The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

https://dx.doi.org/10.15405/epsbs.2019.02.02.30

7th icCSBs 2018
The Annual International Conference on Cognitive – Social and Behavioural Sciences

TEACHING OF MOTHER TONGUE IN 3D VIRTUAL ENVIRONMENT

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Abstract

E-learning in 3D virtual environments became an educational tool at many universities but the real impact on the learning outcomes is not fully known yet. So the aim of our research was to answer the following research question: For what part of the mother tongue teaching is it useful to use a 3D virtual environment and what are the views of students on it? The partial aims of our study were: 1) to find out if there were better educational outputs of respondents who were taught in 3D virtual environment comparing to the control group of respondents who were taught with textbook and 2) to explore the views of respondents on 3D virtual environment. The mixed research design was use to explore the results in educational outputs of experimental and control groups in quantitative part, depending on the type of teaching chosen. In the qualitative part, we searched for the views of the experimental group about the presented educational tool and their attitude to it when teaching and learning mother tongue. The research provided in 2014-2017, during which a total of 303 respondents were included, showed statistically significant better overall results in control group ($p = 0{,}006$). Only in literature teaching part, the experimental groups results were statistically significant better comparing to control group ($p < 0{,}0001$) in questions detecting the role of visualisation in teaching. 3D virtual environments can be used in the learning situations requiring the visualisation for better understanding or memorisation comparing to the textbooks or presentations.

Keywords: E-learning, 3D-virtual environment, mother tongue education

https://dx.doi.org/10.15405/epsbs.2019.02.02.30
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1. Introduction

Currently, the information and communication technologies (ICT) are important educational tools in the school education. From the level of primary education, students meet PowerPoint presentations, interactive textbooks that they can work with on the touch panels or use laptops or tablets. ICT development is very fast and a new equipment and software are delivered to the market not at a rate of years but months. Therefore, it is crucial for the teachers to be familiar with the digital educational technologies, to be digitally literate and to distinguish which ICTs are appropriate for what type of teaching and where, on the contrary, the ICT is totally inappropriate or harmful in the sense of distracting pupils' attention or adding redundant information that the pupil must work with. Many schools follow the trend of including new and highly sophisticated digital technologies in order to make their teaching process more modern. Therefore, in some situations the ICT is included in the teaching process to allow the teacher to work in accordance with the trends of education digitalization without having an idea of its impact on pupils' learning outcomes. For this reason, we realize a long-term research at Faculty of Education, Palacky University in Olomouc to show whether the impact on students' learning outcomes in teaching is positive or not when using ICT.

1.1. Online synchronous learning

Regarding the focus of our research on the impact of ICT on the learning process at universities, we first analysed the ICT used in the university environment. Higher education prevails in a trend that is comparable to secondary schools, i.e. the use of ICT especially for frontal teaching (PowerPoint presentation, interactive textbooks projected on the interactive whiteboard, work with basic software applications such as Word, Excel, etc.). As these software tools are common and have been used by the current generation of pupils and students since childhood, they are not usually difficult to work with. However, the specialty of universities, unlike secondary or primary schools, is **online synchronous learning**, which is mainly used for the combined form of learning (distance study) and for lifelong learning. At universities, this online learning is most often provided by the Learning Management Systems (LMS), which allows student and teacher an interaction through the Internet network and represents more complicated type of work with computer and Internet. Currently, Moodle or MOOC systems (massive open online courses) are the most widespread LMS at universities in the Czech Republic.

Faculty of Education, Palacky University offers online courses for students and participants of lifelong learning through a combination of full-time tutorials and online self-study in LMS Unifor. Based on the feedback questionnaires, LMS Unifor proved to be an inadequate tool for online education in some cases. The participants faced difficulties especially in individual sections orientation of the LMS, which appeared to be confusing, too complex and multi-layered. They lacked the possibility of communication directly with the lecturer or colleague during the self-study which they are used to in commonly used online communication tools such as Skype etc.

Taking into account all these responses, we began to think about alternative e-learning tools that would make the visual orientation in the electronic environment easier for teachers and provide the teachers with the missing socialization element. This demand led to the realisation of the systematic research on innovative e-learning methods. In the first stage, we analysed the possibilities of replacing an existing LMS

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with a type of educational environment that would meet the requirements of the current LMS, but would be also enriched with the required aspects of easier orientation in the learning environment and a feeling of inclusion in the educational community.

