the data provided by the LMS Moodle as a part of her case study research.

The course of English Lexicology, taught during the winter term of the academic year 2015/2016 at the Department of Language Pedagogy and Intercultural Studies (the Faculty of Education, University of Constantine the Philosopher, Nitra, the Slovak Republic) to the English language teacher trainees, was taught in blended learning environment. The lectures were read face-to-face, and the seminars were provided in the form of a blended course in the LMS Moodle. All the lectures in the form of PowerPoint presentations, texts with additional information, Internet resources, interesting web pages and quizzes, and, finally yet importantly, course assignments were available in the Moodle course without any restriction. The only time constrictions were the deadlines of the assignments.

The students regularly attended scheduled seminars; however, they were free to complete their assignments online any time up to the deadline just before the next week seminar. Twenty-nine students were participating in the case study. The researcher analysed the data from the LMS Moodle and concluded that the course materials were accessed "any time on any day of any week" (Puschenreiterová, 2016, p. 110), which proves the time flexibility of e-learning.

In the Figure 1, the hits of all 29 students during the whole term (the winter term 2015) are shown. Tuesday is divided into three parts respectively according to the time of the seminars and the assignment deadline. The students used the online course mostly during the seminars (Tuesday 02:00 – 06:00); Monday and Tuesday up to 02:00 pm follow, clearly due to the assignment deadline. As it can be clearly seen from the Graph in question, no day during the whole week, including Sunday and holidays, is without any hit.

