

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

Gerhard Hube¹, Nicholas Müller²

¹THWS Business School

²Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Contact email: gerhard.hube@thws.de

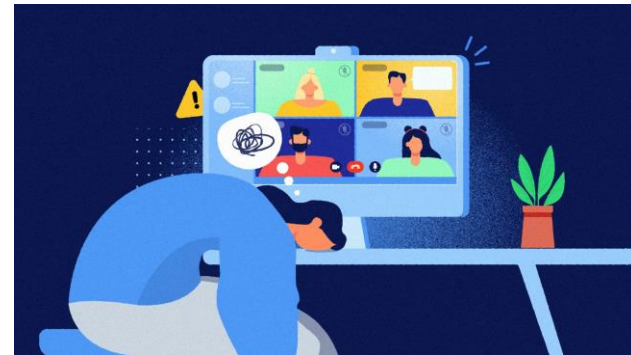
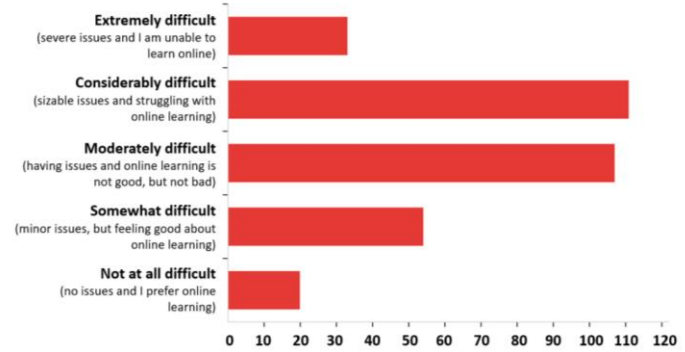
Barcelona, 30.05.2024



I. Introduction

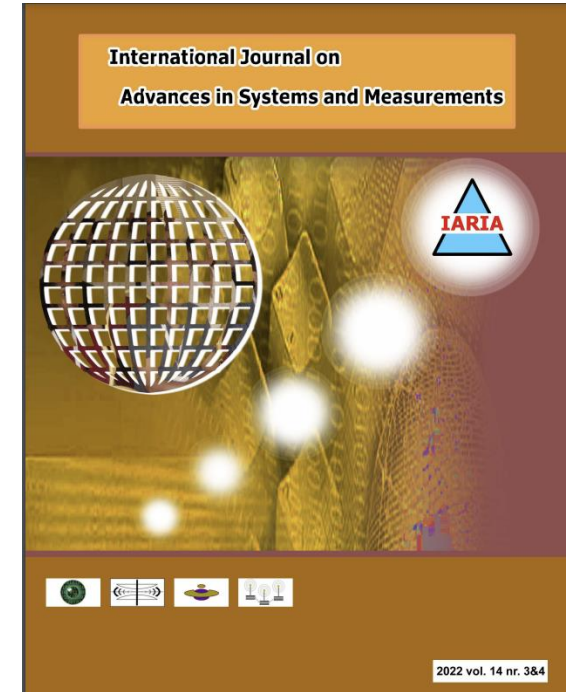
- Massive use of online teaching in almost every education level, mostly with video conferencing tools like zoom, GoToWebinar or similar tools [1], but causing different difficulties especially for online learning [2]
- Due to time consuming and long during online university courses fatigue and weariness can be observed called „zoom fatigue“[3] [4] [5] [6] [7]
- Nevertheless it is presumed that online will be continued because of several benefits in education but also in professional work [8]

Survey of 325 Undergraduates comparing Zoom online learning to the previous in-person classes



