TO THE PSYCHOLOGICAL ASPECTS OF LANGUAGE TEACHING IN 3D MULTI-USER VIRTUAL ENVIRONMENT

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ABSTRACT

This article focuses on the use of a 3D multi-user virtual environment in language teaching and presents the results of four-year research at the Palacky University Olomouc Faculty of Education (Czech Republic). Language teaching was conducted in an experimental form in the 3D virtual worlds of Second Life and Kitely (experimental group) and, in parallel to this, there was also traditional teaching conducted on identical topics in the form of lectures using a textbook (control group). The didactic test, which was presented to both of the groups in an identical form before the start of teaching and after its implementation, verified the effect of teaching in the experimental group by comparing the achieved results of both groups. Out of the three components of mother tongue teaching (grammar, literature, style and communication education) students achieved partial better results (in the case of points focused on the visualization of the subject matter, these were statistically significant) in literature. Students from the control group performed better in grammar and style and communication education. Based on the achieved results, we discuss the selected psychological implications of these results and can state the most appropriate use of MUVE in teaching those topics that have the possibility of role playing, dramatization and group cooperation.

Keywords: *3D virtual reality, multi user virtual environments, online education, language education, psychological aspects*

INTRODUCTION

As a result of the global Covid-19 pandemic, the education sector is currently facing the challenge of rapidly implementing online educational tools into teaching, often in the form of a complete transition to purely online teaching due to imposed hygiene restrictions. Educational institutions at all levels of schooling as well as lifelong learning institutions were not sufficiently prepared for such a quick organisational shift – some of them face problems of insufficient digital competencies of teachers or the lack of knowledge of specific online educational tools that could benefit their pupils and students. In addition to a number of online

communication tools (such as ZOOM, MS Teams, Skype, etc.), there are also various Learning Management Systems and 3D virtual reality environments.

Despite the fact that much has been written about 3D virtual reality, there have been significantly fewer research studies mapping the effect of education through MUVEs – which in addition to three-dimensional simulation of reality also allow for direct social contact with teachers and classmates. Nevertheless, such research is necessary to ensure that these environments are not included in the learning process without knowing what effects (whether positive or negative) teaching in this environment can have on the learning outcomes of students as well as on psychosocial aspects of educational reality.

A literary review of studies mapping the effect of virtual reality learning between 2004 and 2019 (before coronavirus appearance) was conducted by Mistakidis et al. [1] who focused on e-learning effectiveness along with the factors and conditions leading to deep and meaningful learning when using social virtual reality environments in distance mode of higher education. They searched for the cognitive, social, and affective aspects. The findings suggest that the use of MUVE can provide authentic, simulated, cognitively challenging experiences in engaging, motivating environments for open-ended social and collaborative interactions and intentional, personalized learning. Their findings also indicate that educators need to place more emphasis on the socio-cultural semiotics and emotional aspects of e-learning and ethical issues such as privacy and security. Improvement recommendations include meaningful contexts, purposeful activation, learner agency, intrinsic emotional engagement, holistic social integration, and meticulous user obstacle removal.

From the other authors, we can mention the results of Heaney and Arroll's study [2], which explored, in a qualitative investigation of Second Life educators, their attitudes towards MUVE, e.g. the practicalities of dealing with a student who is unable to attend a class for various reasons, whether due to illness, transport problems or bad weather. On the other hand, the positives mentioned in this study were decreased by the disadvantages that the educators saw in particular in the lack of real physical contact with the students or in the fear of unpredictable situations in the virtual environment and the related possible embarrassment in front of the students when they would not be able to resolve these situations. S. Hornik [3] conducted a longitudinal study based on data analysis and interview feedback from students between 2007 and 2010 as part of the implementation of a financial management course at the University of Central Florida. He worked with different sized groups (200 to 800 students) and found that only 1/3 of the students work in Second Life because they enjoy learning in this environment, while the remaining 2/3 have a negative attitude towards Second Life or work in it only because it is part of the assignment given to them in the course. However, his analysis of the data showed that the longer students worked in Second Life, the more they grew to feel that this MUVE was an effective learning tool for them. In 2007, when Hornik started using Second Life for teaching, only 17.3% of the

students reported that Second Life helped them to understand basic concepts in financial accounting, whereas in 2009, after 3 years of systematic teaching, the figure was already 40.7%. behavioural, affective and cognitive engagement and achievement.

METHODOLOGY

In our research, we focused on the use of MUVEs in language teaching. At the Palacky University Olomouc Faculty of Education, we have been teaching through MUVEs for over 10 years and have gradually moved from using the Second Life environment to building our own virtual faculty building in the OpenSim environment Kitely, in which we gradually create our own 3D objects for language teaching [4]. We use this environment both for teaching the mother tongue and its individual components (grammar, literature, style and communication education) and for teaching Czech as a foreign language (environments simulating various conversational environments).