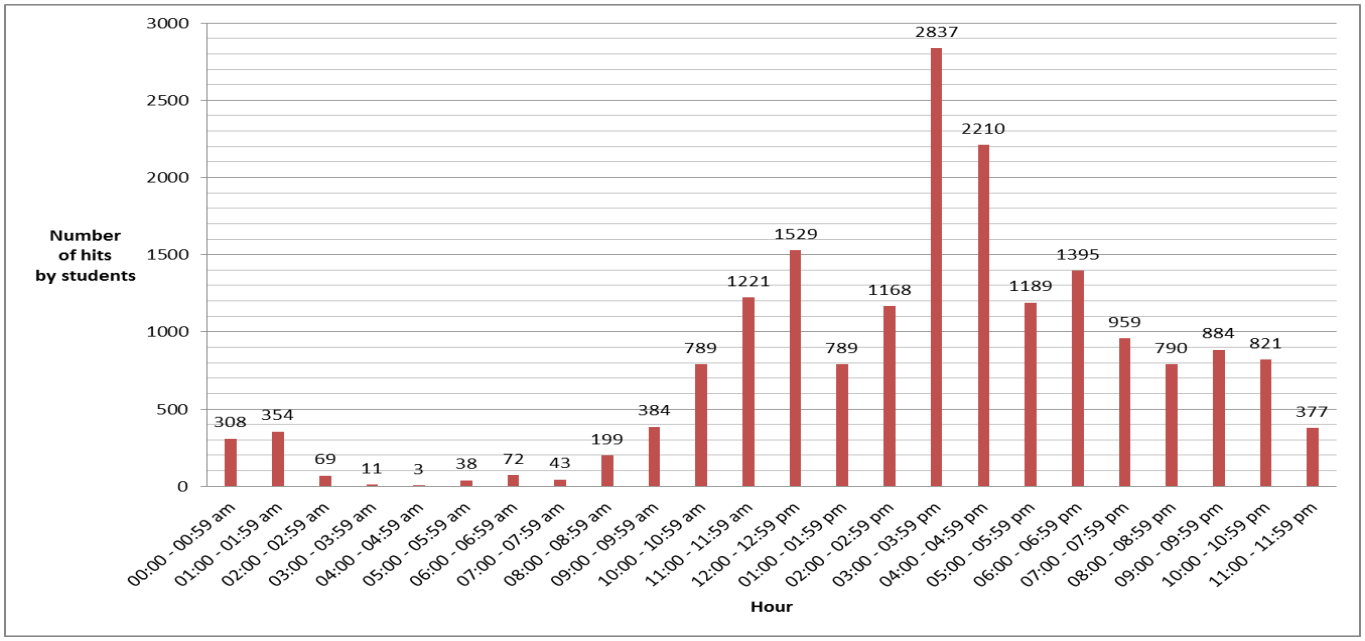

Figure 1 Number of hits – days of week Source: Puschenreiterová 2016, p. 110

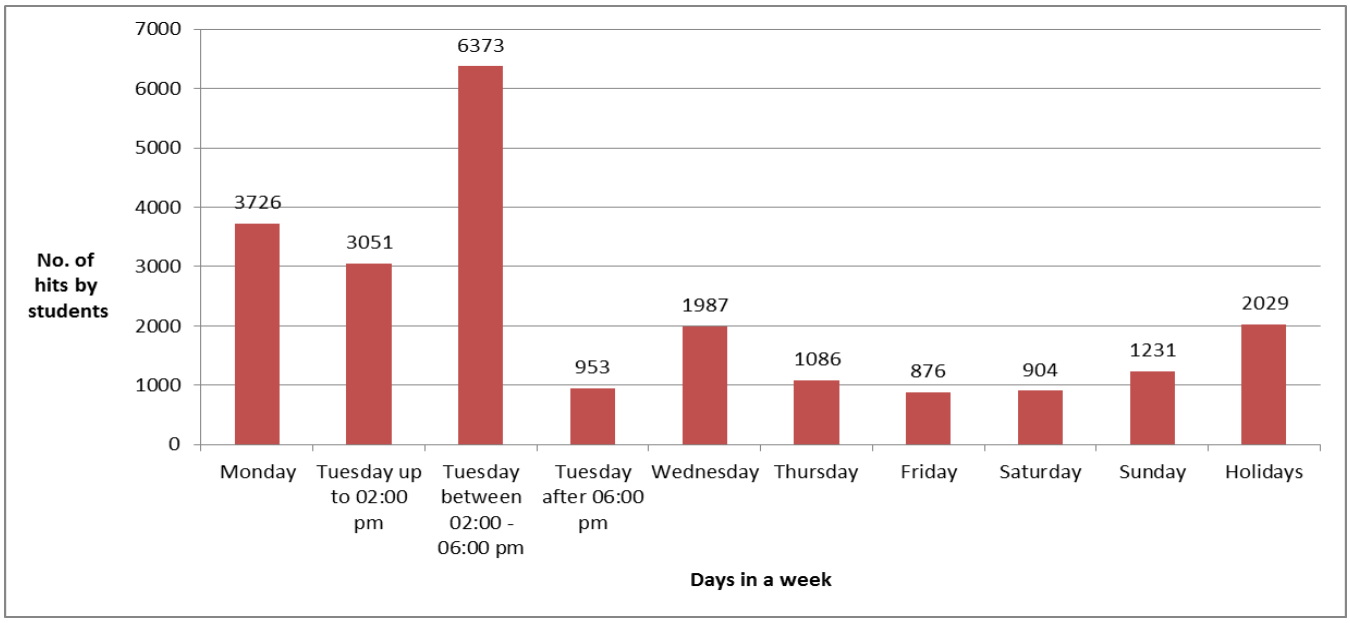

Figure 2 Number of hits / hours over the semester Source: Puschenreiterová 2016, p. 111

Puschenreiterová's (2016) analysis of the time flexibility continues with the analysis of the hits within 24 hours. Again, the hits for the duration of all the semester were included in the analysis. From the Graph 2 it can be deduced that besides the hours of the seminars and shortly before the assignment deadlines, all hours were utilised for assignment completion purposes. There are hits recorded even in the early morning and night hours.

The results of this part of the Puschenreiterová's case study show that the time flexibility of e-learning was definitely one of the potentials fully exploited by the students. There was no time of a day and no day of a semester which would not be used for the online studies.

Similar results were reported by the study conducted nine years before Puschenreiterová. Despite the fact that the conditions were not absolutely the same, it can be stated that the flexibility of time in e-learning is its durable characteristic, and thus e-learning in its specific subcategory U-CALL can be considered sustainable.

Veselá (2009) also analysed the data from a Moodle course used for blended learning. Sixty-seven students of the specialisation European Development at the Faculty of European Studies and Regional Development (the Slovak University of Agriculture, Nitra) participated in her research in the academic year 2007/2008. They studied a similar subject as a part of their intensive language course – in this case it was the course Applied English Lexicology, aimed mostly at the practical part, i.e. the development of English vocabulary. The course is still available at <http://eldum.phil.muni.cz/course/view.php?id=15>, which is the project of the Masaryk University in Brno, the Czech Republic. (Note: Since the course is archived and not updated and maintained regularly, it can be considered as outdated.)

Veselá's (*ibid*.) results are similar to those of Puschenreiterová's (2016). The Figure 3 shows the number of hits per days of the week. Similarly, the number of hits is the highest during the seminars (in this case Mondays, Tuesdays, and Wednesdays) and also correspondingly no one day is left without any hit. The high number of hits during Sundays proves that students used the flexibility of time provided by the e-learning course.