II. Related Work, Motivation

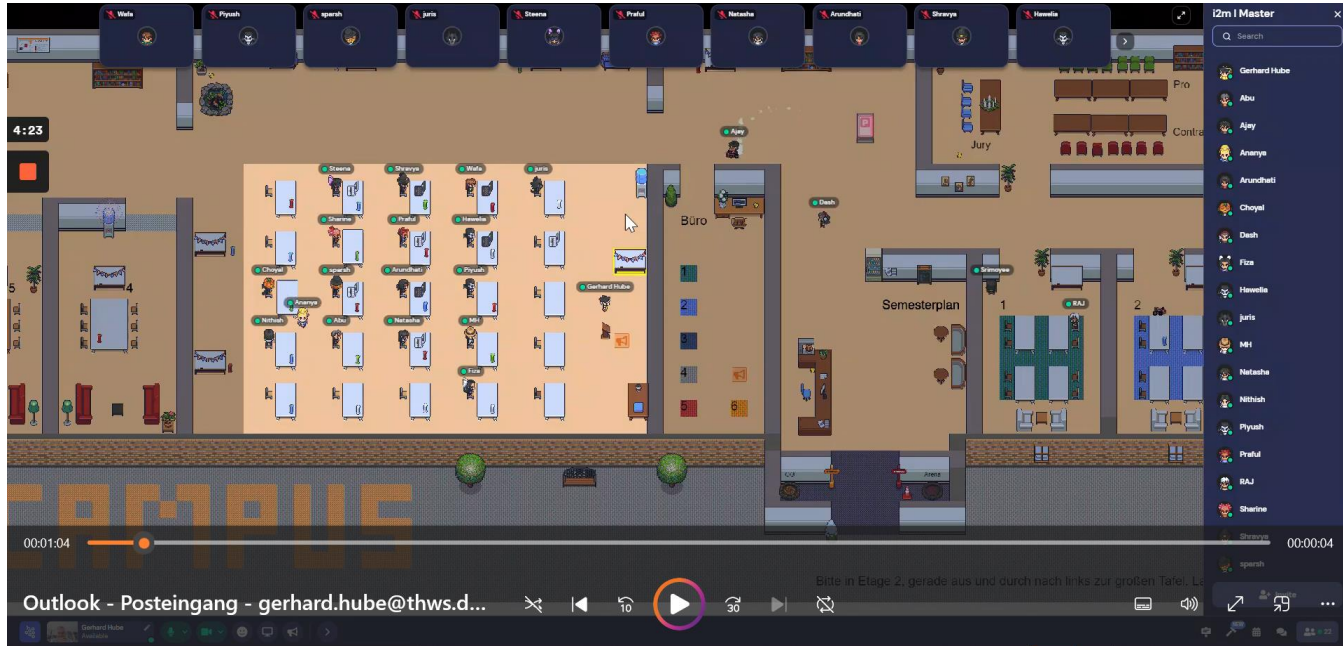
- This paper is based on the first studies published in 2022 in the International Journal on Advances in Systems and Measurements, vol. 15, no. 3 & 4 with the title “2D Virtual Learning Environments for Tertiary Education” [9] and the related to that “Comparison of 2D Virtual Learning Environments with Classic Video Conferencing Systems for Tertiary Education” published in 2023 [10]. To complete the comparison, the two seminars were conducted and examined.
- With this study, we evaluate Virtual Learning Environments over several semesters in the context of seminars not in computer science but in business administration. We also include exam grades for learning outcomes. With these conditions, we fulfill some of the requirements for further research by Lo [11].



first round 2022

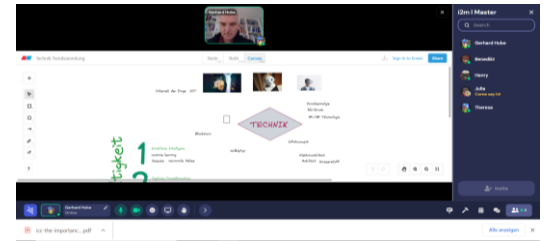
III. Method gather.town

- Breakout rooms and plenum at lecture with gather.town



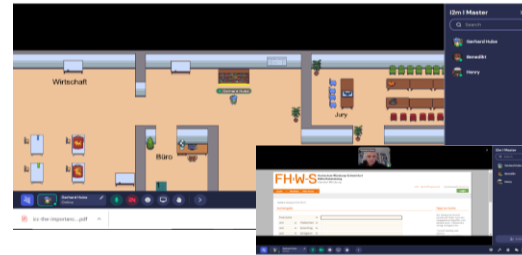
III. Method gather.town

- The software gather.town [12] was used as an immersive 2D desktop environment. This is a web conferencing software that allows to create a complete virtual replica of the teaching building.
- Podium:
The podium is the classic teaching situation. Within the gather.town environment, all students and the tutor are in one large room. The tutor stands in front at the lectern, while the students take their places at the tables.
- Whiteboard:
The whiteboard provides an opportunity for collaborative work. To do this, the whiteboard must first be activated. After that, all users who access the whiteboard at the same time can work together on it. This means that all users get write permissions and can interact with the whiteboard.