Based on a summary of the current experiences of both foreign and Czech authors who claim that the current form of e-learning tools have already reached the limits of what they can offer to users and who expect the logical development of e-learning towards 3D virtual reality (Kluge & Riley, 2008; Kemp & Haycock, 2008; Broadribb & Carter, 2009; Hornik, 2010; Kapp & O'Driscoll, 2010; Heaney & Arroll, 2011, etc.), the subject of the research was chosen the 3D multiuser virtual environment as an educational tool.

The role of virtual reality in e-learning education was then researched as a part of the project supported by Grant Agency of the Czech Republic (GAČR, No. P407 / 11/1306 Evaluation of Educational Materials for Distance Learning and E-learning, principal investigator: M. Klement, collaborator H. Marešová and others.), which was realised at the Faculty of Education, Palacky University in 2011-2012. In the next phase of the research, we proceeded to build a 3D virtual building of the Faculty of Education, Palacky University in the Second Life multiuser virtual environment and then a pilot survey was realized identifying participants' attitudes towards teaching in this environment. The inspiration for creating this environment for us was the experience of a number of foreign universities, such as Oxford University in the UK, Harvard University in the USA, or our partner school at Valdosta State University in the USA, where education in this environment is an inherent tool used to teach especially future doctors, architects or programmers.

Figure 01. Teaching in 3D virtual building of Faculty of Education

1.2. 3D multiuser virtual environment

The 3D multi-user virtual environment (MUVE) has developed through the convergence of virtual simulations, online computer games and social networks (Gartner, 2007). It is defined as virtual 3D environment simulating real space in which multiple users can communicate (modified by Brdička, 1999). It represents the integration of previously used forms of online communication and becomes a medium through which it is possible to create social interactions very close to the communication in real space. MUVE can be divided according to several aspects, from the perspective of the user there are two types of MUVE (Holubcová et al., 2010): game-oriented virtual worlds that usually have predefined "virtual cultures" and an open culture of virtual worlds, which are the most attractive for educational purposes, as

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they allow users to apply to the virtual world the ways of behaviour existing in the real world. An important aspect is the presence or absence of the story - when MUVE is built on the principle of computer games, the aspects of the fictional or real story, playing roles and performing tasks remain. Other MUVEs are a 3D virtual version of classic Internet social networks, chatrooms or real space simulations including the work ones.

Regarding the use of this tool in education, we still refine the definition in our concept and define MUVE as a *social network in a non-immersive 3D virtual environment simulating a real world, with an open culture in which the user moves through the avatar*. By specifying of the definition, we put emphasis on the aspect of real social relationships that are enabled to MUVE open culture users (while MUVE in the form of 3D computer games are based on role play, therefore no natural, but predefined interactions are created in these environments). According to some authors (Říha, 2006) the efficiency of communication increases when the media characteristics are in line with the communication processes – i.e. the immediate feedback, the variability of the symbols (the number of possible ways of communication), the testability (possibility of modification before sending), the replicability, etc. The collaborative hypermedia environment that represents MUVE meets most of the above-mentioned aspects. They are object-oriented systems where the communication takes place in real time, e.g. through audio or video conferencing, or in direct interaction through its 3D graphic representations (avatars).

Unlike previous types of communication (e-mail, text or video chats) that are mostly used separately to communicate, MUVE communication integrates all of these types and increases the online communication effect. The MUVE user can track the communication of the individual participants, he/she can move to a particular participant in a moment, which makes the communication very similar to the real environment. The most extensive MUVE currently includes *Second Life* (SL), which was created in 2003 and currently has more than 19,000,000 inhabitants (nearly 2 million from the USA) in the area over 2,000 km2, who spend more than 30 million CZK per quarter here. (Second Life, 2011).

MUVE offers a range of educational opportunities. Nevertheless, it is necessary to mention also the negatives that are connected with it the virtual environment. The disadvantages include the amount of time spent in front of the computer monitor, which is related to a number of frequently mentioned health problems, such as problems with locomotive apparatus, eye fatigue, lack of physical movement, etc. Risks also include the aforementioned dependence on the virtual environment, and the associated declining ability to communicate in the real world. In connection with anonymity in the internet network, the risk of the probability of inappropriate behaviour increases (e.g. in the form of vulgar expression or harassment of other users).