Our research focuses on examining the impact of teaching in MUVEs on learning outcomes in language teaching. As part of our inquiry, we posed the following research questions:

1. Does teaching in MUVEs lead to better results in memorising concepts when compared to traditional teaching?

2. Is there a significant difference in learning outcomes when comparing MUVE teaching with traditional teaching?

3. Is there a difference between the results of men and women when comparing teaching through MUVEs and traditional teaching?

To answer these questions, we have produced several environments in MUVE that can be used for teaching individual components of the mother tongue (grammar, literature, style and communication education) and for teaching Czech as a foreign language.

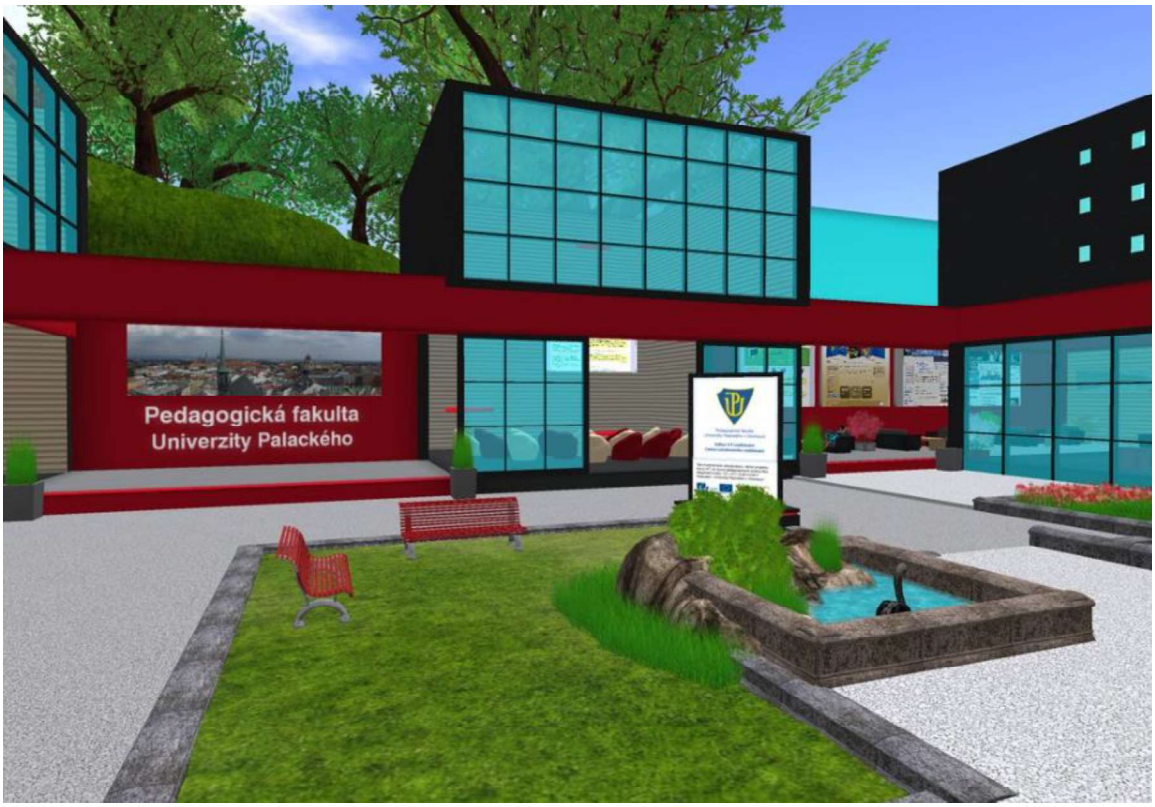

Fig. 1. *Virtual building of the Palacky University Faculty of Education in Kitely.*

The research survey was carried out over a period of 4 years using the method of mixed research design based on a combination of quantitative and qualitative approaches. From the point of view of quantitative research, there was the comparative analysis of the input and output didactic test in the experimental group taught through MUVE and the control group taught in the traditional way (teacher's lecture supplemented by a textbook). In terms the qualitative approach, there was a semi-structured written survey to determine the views of students of the experimental group on teaching through MUVE, processed via the method of grounded theory [5]. By dividing the answers according to certain criteria, the views of students were easier to sort through, determine where the strengths and weaknesses of teaching in a virtual environment were, and identify what could be the biggest issues with its use in practice. Semi-structured questioning was always carried following the completion all the teaching units (i.e., after teaching all components of the mother tongue).