III. Method gather.town

- Workshops, Group discussions:
Workshops are smaller rooms that provide fewer seats than the large seminar rooms. Here, there are tables with seats and a whiteboard. Thus, the users have the possibility to do smaller group work. There is a room that is designed in such a way that a pro and a con side can sit opposite each other and participate in a group discussion by means of the camera.
- Interactive objects:
Within the environment, other interactive objects are stationed in the individual rooms or corridors.
- Lo, [11] did a review of the empirical studies in gather.town and revealed that there is still a lack in studies besides computer science courses, the examination of student's behavior and learning achievements



IV. Measuring Instrument OLLES

- OLLES Questionnaire (modified 35-item form) [13]
- Web-based survey instrument, used in online learning environments in tertiary education
- 7 Dimensions, 5-point Likert scale
 1. Student Collaboration (SC)
 2. Computer Competence (CC)
 3. Active Learning (AL)
 4. Tutor Support (TS)
 5. Information Design and Appeal (IDA)
 6. Material Environment (ME)
 7. Reflective Thinking (RT)
- Also computer use and internet use

V. Procedure & Sample

- Experimental Procedure
 - Introduction to gather.town and the OLLES Questionnaire (Original Language)
 - 4 measurement time points, within whole semester
 - First the seminar – Afterwards the questionnaire
- Sample
 - 16 valid subjects (1 was excluded because of extreme outlier values)
 - Only students from the University of Applied Sciences Würzburg-Schweinfurt within the seminar “trend analysis and innovation assessment” of the master study program “Innovation for small and medium Enterprises”
 - Average age is 24.44 years – minimum 22 years and maximum 30 years
 - 7 female and 9 male

VI. Results first round

- Descriptive Analysis of the OLLES Questionnaire:

TABLE I.

Descriptive Analysis

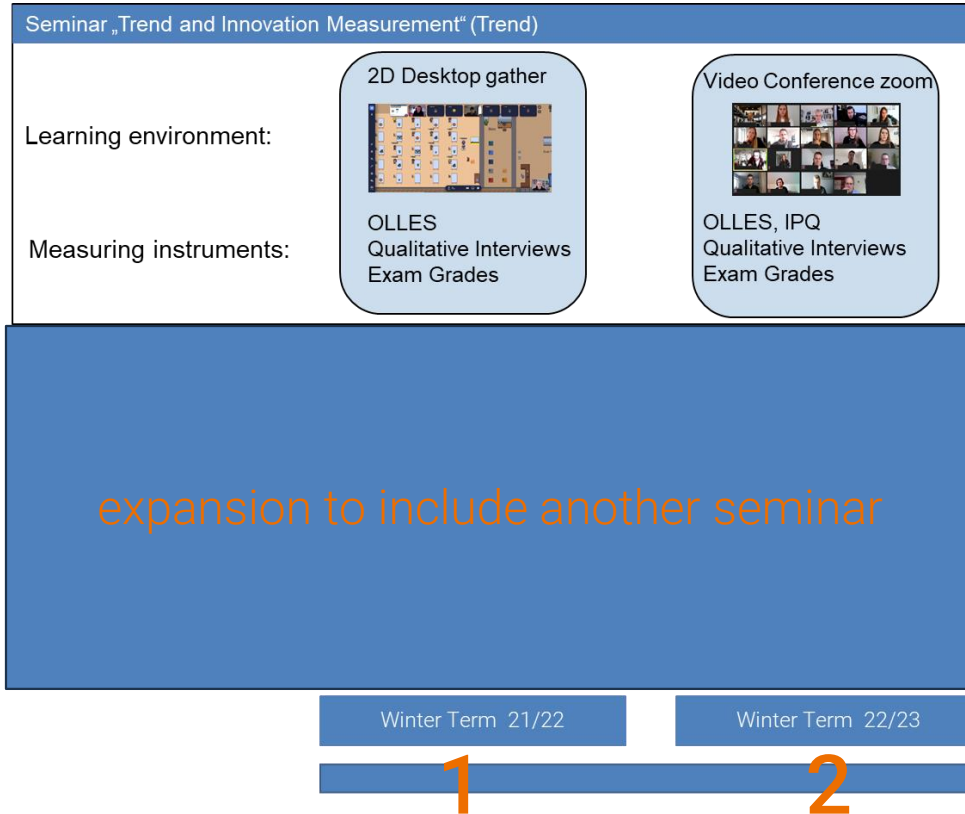
<i>Dimension</i>	<i>Mean Value</i>	<i>Standard Error of the Mean</i>	<i>Standard Deviation</i>	<i>Minimum Value</i>	<i>Maximum Value</i>
Student Collaboration (SC)	3,76	0,11	0,42	3,10	4,60
Computer Competence (CC)	4,57	0,11	0,44	3,55	5,00
Active Learning (AL)	3,64	0,13	0,46	2,70	4,60
Tutor Support (TS)	4,10	0,12	0,55	3,20	4,80
Information Design and Appeal (IDA)	3,73	0,12	0,47	2,93	4,80
Material Environment (ME)	3,84	0,07	0,28	3,50	4,45
Reflective Thinking (RT)	3,19	0,16	0,62	2,25	4,10