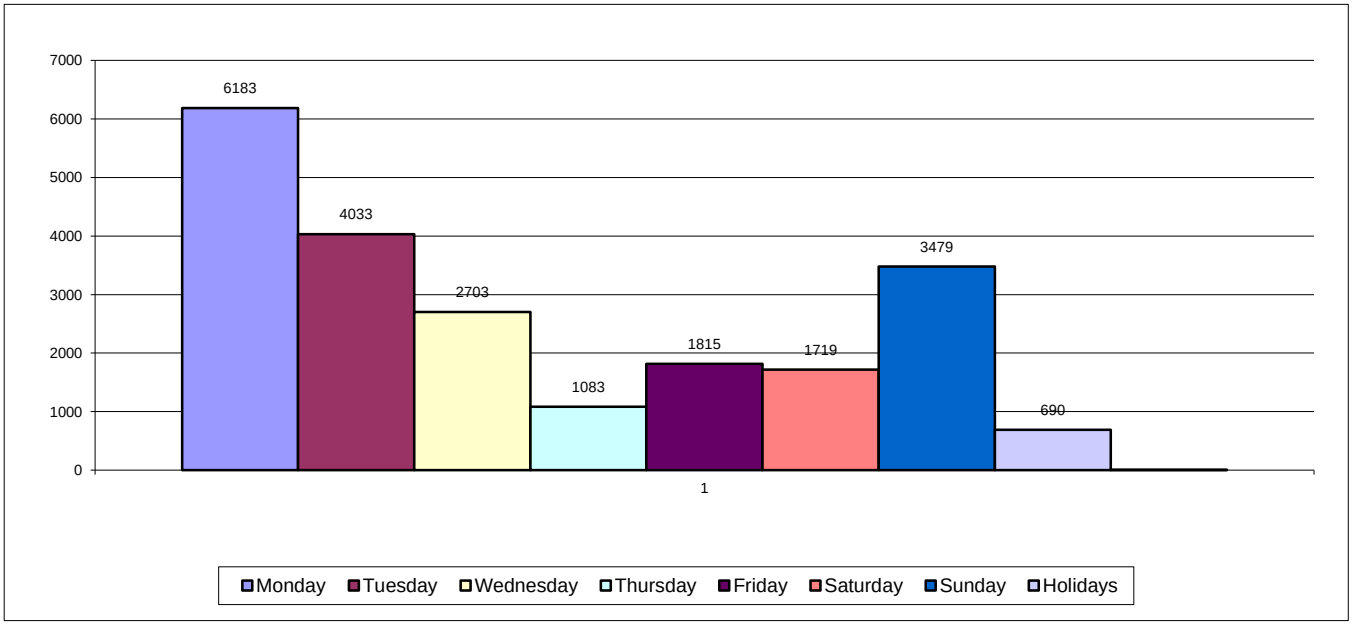

Figure 3 Number of hits – days of week 2008 Source: Veselá, 2009, p. 74

The Figure 4 shows the results of Veselá's (2009) analysis of the hits according to the hours. In this case, an average week was considered; however, for the purposes of this paper, the results can be compared to those in the Figure 2. Except for 05:00 and 06:00 am, all the hours were used by the students exploiting the time flexibility of e-learning.

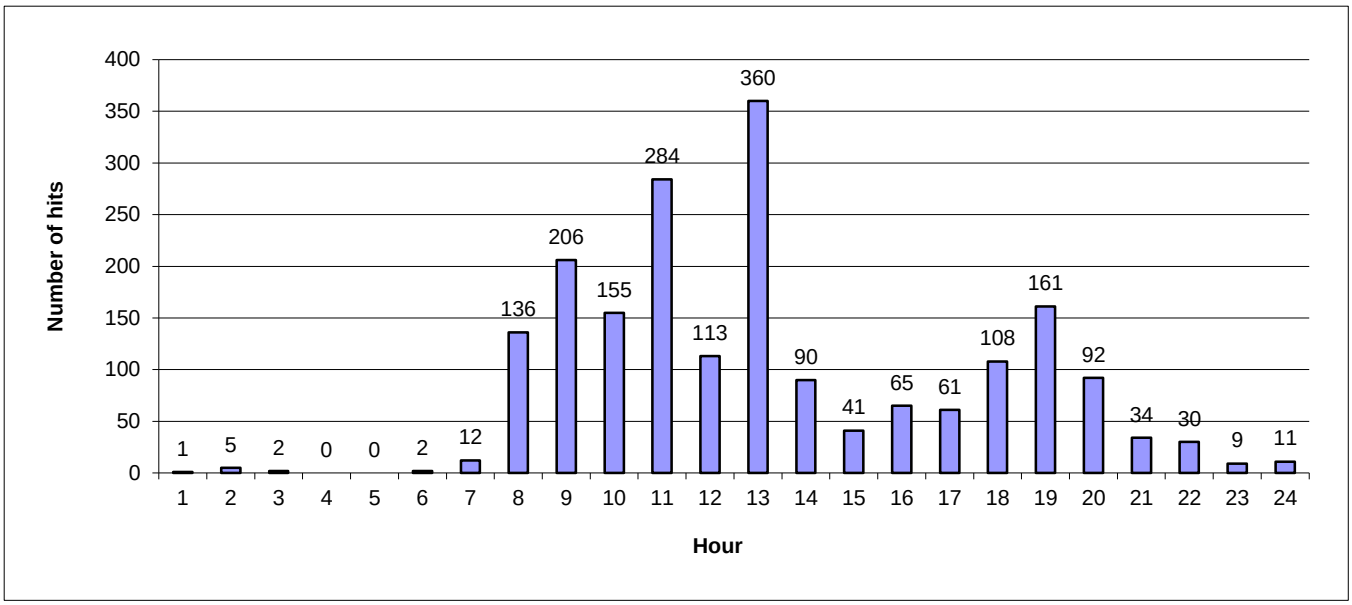

Figure 4 Number of hits – hours per an average week 2008 Source: Veselá, 2009, p. 75

CONCLUSION

Beyond a shadow of a doubt, the digital age has caused a change in the educational paradigm. As Bozkurt and Ataizi (2015) suggest, since learners' characteristics and learners' needs have unquestionably changed, so new pedagogical approaches have appeared. Sterling (2001) in his idea of "sustainable education" changing the educational culture, in which durability is one of the four major characteristics (see above). It can be reached by e-learning and its time flexibility.

Flexibility of learning has been and still is in the centre of interest mainly of those researchers whose concern is focused on students. Several studies prove that flexibility (in our paper limited to time flexibility) gives grounds for student satisfaction (e.g. Pei-Chen Sun et al., 2008, Arbaugh, 2002, Arbaugh & Duray, 2007). Kupetz and Ziegenmeyer (2006) claimed that flexible learning activities stimulate the learners' autonomy, and propose using Web 2.0 tools to meet the need of meaningful learning. We positively agree with their findings; in addition our research proves that time flexibility of learning in the U-learning environment is durable – it does not change during the course of time. Moreover, its importance grows with the development of portable technologies and availability of the Internet.

Learning enters its omnipresent phase – U-learning. The real life examples show that foreign language education can be sustainable in an e-learning environment. The stage of Computer Assisted Language Learning which is characterised by omnipresent learning with the help of modern technologies as learning tools – Ubiquitous CALL – supports the durability of sustainable education.

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IS OPEN ACCESS TO RESEARCH DATA A STRATEGIC PRIORITY OF CZECH UNIVERSITIES?

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ABSTRACT

Open access to research data is one of the key themes of current science development concepts and relevant R & D strategies at least in Europe. A systemic change in the modus operandi of science and research should lead to so-called Open Science. The presented paper questions the extent to which the Open Science concept is reflected in the strategies of Czech universities. The paper first describes basic idea of Open Access to Research Data including principles of „FAIR data" as one of the key assumption of it. After a brief characterization of the Czech university sector, the results of the empirical analysis of the inclusion of the Open Access to Research Data concept in the current strategic plans of the Czech universities are presented. The conclusion of the paper is then an evaluation of the results, which reveal an underestimation of the Open Science concept in the current strategic plans of the Czech universities.