2. Problem Statement

As in the Czech environment such a research has not yet been systematically realized, the main aim of our research was to find out to what extent MUVE is suitable for teaching in general and to explore the MUVE effect on learning outcomes in teaching mother tongue of the university students. Regarding the foreign authors, a number of studies focused on the motivational and social aspects of MUVE have emerged in recent years (e.g. Dickey, 2005; de Jong, Van Der Meijden, & Von Berg, 2005). The most cited arguments for MUVE involvement in teaching are mainly the support of an active learning process based

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on learning through the game (de Jong et al., 2005). The fundamental progress in terms of educational use of MUVE is related to the possibility of communicating of more people in the real time in one place.

MUVE has brought a new dimension of **experience learning** into the educational process. Dalgarno and Lee (Dalgarno and Lee, 2009) in their research of the 3D educational environment point out the positive effects of MUVE education, especially on the sense of identity, the "common being" of the people from different geographic areas, while the presence of others in the learning environment which the learner comes into contact with during the education, increases the internal motivation and engagement of an individual, like in a real educational environment. The ability to cooperate and create collaborative projects in real time enhances this aspect - MUVE enables cooperation on collaborative projects or building knowledge to physically distant users whose cooperation in the real world is difficult and costly. It also enables students to simulate the real-world situations where they can learn e.g. to work with objects and demonstrate the learning content in the virtual space, participate in the activities and processes that are unavailable in real space (e.g. construction of molecular structures, aircraft piloting, etc.).

The importance of the presence of the sense of identity and the sense of community in the process of active learning in the online learning environment is also pointed out by Wang et al. (Wang & Kang, 2006). In their active learning model, which they call “cybergogy” – cyber pedagogy, they point to three areas that must be present to make the learning strategy successful. These areas include the cognitive, social, and emotional aspects - during the on-line education, a student must put the prior knowledge into the context with the new knowledge, he/she must be motivated to learn and positively involved in the learning process.

As part of our research focused on the use of MUVE in teaching mother tongue, the learning outcomes of students achieved by the traditional teaching method were compared with MUVE learning outcomes and the views of students on the use of MUVE in mother tongue were analysed. We define the traditional way of teaching for the purposes of research as teaching methods that are steady, proven by practice and firmly grounded in the educational process (Maňák, 2003), for the purposes of our target group, we understand by that the teaching in the classroom, where teacher's interpretation, blackboard, classical textbooks, workbooks, worksheets or textbooks are used to demonstrate the phenomena, objects, relationships and interrelationships between them. The virtual way of teaching is defined by MUVE teaching, which uses the teacher's interpretation, manipulation of 3D objects and sub-texts, teamwork and collaboration in deriving mutual relationships and contexts of the subject..

3. Research Questions

Our research was based on the mixed research design, combining a quantitative and qualitative approach. Taking into account the scope of this paper, we focus only on the selected areas of the research. The main research questions of the quantitative part included, among others, the following: 1) Does MUVE teaching bring better results in comparison with the traditional type of teaching in the area of term memorising? 2) Is there a difference in learning outcomes when compared to MUVE and traditional teaching? Among the main research questions of the qualitative part were those following 1) What are the opinions of the university students on the use of MUVE in teaching mother tongue? 2) Which school is level MUVE the most suitable application for?

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The following hypotheses regarding the quantitative research were formulated in connection with the research questions:

H1: The learning outcomes of the students taught MUVE will be better than those of the students taught in traditional way.

H2: MUVE leads to better learning outcomes in the area of memorising than traditional teaching, as it enables the student to approach the knowledge or knowledge constructions actively in comparison with the traditional type of teaching that only passively accepts information..

4. Purpose of the Study

The research sample consisted of 303 respondents, 160 of whom participated in the virtual teaching process (experimental group) and 143 in theoretical lessons (control group). The research took place in the years 2014-2017 at the Faculty of Education, Palacky University. The group of respondents was composed of students of the Czech language teaching at the Faculty of Education, Palacky University in Olomouc. The average age of researched respondents was 20.1 (± 0.3) years. The selected sample of respondents met the following criteria: all the respondents were students of the Czech language teaching, all the educational units were provided with the same input information, all respondents' ICT competences were first evaluated based on the international concept of standardized computer skills (ECDL), all respondents were taught in all 3 researched components of the mother tongue, all passed the test before and after the class, all the lessons were conducted by the same teacher. Before starting the research, MUVE learning objects were prepared according to the pre-selected learning topics. Lessons from lexicology, specifically vocabulary teaching from the time point of view (archaism, historicism and obsolete words) were chosen from the grammar area. The environment for manipulation with specific 3D objects was set up that the students had to assign to the specific obsolete words. For the literature area, William Shakespeare as a content of education was chosen and a virtual replica of the Globe Theatre was prepared, where the students could manipulate with the characters of W. Shakespeare's plays. In the area of stylistic and communication education, a virtual simulation of a traffic accident was prepared. The students had to prepare a report after finding out what happened in the given situation.