VIII. Conclusion after first round

- All dimensions of the OLLES questionnaire reach high to very high scores
 - From a purely descriptive point of view, it can therefore be assumed that the gather.town environment is holistically suitable as a learning environment in the tertiary sector
 - No comparison group so far
- Daily Computer and Internet use and a sufficiently explained environment
 - No poor ratings for the environment due to possible lack of technical skills
- Repeated measurement of user ratings of the gather.town environment showed that there was virtually no difference.
 - A one-time survey after the first unit or even after the last unit is quite sufficient

second round 2023

Decision for second round



III. Method Zoom Video Conferencing

- Zoom is one of the classic video conferencing tool with quite wide spread usage for education, especially while COVID-19 pandemic but also after reopening universities in 2021 [14] [15].
- With Zoom it is possible for one or more people to interact through chat messages, video based visual communication, and group work [16].
- Besides the communication in the whole group of participants, it is also possible to create subgroups (Break out rooms) for group work or group discussions. There is also the possibility to share the screen with other participants, to do little surveys and to use a whiteboard. The classic appearance is the monitor full of video tiles with the participants of the zoom meeting



IV. Enhancing Measuring Instruments

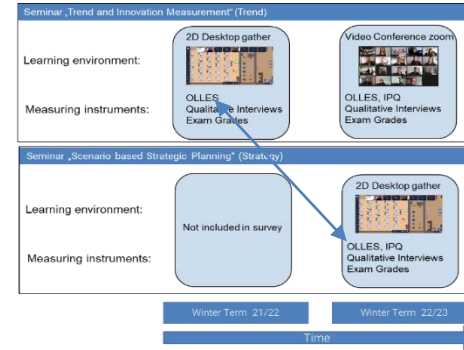
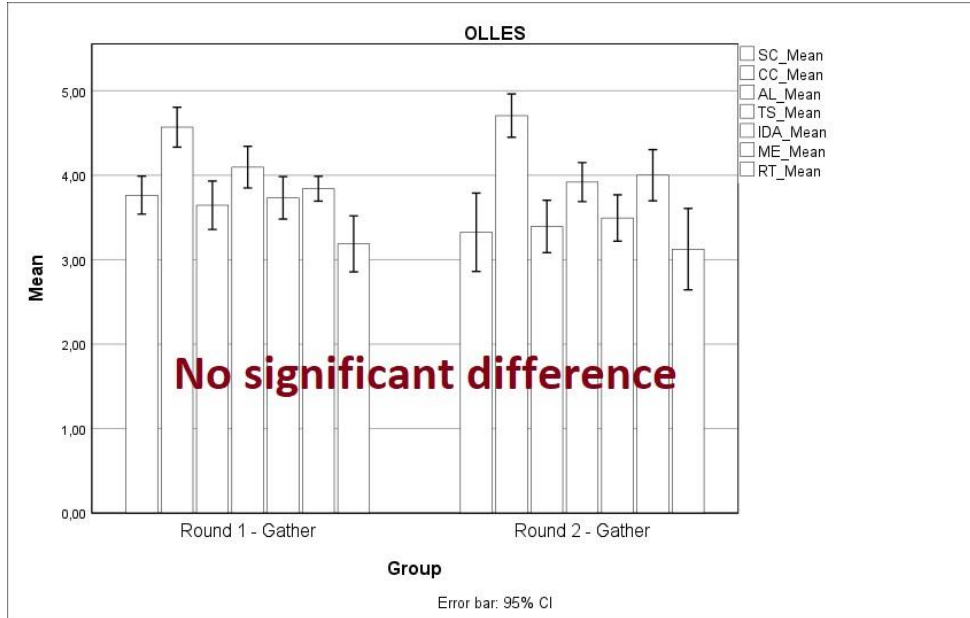
1. ONLINE LEARNING ENVIRONMENT SURVEY (OLLES) Questionnaire [11]
Web-based survey instrument, used in online learning environments in tertiary education, 7 Dimensions, 5-point Likert scale, Student Collaboration (SC), Computer Competence (CC), Active Learning (AL), Tutor Support (TS), Information Design and Appeal (IDA), Material Environment (ME), Reflective Thinking (RT)
2. IGROUP PRESENCE QUESTIONNAIRE (IPQ)[17]
The IPQ has three subscales and one additional general item not belonging to a subscale. The three subscales are Spatial Presence (the sense of being physically present in the VE), Involvement (measuring the attention devoted to the VE and the involvement experienced) and Experienced Realism (measuring the subjective experience of realism in the VE). There is also a general item that assesses the general “sense of being there”. This item has high loadings on all three factors, with an especially strong loading on Spatial Presence
3. Qualitative interviews [1]
After checking remembering of lectures, at least one question was asked about each dimension of the OLLES to develop a deeper understanding of why one of the dimensions had performed well or poorly. It was also investigated whether the subjects prefer face-to-face classes, a virtual learning environment such as gather.town or classic video conferencing like Zoom and why