KEYWORDS

Research data, open access, Czech universities, open science, FAIR data.

1 INTRODUCTION

The rapid development of information and communication technologies in last few decades affected all economic and social sectors and nearly all human activities. Academic sector is not an exclusion in this context. Science and research activities rely on many ways on ICT and in same time research generate lot of digital content. This digitalization brings new challenges and one of nowadays trend is open access and so called Open Science. So academic institutions looking to the future reflect this trend in their strategic plans and implement it to their publication and data operational agenda.

This paper focus on Czech university sector in this context with the question on how Czech universities reflect this trends in their strategic plans. There will be summed up basic concepts of Open Science and Open Data at first and then there will be provided characterization of Czech university sector. The core contribution of the paper is to provide results of empirical analysis of strategic plans of Czech universities resulting in a discussion of nowadays state and future outlook.

2 OPEN SCIENCE AND OPEN DATA

Science and its individual disciplines are evolving. There is also a change in the way of its operation and the source and mechanism of science funding. The number of researchers and the number of scientific journals and other publishing platforms are increasing. There is also a growing number of research institutions and university students. Technological development (which in itself is the result of scientific knowledge) offers new tools for research and dissemination and publication of results. Digital technologies offer a faster and cheaper way of presenting results than before. The society's relationship to science and

the development of science is also changing. Science and its strategic development have become part of wider political concepts.

In the last decade we can therefore meet the concept of Open Science (or earlier Science 2.0) with three main attributes (EC 2014):

1. A significant increase of scientific production, open research and remote collaboration and online (open) access to scientific information.
2. An emergence of data-intensive science by availability of large-scale datasets (petabytes) and by high performance computing.
3. An increase in the number of actors in science.

Open Science is therefore a systematic change in the modus of operandi of research activities and is affecting the research cycle and all of its stakeholders. Research process in open form is shown in the following figure.

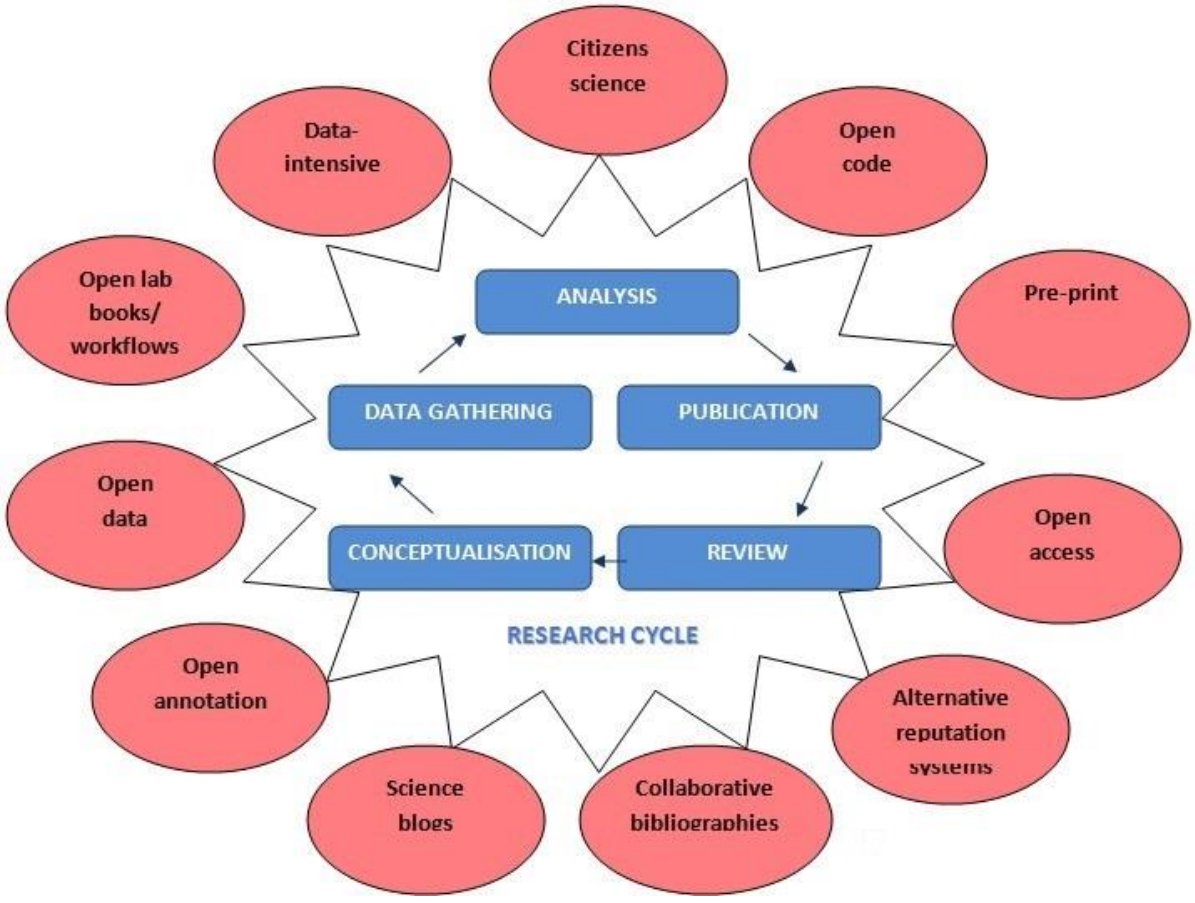

Figure 1 Open Science trends – Source (EC 2014)