Figure 02. 3D virtual replica of Globe Theatre in the Faculty of Education campus

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5. Research Methods

For the quantitative part of the research, there was chosen a comparative analysis of the input and output of the didactic test regarding both the experimental and control group. In terms of qualitative approach, the method of semi-structured written questionnaire which was processed according to the method of grounded theory was chosen (Strauss & Corbinová, 1999).

An input and output form of the didactic test was created for each component of the mother tongue (grammar, style and communication education, literature), the content of the input and output test for each component of the mother tongue being the same. The didactic test was evaluated statistically according to the predefined criteria (a score or percentage scale was created to evaluate the results of the test). The validity of the questionnaire was determined by the expert's assessment, the reliability was verified by the Kuder-Richardson coefficient of reliability and by the half-split method using the Spearman-Brown formula (Chráska, 2007).

For the purposes of pedagogical research, the value of the reliability coefficient must be at least 0.8. (Chráska, 2007) which we fulfilled in our case: $r_{kr} = \frac{5}{5-1}\left(1 - \frac{3{,}308}{3{,}04^2}\right) = 0{,}803$. The Student's T-test (Chráska, 2007) was also used to compare the effectiveness of both learning approaches and the difficulty of the test tasks and their sensitivity was also calculated for the appropriate set-up of test questions, based on the results of the ULI coefficient calculation (Chráska, 2011). The test results for each area were described using mean value, standard deviation (SD) and median values. In addition to the point score, the percentage of success in the test was calculated, when the overall raw score was based on the maximum achievable raw score for a given test area. Overall success in the test was counted as a sum of the test results before and after the teaching.

The IBM SPSS Statistics version 22 statistical software was used to verify the validity of the hypotheses. The test results obtained in the control and experimental groups, the results achieved in the men and women group were compared using a Mann-Whitney U test. The nonparametric test was chosen due to the abnormal distribution of the score values. Normal distribution was verified using Shapiro-Wilk's test. All tests were performed at a significance level of 0.05.

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The following categories and subcategories (Marešová, 2012) were defined for the qualitative research in the framework of the axial coding:

1) **motivation** - we tried to find out from the answers whether an environment different from the real world affects their willingness to learn and perceiving of new information,

2) **sense of identity** - to what extent in a virtual reality they feel themselves, whether they identify themselves with the avatars or perceive them only as a stranger in a game,

3) **environmental parameters** - environment assessment was monitored in several aspects - technical parameters of environment, possibilities of communication in MUVE, relationship of virtual and

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real environment during work in MUVE. The following subcategories were then classified: social interactions (possibilities of communication in MUVE, MUVE community involvement), immersion (the degree of immersion into MUVE), consistency with reality (the degree of the real world imitation), avatar's control (controlling the movement of the virtual characters) sense of perspective (degree of the illusion of moving in a real environment).

6. Findings

Regarding the results of the quantitative survey, a control group (the traditional way of teaching) achieved 8.3% better results ($p = 0.006$) in the total average performance (the performance of the respondent in the test before and after the lesson, i.e. the sum of points for individual questions) before and after teaching. In the area of the grammar, both groups had comparable results before teaching, after the teaching, a better result was found in the control group ($p = 0.0001$). In the area of literature, better results were achieved before and after teaching in the experimental group. The overall result was therefore better for the experimental group ($p = 0.01$). The average success rate in the experimental group was 60.0%, in the control group 54.5%.

As far as the rate of success in the test after the realized teaching is concerned, the grammar improved significantly by 18.7% in the control group and the experimental group had an improvement of 7.8% after teaching, the difference being statistically significant ($p < 0.0001$). In the area of literature, the experimental group improved by 28.5%; the control group had an improvement of 29.5%, which was not significant ($p = 0.551$). In the area of style and communication education, there was a marked improvement in the control group by 39.5%, while in the experimental group it was only 16.4%, the difference being statistically significant ($p <0.0001$).