V. Procedure & Sample second round

- Experimental Procedure
 - Introduction to gather.town and zoom environment, testing of basic functions,
 - Introduction to OLLES questionnaire (used in original English language)
 - Both seminars were held over 5 days each
 - 2 measurement time points, after first seminar and after the last seminar
 - Qualitative interviews were collected a few days after the last seminar conducted within the VLE gather.town resp. zoom
- Sample
 - 16 valid subjects, only students from the Technical University of Applied Sciences Würzburg-Schweinfurt within the seminars “trend analysis and innovation assessment” (Trend) and “Scenario Based Strategic Planning” (Strategy) of the master study program “Integrated Innovation Management”
 - Average age of 25.19 years, with a minimum of 22 years and a maximum of 33 years.
 - Of the n = 16 subjects, 5 are female (31.3 %) and 11 are male (68,7 %)
 - comparison of two measurement points, only 11 subjects with completely questionnaires.

VI. Results second round

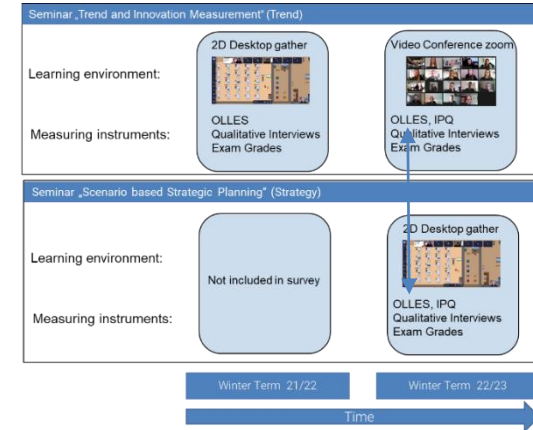
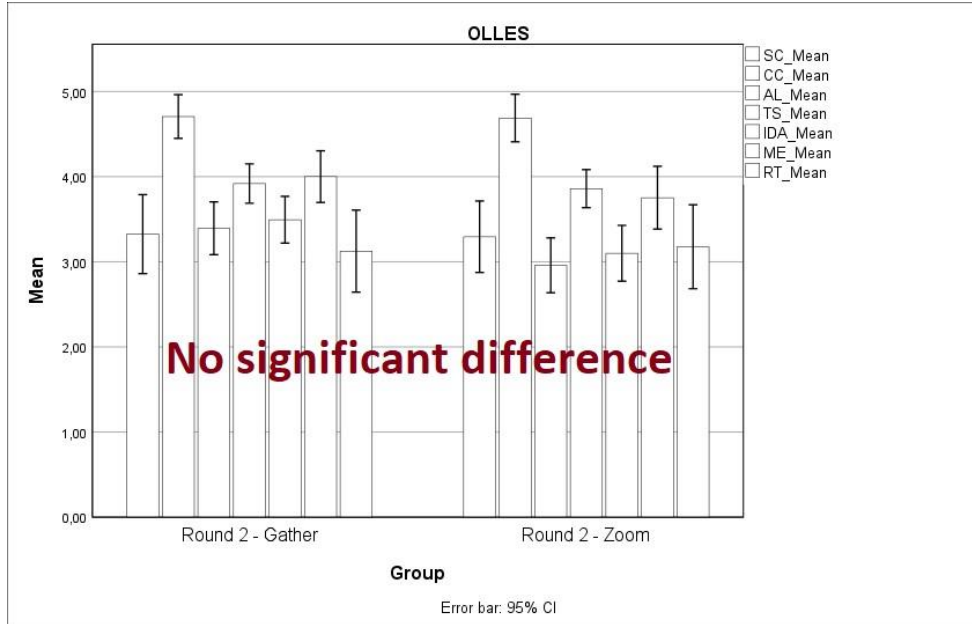
- Comparison OLLES between Gather and Gather