Although there are many Open Science trends, open access is the most discussed and elaborate one, at least in terms of science policy within the European Union. According to (EC 2017) "*open access refers to the practice of providing online access to scientific information that is free of charge to the end-user and reusable*" and scientific information are divided to categories: peer-reviewed scientific research articles and research data. It is very important how access is defined. Access is not only "*the right to read, download and print – but also the right to copy, distribute, search, link, crawl and mine.*"

Research data in this context are data (statistics, results of experiments, measurements, observations, survey results, interview recordings and images) in digital form allowing users to freely access, mine, exploit,

reproduce and disseminate them. Open access to scientific publications and research data will according to European science policy (especially through Horizon 2020) improved quality of results, encourage collaboration, avoid duplication of effort, speed up innovation and involve citizens and society to science.

3 FAIR DATA

A much more detailed specification of research data features within the Open Data concept is the so-called FAIR Data principle. The basic document dealing with FAIR Data is the Guidelines on FAIR Data Management, which specifically addresses the recommendations for the Horizon 2020 R & D beneficiary or the participants involved in the Open Research Data Pilot, but its impact on the scientific community is wider and touches the issue of openly accessible scientific data in general. The guide does not detail the principle of FAIR data. It contains only an initial indication that it helps the beneficiaries to make their research data findable, accessible, interoperable and reusable (FAIR) and also states in the annex that the research data should comply with the FAIR principles, and refers to FORCE11 and a published article in Nature (Wilkinson 2016) for further details.

So let's look at the FAIR data concept. The principles are not only related to the data itself (in a strict definition), but also to the research procedures, algorithms and tools that lead to the production of such data. In the basic breakdown, there are 15 principles or recommendations that research data should meet:

To be Findable:

F1. (meta)data are assigned a globally unique and persistent identifier

F2. data are described with rich metadata (defined by R1 below)

F3. metadata clearly and explicitly include the identifier of the data it describes

F4. (meta)data are registered or indexed in a searchable resource

To be Accessible:

A1. (meta)data are retrievable by their identifier using a standardized communications protocol

A1.1 the protocol is open, free, and universally implementable

A1.2 the protocol allows for an authentication and authorization procedure, where necessary

A2. metadata are accessible, even when the data are no longer available

To be Interoperable:

I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.

I2. (meta)data use vocabularies that follow FAIR principles

I3. (meta)data include qualified references to other (meta)data

To be Reusable:

R1. meta(data) are richly described with a plurality of accurate and relevant attributes

R1.1. (meta)data are released with a clear and accessible data usage license

R1.2. (meta)data are associated with detailed provenance

R1.3. (meta)data meet domain-relevant community standards

These policies should not serve as a standard or specification, nor does it address the technical implementation of the data produced and stored. Their intention is to assist scientific institutions and research teams in deciding on a specific way of realizing the digital outputs of their research so that these outputs can be searched, accessed, involved in further research, and further exploited within the scientific

community (and not only). It is in fact an explanation of the scientific-methodological requirements for digital outputs of scientific work and the scientific and methodological assumption of machine evaluation and mining of research data.

3 HIGHER EDUCATION SECTOR IN THE CZECH REPUBLIC

There are 64 higher education institutions (universities and colleges) in the Czech Republic. The data are for August 2018 and concern institutions based in the Czech Republic, not the branches of foreign universities (these are 16). According to Act no. 111/1998 coll. (amended and consolidated) on Higher Education Institutions and on Amendments and Supplements to Some Other Acts (the Higher Education Act) higher education institutions may be public, private or state institutions. And the act distinguishes also two types of higher education institutions: university or a non-university type. Higher education institutions of the non-university type provide Bachelor's degree programs and may also carry out Master's degree programs as well as creative activities. Universities than may provide all types of degree programs as well as related scholarly, scientific, research, development, innovation, artistic and other creative activities.

Of the number of 64 higher education institutions, there are 35 non-university and 29 university type. Most universities are public, 2 are state and 3 private. In contrast, most non-university higher education institutions are private and only two are public. The breakdown by type and arrangement is clearly shown in the figure below.

