

Further Comparison of 2D Virtual Learning Environments with Classic Video Conferencing Systems for Tertiary Education

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Abstract— This work is a follow up to our previous studies “2D Virtual Learning Environments for Tertiary Education” carried out in 2022 and “Comparison of 2D Virtual Learning Environments with Classic Video Conferencing Systems for Tertiary Education” carried out in 2023. The main focus was to analyse the suitability of a 2D Virtual Learning Environment (VLE) for tertiary education using the desktop-based 2D immersive environment 'gather.town' and to compare it with classic video conferencing systems. In these two studies, the results suggest that the immersive 2D environment is holistically suitable as a learning environment in the tertiary sector and, including exam grades, it was found that students perform better with virtual 2D learning environments than with classic video conferencing systems. In this short paper, we conclude the study of the Master’s courses with the video conferencing system in the series of seminars and look forward to the next round of examination with the virtual 3D learning environment.

Keywords-Virtual Learning Environments; Online Teaching; Tertiary Education; 2D Environments; Desktop Virtual Reality; Zoom; gather.town; 3D Environment.

I. INTRODUCTION

This paper is based on the first studies published in 2022 in the International Journal on Advances in Systems and Measurements, vol. 15, no. 3 & 4 with the title “2D Virtual Learning Environments for Tertiary Education” [1] and the related to that “Comparison of 2D Virtual Learning Environments with Classic Video Conferencing Systems for Tertiary Education” published in 2023 [2] [3]. To complete the comparison, the two seminars were conducted and examined, as shown in Figure 1. Contrary to the original planning in [2], a 3D desktop environment was not used, but Zoom as a classic videoconferencing system. The use of 3D desktop is now planned for the winter term 24/25. Several studies have been published on online learning, especially with Learning Management Systems (LMS) such as Moodle and video conferencing systems, especially Zoom [4] [5] [6], accompanied by papers on the phenomenon of “Zoom fatigue” [7] [8] [9]. This highlights the need for alternative online learning environments with less immersive desktop environments such as gather.town [10]. Lo and Song [11] con-

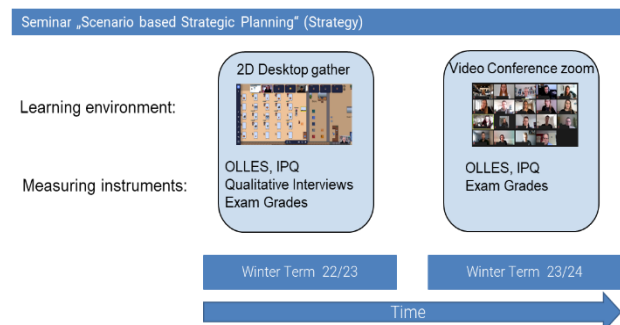


Figure 1. Timeline, seminars, learning environments and measuring instruments for this study.

ducted a review of the empirical studies in gather.town and found that there is still a lack of studies outside of computer science courses that examine students behaviour and learning outcomes. The authors also found that most of the studies were of short duration and suggested studies of longer duration. In conclusion, the suitability of 2D Virtual Learning Environments for tertiary education has been analysed descriptively and tested statistically through a first comparison between 2D Virtual Learning Environments and classic video conferencing systems. This comparison will now be completed with the inclusion of the second seminar strategy. The aim of this and the following research is to analyse the differences between the learning environments in order to improve online education in tertiary education. As the learning environments gather.town and Zoom have been described in our previous paper [2], as well as the measurement tools used, the Online Learning Environment Survey (OLLES) [12], the Igroup Presence Questionnaire (IPQ) [13] and qualitative interviews we only give the experimental procedure and the sample in Section 2. Section 3 summarises the results, which are then discussed with some limitations in Section 4. Section 5 concludes the paper with the main conclusions and future research.

TABLE I. MANN-WHITNEY U TEST WITH RESULTS OLLES FOR STRATEGY

<i>Dimension</i>	<i>Median gather.town</i>	<i>Median Zoom</i>	<i>exact p</i>	<i>z-Value</i>	<i>Effect size r</i>
Student Collaboration (SC)	3.30	3.80	0.169	-1.401	-0.275
Computer Competence (CC)	5.00	4.90	0.858	-0.201	-0.039
Active Learning (AL)	3.10	3.20	0.521	-0.667	-0.131
Tutor Support (TS)	3.80	3.60	0.159	-1.432	-0.281
Information Design and Appeal (IDA)	3.40	3.60	0.765	-0.318	-0.062
Material Environment (ME)	4.05	4.00	0.907	-0.133	-0.026
Reflective Thinking (RT)	2.85	3.00	0.688	-0.422	-0.083

II. METHOD

A. Experimental procedure

Before the first seminar, all subjects were familiarised with the Zoom environment, which was quite common for students. In addition, the OLLES questionnaire was introduced as it was used in its original English language, but the subjects were not native English speakers. Both seminars were held over 4-5 days, with each session starting in the early afternoon and lasting 5-6 hours. Both seminars were held exclusively in Gather and Zoom, respectively, with a total of one measurement point after the last seminar. Both questionnaires were completed online immediately after the seminar. Assuming similar results for the qualitative interviews at the point of Zoom as in the previous round [2], they were not conducted for the Zoom seminar in this round.