- Student Collaboration (SC),
- Computer Competence (CC),
- Active Learning (AL),
- Tutor Support (TS),
- Information Design and Appeal (IDA),
- Material Environment (ME),
- Reflective Thinking (RT)

VI. Results second round

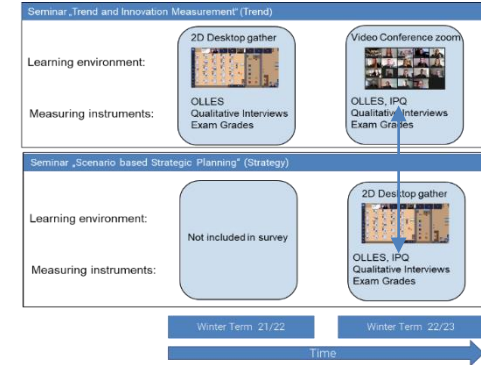
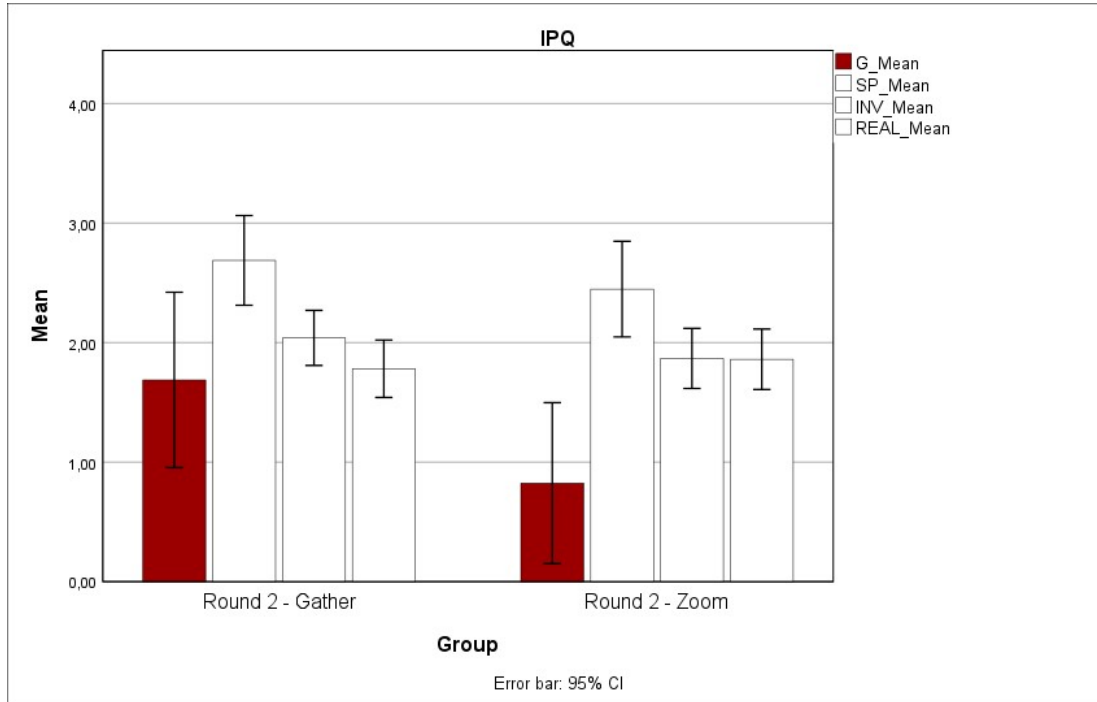
- Comparison OLLES between Gather and Zoom



- Student Collaboration (SC),
- Computer Competence (CC),
- Active Learning (AL),
- Tutor Support (TS),
- Information Design and Appeal (IDA),
- Material Environment (ME),
- Reflective Thinking (RT)