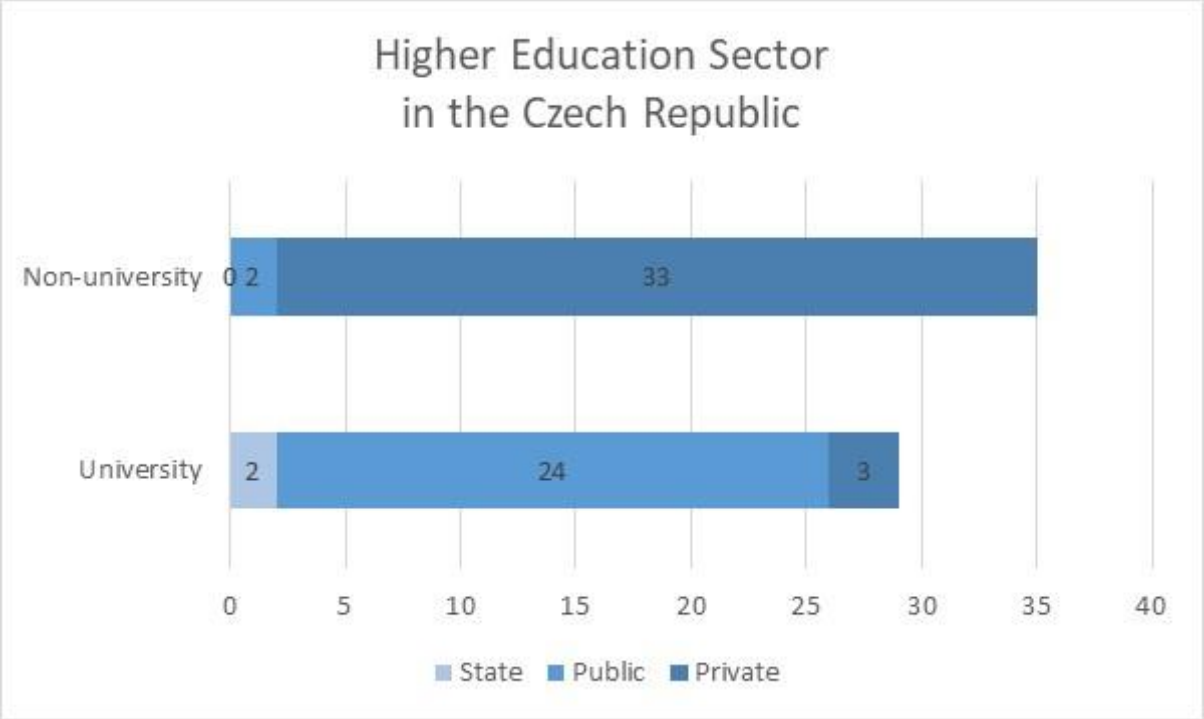

Figure 2 Higher education sector in the Czech Republic (data source: Register of Higher Education Institutions, Czech Republic)

Given that the non-university sector realizes mainly professional bachelor study programs, we will deal exclusively with the university sector in the following text. There are in our focus (open) research data and, from the point of view of higher education, universities are by law the main carriers of research and development and exclusive providers of Ph.D. study programs.

According to the Higher Education Act each higher institution prepares, discusses in its bodies and with the Ministry of Education, Youth and Sports and publicly publishes the strategic plan for the educational and creative activities of the higher education institution and the annual implementation plan of this strategic plan. The higher level of strategy document is general strategic plan for the educational and creative activities of the Ministry of Education, Youth and Sports. These strategic plans (ministries and

individual institutions) are thus key documents for the development and direction of jungle higher education institutions in the Czech Republic.

4 OPEN RESEARCH DATA AS A TOPIC OF STRATEGIC PLANS OF CZECH UNIVERSITIES

In the first part of this article, we characterized Open Science and Open Research Data. Although the cited documents are mainly related to the program Horizon 2020, their impacts are wider and clearly represent the trend in science and research operation. Before proceeding with further step, it is appropriate to make a turning point to existing analyze of the state of the art of implementation of Open Science concept in the Czech Republic.

The analytical document *Access to and Preservation of Scientific Information in Europe* (EC 2012) states that there are "*very little or no open access to research data policies in place, but some plans in place or under development*." Coordination in this area in the Czech Republic is then left to the university libraries, or their associations, according to the cited document. Association of Libraries of Czech Universities (ALCU) signed in year 2012 Berlin declaration and publish *ALCU Open Access Policy.* Subsequently, on June 14, 2017, the Czech National Strategy for Open Access to Research Information for 2017-2020 has been approved by the Government of the Czech Republic. So the Open Science principles are therefore gradually implemented at a general political level. The question therefore is, how this issue reflect Czech universities in their strategic plans.

As stated above, the strategic plan is the main and basic strategic document of Czech universities. For this purpose, the author of this paper analyzed the strategic plans of all Czech universities. Specifically, these were strategic plans for years 2016 – 2020 obligatory published by each institution. The key searched term was Open Research Data and Open Science in the individual priorities of each institution's strategic plan. The results are illustrated in the following graph.

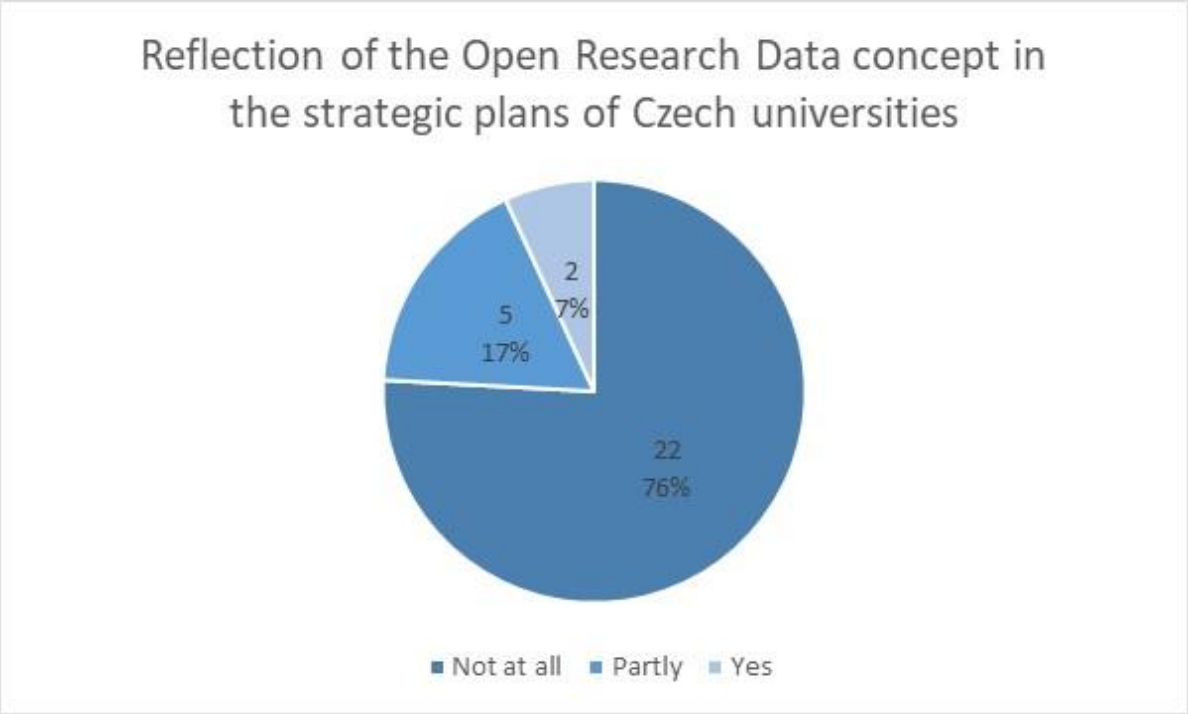

Figure 3 Reflection of the Open Research Data concept in the strategic plans of Czech universities