Teaching through MUVE was implemented for 3 basic components of mother tongue teaching – grammar, literature and style and communication education. For each of these components, 3D virtual objects for the various taught topics were created and as well as an input and output didactic test, which was identical for the experimental and control groups. The didactic test was evaluated statistically according to predetermined criteria, the validity and reliability of individual tests were verified. Validity was determined by the assessment of a relevant expert, reliability was verified via the Kuder-Richardson reliability

coefficient and the halving method using the Spearman-Brown formula [6]. The reliability of the didactic test was calculated using the Kuder-Richardson reliability coefficient after the first grammar test. The reliability coefficient can take values from 0 (= complete inaccuracy and unreliability of the test) to 1 (= maximum accuracy and reliability of the test). For the purposes of pedagogical research, it is necessary to reach a value of at least 0.8 [6]. After substituting the values, we obtained a reliability coefficient of 0.803, so the test could be considered sufficiently reliable for testing students. To compare the effectiveness of both teaching approaches, we also used Student's t-test, which verified whether the differences in the results are statistically significant [6]. Sensitivity was assessed based on the results of calculating the ULI coefficient.

The test results for each area were described using mean, standard deviation (SD), and median values. In addition to the point score, we also calculated the percentage of success in the test, where the total gross score was compared to the maximum achievable gross score for the given area of testing. The overall success in the test was calculated as the sum of the results in the test before and after the course. IBM SPSS Statistics version 22 was used to validate the hypotheses. Test results achieved in the control and experimental group as well as the results obtained in the group of men and women were compared using the Mann-Whitney U test. A non-parametric test was chosen due to the non-normal distribution of score values. Normal distribution was verified using the Shapir-Wilk test. All tests were conducted at a significance level of 0.05.

The research group consisted of a total of 303 respondents – 160 of them participated in virtual teaching, 143 in theoretical teaching. The group of respondents consisted of students of the Czech language and literature at the Department of Czech Language and Literature of Palacký University Olomouc. The average age of the survey respondents was 21.6 (± 0.3) years. All respondents participated in a quantitative survey through didactic tests before and after teaching. Students included in the experimental group – who were taught through MUVE – were also included in the qualitative research through semi-structured questioning.

In all teaching units, respondents received the same information, all participated in teaching in all three components of their mother tongue, all were assigned on the basis of predefined and described categories to a specific user level for working with information technologies – the criteria for this were determined through the international concept of standardised computer skills by the ECDL (http://www.ecdl.cz). A total of 48.1% of students reached the basic level according to ECDL and 51.9% were intermediate according to the ECDL. The advanced user category was not represented in the research, as it could represent a contamination of better results due to the greater ability of these respondents to manage the virtual reality environment. As a result, one respondent who was determined as an advanced user was excluded from the group. At the

same time, we maintained the homogeneity of the experimental and control groups.

RESULTS

In the overall performance in the implementation of teaching units in the experiment, the overall average performance was better in the control group, which achieved an 8.3% better result (the total average performance of the experimental group was 43.8%, for the control group it was 48.1%, p = 0.006), the following table summarises the details:

Table 1. *Overall performance in the test.*

Components of the mother tongue teaching	Experimental group	Control group	Statistically significant difference
Grammar	27.8%	33.9%	+
Literature	60%	54.5%	YES
Style and communication education	42.6%	51.5%	YES

Source: Own source

The differences in the results between the experimental and control groups in the individual components of the mother tongue teaching were statistically significant, an overview is provided in the following table:

Table 2. *Performance in individual components of mother tongue teaching.*

	Experimental group average + SD	Experimental group median	Control group average + SD	Control group median	**P**
Grammar 1 (before) points	24.5 ± 8.2	24.0	29.7 ± 10.1	28.0	**0,0001**
Grammar 2 (after) % of success	27.8 ± 9.3	27.3	33.9 ± 11.3	31.8	
Literature 1 (before) points	26.1 ± 6.0	21.0	19.6 ± 4.8	20.0	**0,01**
Literature 2 (after) % of success	60.0 ± 16.7	58.3	54.5 ± 13.4	55.6	
Style and communication education 1 (before) points	13.6 ± 4.7	11.5	16.5 ± 3.9	16.0	**0,002**
Style and communication education 2 (after) % of success	42.6 ± 14.6	40.6	51.5 ± 12.3	53.1	

Source: Own source

Prior to teaching, the results in the area of a grammar of the experimental and control groups were comparable. After teaching, there was a more significant improvement compared to the results before teaching in the control group – improvement by 18.7%. The experimental group improved by 7.8% after teaching. This difference was statistically significant ($p < 0.0001$). In the field of literature, there was the same average improvement after teaching in both groups – in the experimental group it was an improvement of 28.5%, in the control group there was an improvement of 29.5%. The difference in improvement results after teaching between the two groups was not significant ($p = 0.551$). In the area of style and communication education, the results of both groups prior teaching were comparable, after teaching there was a greater improvement in the control group. The improvement in the control group was 39.5%, in the experimental group there was an improvement of 16.4% after teaching. This difference was statistically significant ($p < 0.0001$).