VI. Results second round

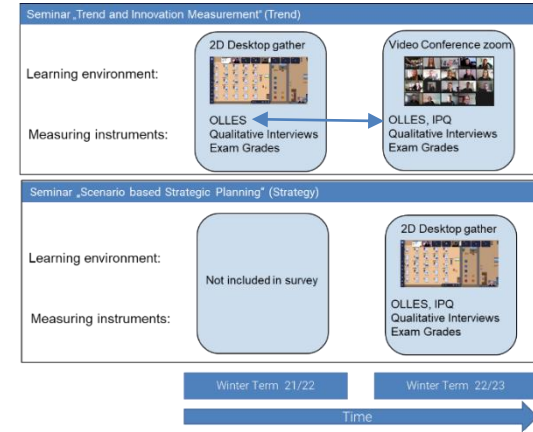
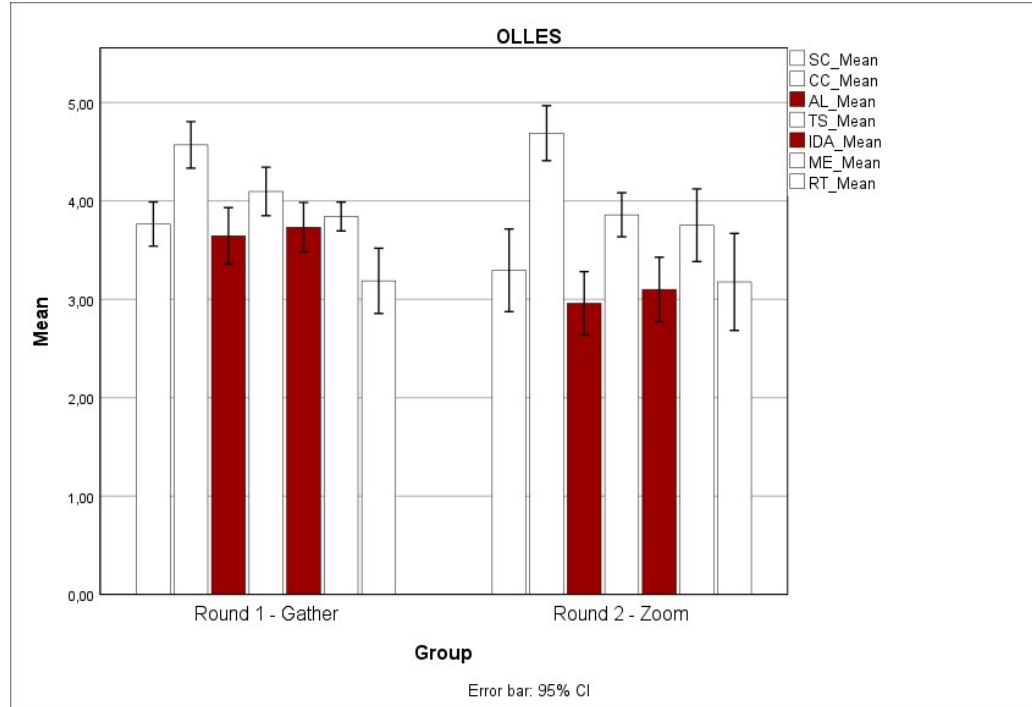
- Comparison IPQ between Gather and Zoom



- G: general item that assesses the general “sense of being there”. This item has high loadings on all three factors, with an especially strong loading on Spatial Presence.
- SP: Spatial Presence (the sense of being physically present in the VE)
- INV: Involvement (measuring the attention devoted to the VE and the involvement experienced)
- REAL: Experienced Realism (measuring the subjective experience of realism in the VE).