There is neither explicit nor implicit reflection of Open Science principles in the current strategic plans (i.e. for years 2016 – 2020) of most of the Czech universities. There are 22 universities, which make up more than three quarters of the entire university sector. Five universities partly reflect concept of Open Science in their strategic plan. Specifically, the Academy Of Performing Arts in Prague, Czech Technical University

in Prague, University of South Bohemia in České Budějovice, Palacký University Olomouc and marginally Academy of Arts, Architecture and Design in Prague. Only Masaryk University and Brno University of Technology reflects explicitly Open Data in their strategic plans. In case of strategic plan of Masaryk University there is the statement (MU 2015): "*Developing tools for the efficient storage, processing and retrieval of scientific data (i.e. open research data) as well as relevant university policies*." In case of Brno University of Technology there is than statement: "*to publish Open Data and create knowledge databases*".

It should be noted that there may be documents of lower strategic level regulating the issue of Open Research Data at individual universities. However, this is not a major cross-university priority, resulting from absence in the university's strategic plan.

CONCLUSION

The Open Science concept has been the subject of European Union science policy at least in the last decade and represents a more general trend in science development. The Czech Republic has joined this trend at the government level since 2017. At the level of the Association of Libraries of Czech Universities, this trend has at least been formally reflected in the Czech university sector since 2012. The reality of the strategic plans of the Czech universities is different. Two thirds of Czech universities do not reflect this issue in their strategic plans. Only Masaryk University and Brno University of Technology reflects explicitly Open Data in their strategic plans. It should be added that this state is not due to the fact that the concept of open data has already been satisfactorily implemented in the day-to-day research of Czech universities.

In conclusion, it can be stated that the significance of the Open Data concept is still underestimated by Czech universities. Thus, there is still considerable potential for development in this area. And it is also one of the ways of opening and improving high-school education and research of Czech universities.

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GAMIFICATION IN LMS COURSES

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ABSTRACT

This paper attempts to respond to the use of the elements of gamification in education. With the help of research papers, we have chosen three different systems in which the elements of gamification are included and we have focused on their use in education.

KEYWORDS

Gamification, ClassDojo, Edmodo and Classbadges

1 INTRODUCTION

Gamification in education is not a new topic; it has been the focus of a number of studies. The overview study "A Systematic Mapping on Gamification Applied to Education" describes the positive impact of gamification on the student's willingness to participate in the education process, their learning outcomes, learning habits and socialization skills (Borges et al., 2014). Virtual badges also improve students' motivation to complete an assignment. (Denny, 2013) This paper focuses on analyzing gamification elements in open web systems and their incorporation into a general LMS (Learning Management System). Gamification is used in many different areas, not only in education. There are loyalty programs (used not only in online shopping) designed by merchants to encourage customers to shop by offering reward points which they then can exchange for discounts on future purchases, gift certificates, etc. And even though it is the merchant who benefits from this strategy in the end, the customer feels good about having saved money. Gamification is also used in a work environment (the authors focus on pedagogical employees at school). Employers try to motivate their employees by providing various bonuses, which can be divided into three categories: behavioral (related to an individual's behavior and mental state); feedback (feedback aimed at providing measurable results and evaluation); promotional (appreciating professional growth and progress). (Neeli, 2012)

2 LEARNING PLATFORMS WITH GAMIFICATION ELEMENTS

There are open web systems which are widely used and which contain some gamification elements. When designing our own LMS, we analyzed them in order to determine how they could be used in the education process, either in instruction or during both the pre-interaction and post-interaction stages of the education process. We only analyzed social-based applications, not LMS-like systems. Following the research of scientific papers, we selected three systems: ClassDojo, Edmodo and Classbadges. However, since the last system proved unstable and unavailable during testing, we decided to exclude it.

2.1 ClassDojo

ClassDojo is a web platform which enables better classroom organization and administration. The platform is primarily used by the teacher, with the students being passive users who only follow their statistics, grades and gamification elements such as badges. The teacher can choose whether they want to register as a teacher, principal, student, parent or guest. When registered, the teacher creates a virtual classroom and adds students. When added to the classroom, students do not need to register. After students are added to the classroom, a PDF file with instructions for parents is generated, containing information about the classroom and how the students can access it. The main gamification elements of this platform are badges which students acquire for good behavior or when they complete an assignment. However, there are both positive and negative badges. The badges are similar to grades at school. However, they are not expressed by a number, but rather verbally: helps his/her peers, works hard, participates in class, did not complete an assignment, etc. The teacher can either create their badges or use badges created by other users. Moreover, the teacher can also divide students into workgroups (Desk 1, Desk 2, etc.).

Each student has their own avatar. All the activities are displayed on the taskbar where the teacher can find the classroom work sheet (the number of positive/negative badges), can see which parent is online or can record students' attendance (present, late, absent). There is also a bulletin board (which is similar to the wall on Facebook) where classroom members can post comments, pictures or videos which the others can respond to or simply "Like" them.