DISCUSSION

The results of our research did not show a significantly higher success rate of students in the experimental group. However, one reason for this could be the novelty of the MUVE environment in which they moved, so part of their attention was focused mainly on the ability to control their avatar, move in the environment and also explore individual details of the environment. For the control group, which was taught through a traditional method to which they have been accustomed to for years, there was no such mental distraction. Therefore, future research is needed that would be focused on longer-term (e.g., one-year) teaching through MUVE, during which students would already be able to move in the environment with confidence.

Firstly, we can conclude that if teaching takes place in this environment, it is more appropriate to employ the method of **mutual cooperation** – in the case where the manipulation of 3D objects was controlled by the teacher and students had to agree on where the objects will go and how, they subsequently achieved better results than if they were left to their own devices and their work could lead to partial problems that teachers or other students were not even aware of. We, therefore, recommend that teaching through MUVE be based mainly on guided teaching and a collaborative approach, leaving the student alone in solving tasks seems to not be very effective.

However, there may have been other variables that affected the end results. The respondent set itself represents a certain limitation, as it was composed only of students of humanities – it is likely that students from technical fields (or IT fields specifically) would have achieved different results. The level of the students' computer skills therefore played a role here, which is why we recommend that sufficient training time be devoted to learning how to work in a MUVE – potentially even performing simple tasks – and only start the course once students are sufficiently confident in navigating the environment.

In interpreting the above results, we are working from the assumption that the involvement of multiple sensory perceptions and the **emotional component** leads to a better memorisation of knowledge. According to Dale's [7] cone of experience, individuals should remember up to 90% of what they do (that is, they learn from experience). This section of the experience cone also includes participation in virtual teaching in the form of a virtual reality simulation. Similarly, Kalhous et al. [8] state that the more senses are involved in cognition, the more knowledge the learner should remember. We saw this reflected in the teaching of literature, but not in the teaching of grammar and style and communication education.

From a psychological point of view, it is necessary to take into account that a person's personality differs significantly in real and virtual space. O´Driscoll [9] defined several characteristics of 3D MUVE that influence the behaviour of an individual in a 3D virtual environment – it is mainly the sense of self in the other space, **identification with the avatar**. When creating a virtual avatar, the user can create a persona into whose appearance or behaviour he/she can project his/her desires or, on the contrary, suppress negative aspects of his/her personality that bring complications in real situations. This can lead to more open communication with others, as those appearance or personality characteristics that make a person feel an inferiority complex or a certain handicap in the real world disappear in the virtual world.

Regarding the method of **problem-based learning**, which we used for style and communication education when teaching how to write a news report, we found that this method was not entirely suitable for MUVEs, because students were distracted by many side activities and elements, which were described mainly in the analysis and description of the results of a qualitative research survey (the need to control the avatar, complex control of the camera, etc.). MUVE is also not a suitable tool for topics where the focus is more on memorisation, because the need to divide one's mental attention between the topic itself and controlling one's avatar in the environment reduces the overall concentration of the students and, by extension, their ability to commit things to memory. This was also confirmed by the results of the qualitative part of our research, where the semi-structured questioning of the respondents of the experimental group showed that they felt overwhelmed by the programme's controls.

CONCLUSION

MUVE is currently one of the most important online tools used worldwide, especially for language teaching, as it enables synchronous online communication in real-time independent of physical space and, unlike other online tools (ZOOM, Skype, etc.). It virtually simulates the non-verbal components of communication (e.g., proximity, facial expressions, gestures, etc.), which are as essential to

language communication as verbal communication. However, it is not always entirely suitable for language teaching.

Based on our results, we can say that the most appropriate use of MUVE can be seen in teaching topics that have the potential for role playing, dramatization, experiential learning, involvement and mutual cooperation of the group. In contrast, due to the need to divide one's attention between the subject matter and controlling one's virtual reality avatar, it is less suitable for teaching topics the lean more heavily on learning through memorisation or terminology (e.g., vocabulary, categorisation of grammatical phenomena, etc.). MUVE, therefore, seems to be the most suitable for the use of simulation of conversational situations (foreign language teaching through role-playing), literary topics (role-playing, dramatisation) and for group teaching that requires participants to work together.

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