We also analysed the impact of MUVE's visualization of learning topics on results in the area of immediate memorization of knowledge. The selected questions in the individual didactic tests were directly targeted on all the three components of the mother tongue. Statistically significant results were obtained in the literary part - a statistically significant difference was found in the results of the literature test for questions No. 3a ($p = 0.003$) and the questions No. 3b ($p <0.0001$), while the experimental group was shown a higher average point score, i.e. a better result than the control group. On the contrary, a statistically significant difference between the experimental and the control group was found after teaching in the results of the grammar test, question 1 ($p = 0.022$) and questions 2 ($p = 0.010$). The control group showed a higher average score, i.e. a better score than the experimental group. Similarly, in the style and communication education, there was a significantly higher improvement in the control group ($p = 0.004$) in question 3.

We could only partially confirm the established hypothesis about the greater success of the experimental group by these results, namely in the area of literary education; in the other two components of the mother tongue, the respondents' results of the control group were better. The reason for this may be the novelty and the unusualness of the MUVE environment, while working with and controlling this environment drained the respondents the amount of mental energy and attention they could devote to the subject itself- The respondents in the control group worked with methods that are routine and experienced to them so that everyone could focus the conscious attention on the subject of learning itself.

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The second reason are the different levels of ICT competence, therefore some respondents of the experimental group diverted their attention from the learning process to mastering the MUVE control technique while the control group did not have any special competencies to master the learning process. Another reason can be over-reliance on student independence. On the one hand, this may seem advantageous because students have to demonstrate their independence and ability to solve problematic situations because, as stated by Kluge and Riley (2008), the involvement of virtual reality in education can help orient student learning and help to understand the problem in its own way as a counterpart to the transmission of finished knowledge. Similar findings are made by Kalhous and Obst (2002), but they point to the need to introduce students with gradual phases of the solution to acquire a workflow algorithm. But if students have no or little clues, such an approach may be paralyzing, the task is too difficult, and the student may not be able to get the correct sequence of steps that he/she can go through individually to solve partial problems.

Regarding the visualization, it has turned out to be beneficial only for some components of the mother tongue (specifically for some parts of the literary component). On the contrary, the virtual environment did not appear to be too beneficial for the rest of the components (especially grammar and the theme of stylistic and communication education in the case of reporting), which was significantly reflected in the lower performance of the students of the experimental group compared to the control group. The reasons for this result are mainly seen in the fact that the students of both groups received the same input information but the way they worked with them was different - the teaching in the experimental group was more individualized compared to the traditional teaching and the respondents faced higher mental requirements, as they had to manipulate 3D objects, concentrate on mastering the movement of the avatar in a 3D environment, communicate with other avatars, and were forced to accept and process a large number of background information seemingly unrelated to the subject, while students in the control group focused only on the topic of the teaching itself.

A significant impact was also caused by the fact that the students in the experimental group worked in a new educational environment for them and with the non-traditional methods of object manipulation and collaboration, while the control group learned in ways that are routine and experienced for them, thus no longer requiring mental attention during these actions. This surprisingly did not appear in the teaching of literary education, where the effect of visualization on the result of memorization was statistically significant confirmed in favour of teaching in MUVE. This can be explained by the effect of the "experience learning" principle, which is better applied in the case of literary education as it is connected with the experience of the literary work and the aesthetic emotion and at the same time informational component retreats (as opposed to e.g. from the grammar). Learning through experience is based on the essence of the higher ability of human memory to absorb information whose perception is accompanied by intense emotions. This intense emotion was represented by a move around in the virtual replica of the Globe Theatre, when the students could better understand the characters of the Shakespearean dramas they met in the theatre, while in the control group, the respondents only worked with the text of specific theatre plays.