2.2 Edmodo

Edmodo is a web platform aimed at communication and organization of a classroom. The user can log into Edmodo as a teacher, student or parent, with each role being clearly defined. A teacher can create virtual classrooms and then invite students by sending them a link, email, text message or special code. Its design and color make Edmodo look like Facebook. As Facebook, it also has a "wall". On the wall both teachers and students can post their comments, view others' comments and respond to them (as well as like, share or forward them). Teachers can also create tasks, quizzes or surveys. They can also choose whether an activity will be for all or only some students. Students have allocated time to complete the activity. Their answers are displayed so the teacher can see them. Apart from comments, one can also add files and attachments and then sort them into folders. One can log into Edmodo with one's Microsoft and Google account, respectively, and thus can use one's Google Drive/OneDrive. This feature makes it easier for the user to manage their files. Edmodo's main gamification elements are badges, progress tracking and also tasks and projects. Murar (2015) argues that even though Edmodo was not designed as a gamification tool, its elements make it possible to use it as such.

2.3 Google Classroom

Google Classroom is a web platform free for those who have a Google account, irrespective of an operating system. This application uses Goggle Documents, Gmail and Google Calendar for educational purposes. It saves the teacher's time by limiting the time they need to spend on the organization of instruction (e.g. assigning tasks to students and communication with students), thus making the classwork much easier. Again, the teacher can create and configure a classroom and then send students a special code with which they log into it. A virtual classroom enables students to keep track of their assignments, when they are due and of their timetable. When they submit their assignment, they obtain immediate feedback as the teacher

is notified of every student's activity. The platform does not contain any specified gamification elements. However, to a certain extent, the ability to monitor one's own progress and assignment evaluation can be viewed as such. However, of the three mentioned platforms, Google Classroom contains the least gamification elements – none.

3 LMS MODEL WITH GAMIFICATION ELEMENTS

Based on an analysis of the aforementioned systems and general requirements of LMS, we designed a system with the following game mechanics:

3.1 Badge acquisition

The user can obtain badges either knowingly or unknowingly. They can knowingly collect badges for completed courses, the number of added friends, the number of reviews written or their overall activity in the system. The user can also collect them unknowingly, e.g. for registration or when they are awarded a badge by the teacher.

3.2 Score

Every user's success is measured by score. The user can use score not only to measure their own success, but also to compare themselves either with their friends or with their peers in individual courses. There are various ways to acquire points.

3.3 Course completion

Course completion should be the main activity of each student in the system. The student increases their score by enrolling in individual courses and studying. For each course the student obtains a different amount of points – the amount of points for each course is calculated by the system based on the difficulty and length of the particular course.

3.4 Completing daily challenges

The user can acquire extra points for completing bonus content or the so-called daily challenges. Daily challenges are based on randomly selected questions which the student has already encountered during the course of their study and therefore should know the correct answer. Each day, the student can complete such a challenge by correctly answering ten random questions. They can earn as many as ten points – one point for each correctly answered question. The user who has not yet answered the minimum number of questions – and therefore cannot participate in the daily challenge – is asked to earn more points, i.e. to enroll in more courses.,

3.5 Levels

The user automatically advances to the next level when they have earned enough points. The user can learn the number of points required to advance to the next level either on their profile page or on the system's main page.

3.6 Leaderboards

There are two kinds of leaderboards – global leaderboards (realized only on the main page) and leaderboards visible on the pages of individual courses following the user's registration. The global leaderboards contain all the users in the system. However, for motivational reasons, only the first ten users are displayed. This way the users do not see who is the last. Since they can only see the "Top 10", it motivates them to try harder and break into the Top 10. Another global leaderboard is called "My Neighbors", which contains all the users who are at the similar level as the currently logged-in user.

The number of points determines the position in the leaderboard. The user with more points is ranked higher in the leaderboard. The course leaderboards display the number of points earned in the particular course.

3.7 Daily challenges

Daily challenges are based on motivation – the user needs to log into the system every day and answer ten questions. Daily challenges are based on randomly selected questions (selected by an algorithm) which the student has already encountered during the course of their study and therefore should know the correct answer. If the user wants to earn the points, they need to answer (either correctly or incorrectly) all ten questions. Each question can be answered only once. If the user answers correctly, the question will be marked "Correct". If they answer incorrectly, the question will be marked "Error". Therefore, the user knows which questions they answered correctly and which incorrectly. After answering the last question, the user is redirected to a final page on which their total number of points is displayed (providing them with feedback on how they did in the daily challenge).

For each correct answer, the user earns one point. They earn no point nor lose any point when they answer incorrectly. Therefore, the user is not penalized for an incorrect answer.

The user can earn as many as ten points and as little as zero points. The user can see the number of points on the final page for the remainder of the day.

The user can complete only one daily challenge per day. It is monitored whether the user has already completed their daily challenge or not. If, on any given day, the user fails to answer the ten questions, they earn no points and can complete the daily challenge the following day.

The user who has not yet answered the minimum number of questions cannot participate in the daily challenge. Such users are then redirected to an information page where they are presented with the daily challenge requirements and are asked to earn more points, i.e. to enroll in more courses. The list of courses is displayed on the very page.

4 CONCLUSION

Following an analysis of open educational applications with gamification elements and detailed research of scientific papers, the authors designed a gamification-based LMS model. Moreover, the authors also defined a list of game mechanisms which every course should contain. Some of those mechanisms were marked as automatic, i.e. they are part of every new course, which means that the author does not have to define them manually. The author can then add other elements. An LMS based on this paper will be created and tested in instruction.

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