B. Sample

All data were collected at the Technical University of Applied Sciences Würzburg-Schweinfurt during the seminar “Scenario-based Strategic Planning” (hereafter just “Strategy”) of the master programme “Integrated Innovation Management”. The seminar “Strategy” was held in Zoom, as shown in Figure 1. As could be shown in the previous studies, it seems to be sufficient to have only one measuring point. This was proved by using the Wilcoxon test, which showed that there was no difference between time point 1 and time point 2 regarding the OLLES questionnaire. The same was done for the IPQ. There were differences on one scale, which can be explained, and the difference was not confirmed in the second seminar Trend [2]. A total of 12 subjects participated in the Strategy seminar. However, only 10 subjects completed the questionnaires. This leaves n = 10 valid subjects for the final analysis. The average age of the subjects is 24.3 years, with a minimum of 22 years and a maximum of 26 years. Of the n = 10 subjects, 6 are female (60.0%) and 4 are male (40.0%).

III. RESULTS

In this first round of data analysis, the results of the OLLES questionnaire were compared to check for differences between the two different online learning environments. This was done by checking whether the central means and medians of the two surveys were significantly different. This is done by calculating whether the mean or median of the “Strategy Zoom” survey differs from the mean or median of the “Strategy gather.town” survey. The t-test for independent samples (two-sample t-test) is used to calculate the differences between the means. This requires that the indices are normally distributed. This is not the case for the CC_Mean and TS_Mean indices. Therefore, the analyses are recalculated using the U-test for independent samples (Mann-Whitney U-test). This calculates whether the two medians are significantly different. As shown in Table I, the medians of the two surveys, gather.town and Zoom, are not significantly different.

IV. DISCUSSION

In contrast to the results of the second round in winter term 22/23, the results show no significant differences between the virtual learning worlds gather.town and Zoom. In the second round, significant differences were found in the variables Active Learning (AL) and Information Design and Appeal (IDA) [3]. Although it was a different seminar, the didactic and structural elements are very similar and therefore do not explain the difference. Probably the small number of subjects makes it difficult to interpret the results. A further analysis of the not yet evaluated data could possibly help. Therefore, in the next step, also the results of questionnaire IPQ and the exam grades of the Strategy and Trend seminar will also be examined. Furthermore, it might be interesting to look at the different results of the two seminars in Zoom, once in Strategy and once in Trend (Figure 2).

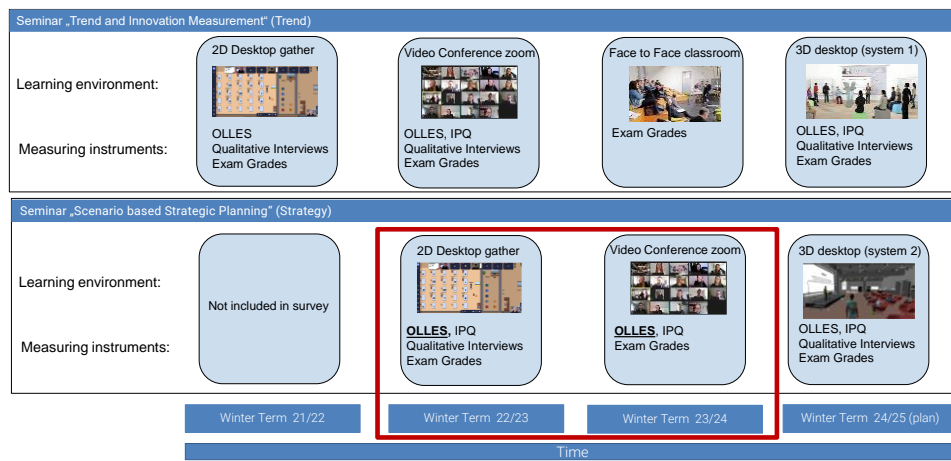


Figure 2. Overview of seminars, learning environments and measuring instruments for finished and planned studies.

V. CONCLUSION AND FUTURE WORK

This study, with the partial results of the third round of the long-term study on virtual learning environments, confirms the previous rather small differences between the virtual learning environments gather.town and Zoom. At least for the results of the OLLES questionnaire that has been analysed so far in the third round. The differences in the OLLES variables Active Learning (AL) and Information Design and Appeal (IDA) could not be confirmed in this round; in fact, there were no statistically significant differences. The results of the IPQ questionnaire have yet to be analysed. In addition, another round is planned for WS 24/25, in which the same seminars will be held in a virtual 3D desktop environment (Figure 2). As discussed in previous publications, the small number of subjects is a limiting factor in interpreting the results, but at the same time the research design allows for comparative analysis over a long period of time. Nevertheless, it will be explored how the number of subjects could be increased and also to what extent ethical aspects could be addressed by the use of VLE in education [14] [15].

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