In the framework of qualitative research, it was found that there are factors that influence respondents towards positive evaluation of MUVE and its use in teaching. This was particularly the area of motivation, with 57.82% of the responses being positive (the most frequently cited reasons were the new

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experience, the involvement of more senses), the social interaction positively evaluated by 55% of the respondents (similarity to real interpersonal contact, use of chat for natural interpersonal communication), communication tools that 53.75% of the respondents evaluated positively (valued them as a useful for the group communication, they used information from chat to help with the control difficulties) and a pleasant feeling of perspective for 68.13% of the research participants (especially the wider possibilities in comparison with the reality, the visual representation of a particular learning content). Among the factors contributing to the negative view of MUVE are above all the problems with identifying and controlling the avatars, which made difficulties to 54.38% of the respondents (the impossibility to choose the avatar and the limited possibility of editing, the unnaturalness of the movements, the feeling of artificial interpersonal virtual contact), Above mentioned factors are associated with the lack of identity sense, which negatively perceived 52.71% of the respondents (they felt a sense of unnaturalness, artificiality of the world and experience, little time to identify with the virtual world and to form one's own identity) and 48.21% of the participants perceived a lower degree of immersion into virtual existence (they felt a short time for deeper penetration into the program, unnatural graphics). The similarity with reality was also negatively evaluated, with 51.25% not feeling enough consistency with the real world (especially unrealistic possibilities of movement, difficult camera control).

Regarding the recommendations, most of the respondents voted for the 2nd level of primary schools (36.8%) and for secondary schools (25%) as grades of schools that MUEVE could enrich the most. 15.3% of the respondents would recommend MUEVE for the universities, 14% for higher vocational schools, and 7.6% for the first level of primary schools. 1.6% of the respondents perceived MUVE as unsuitable for education. Their choice was justified by the age and maturity of the children and the premise that multimedia is part of their everyday life. Since current pupils of secondary and second level of primary schools belong to the generation Z, born after 1990 (Oblinger and Oblinger, 2005), who orientate in the ICT environment with absolute certainty, they create their own messages and generate independent media messages, they do not expect any more significant problems when working at MUVE. On the other hand, it is necessary to balance the fact that generation Z spends much of their day in the online environment, therefore ICT should be used judiciously and applied in those cases where the teachers find their justification (in cases where the positive effect of visualization on the knowledge acquisition) so that pupils are not overwhelmed with information and stay in cyberspace.

7. Conclusion

The contribution of the presented research is mainly perceived in the mapping of 3D virtual reality as an educational tool in the light of the dynamic development of the educational technologies and their mechanical introduction into the teaching without proper consideration of the new ICT tools benefits and effectiveness that are not sufficiently supported by the research and validation. In the framework of educational theory, it will redefine some concepts within the traditional educational paradigm in connection with MUVE teaching - whether it is a new way of understanding educational communication on the principle of social interaction in the sense of community learning in the virtual environment or presence of nonverbal communication in communication situations, the principle of interactivity in terms of manipulation of objects in a virtual environment into which it is possible to interfere and change their

properties, redefining the notion of the principle of clarity in the sense of extending the term "simulation of real experience" in the field of virtual simulations, expanding the understanding of the concept of situational learning by simulation in a virtual environment, or a shift in the understanding of the nature of learners who do not enter the learning process directly, but through virtual characters that take different patterns of behaviour in the virtual space. Last but not least, it is also a widening of the educational reality by the terms of gamification, a virtual environment to convey the knowledge through the game and role playing or crowdsourcing as a sharing of knowledge among the members of the learning community.

For the educational practice, it means the enrichment of existing educational methods in the area of multiuser virtual reality, e.g. the demonstration methods (demonstration experiment or excursion performed in a virtual environment) or activating methods (situationally grounded discussion or staging methods in a virtual environment). However, it is necessary to keep on with the further research which focuses on: the level of ICT competencies of teachers for working with these tools and the analysis of their attitudes towards them, further comparisons of the teaching effectiveness in other subjects compared to the traditional teaching, the study of the relationship between MUVE student's learning style or evaluation of the effect of social interaction presence allowed by MUVE in relation to the motivation and learning outcomes of the students.

Moreover, it must be kept in mind that MUVE is only one of the teaching tools of many and that its use is not based essentially on the technology itself, but on the way it is used. There is an irreplaceable role of the teacher, who must always realize that every person is unique and he/she needs a different approach, a different way of giving information. That is why different technologies are proven for different groups of students. Nevertheless, it is always necessary to take into account that technology is only a complementary component of the educational process and can never fully replace education, as teaching is based not only on the construction of knowledge but also on the creation of attitudes and the transfer of moral values that cannot be mediated by the technologies themselves.

Acknowledgments

This text was supported by project No. IGA_PdF_2018_009 *Pedagogical problems and their solutions through ICT*.

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