VI. Results second round

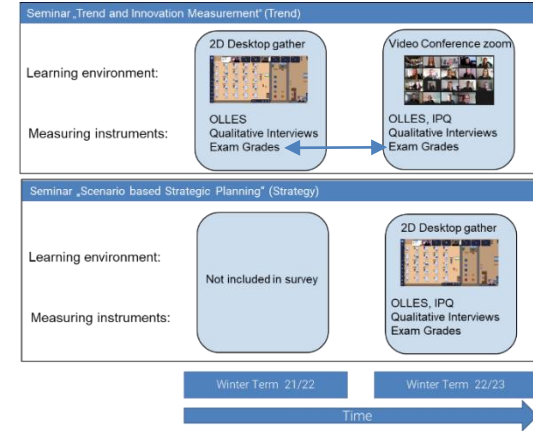
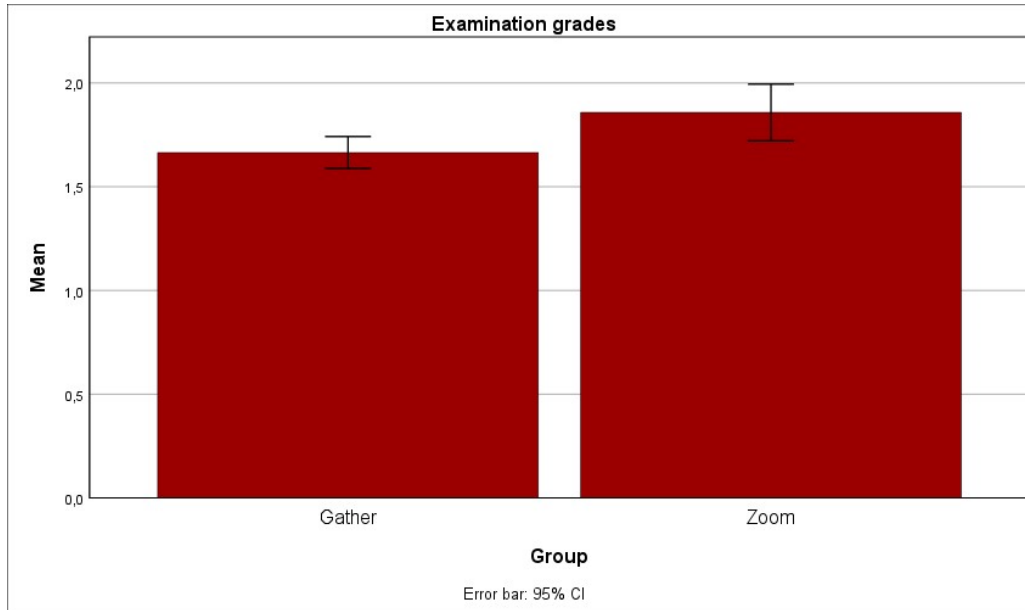
- Comparison OLLES between Gather and Zoom



- Student Collaboration (SC),
- Computer Competence (CC),
- Active Learning (AL),
- Tutor Support (TS),
- Information Design and Appeal (IDA),
- Material Environment (ME),
- Reflective Thinking (RT)

VI. Results second round

- Comparison Exam Grades between Gather and Zoom

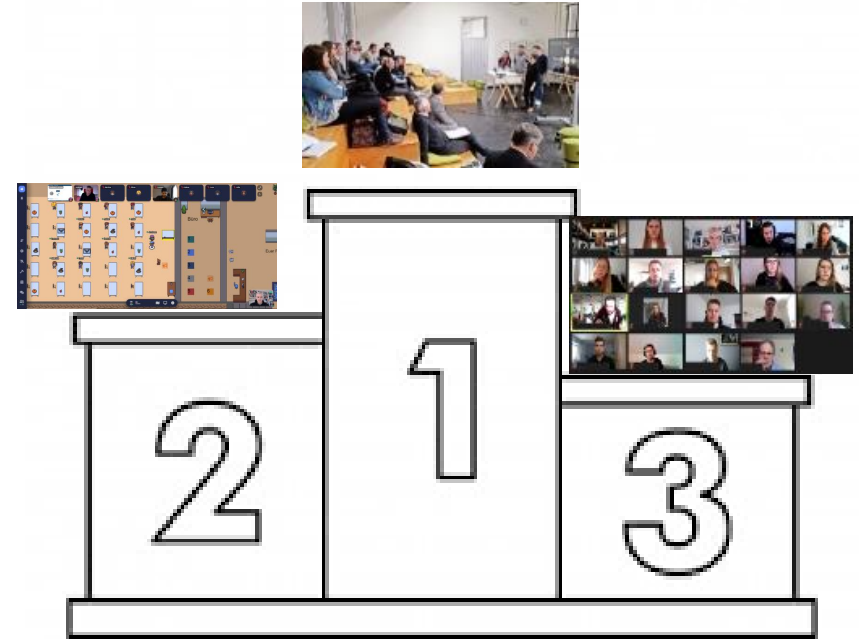


Examination grade:

- 1: very good
- 2: good
- 3: satisfactory

VI. Results Qualitative Interviews

- Almost all subjects showed a hierarchy in their preferred choice of teaching styles. Classroom teaching is clearly preferred. This is followed by the use of 2D Virtual Environments. Classic video conferencing systems are least preferred.
- If we take a closer look at this hierarchy, we can see that the more opportunities for interaction and the more personal a teaching style is, the more it is preferred.
- This is also consistently confirmed by the responses to the qualitative questionnaire. Subjects consistently said they preferred gather.town over Zoom because they had more human proximity and also more opportunities to interact with other students.

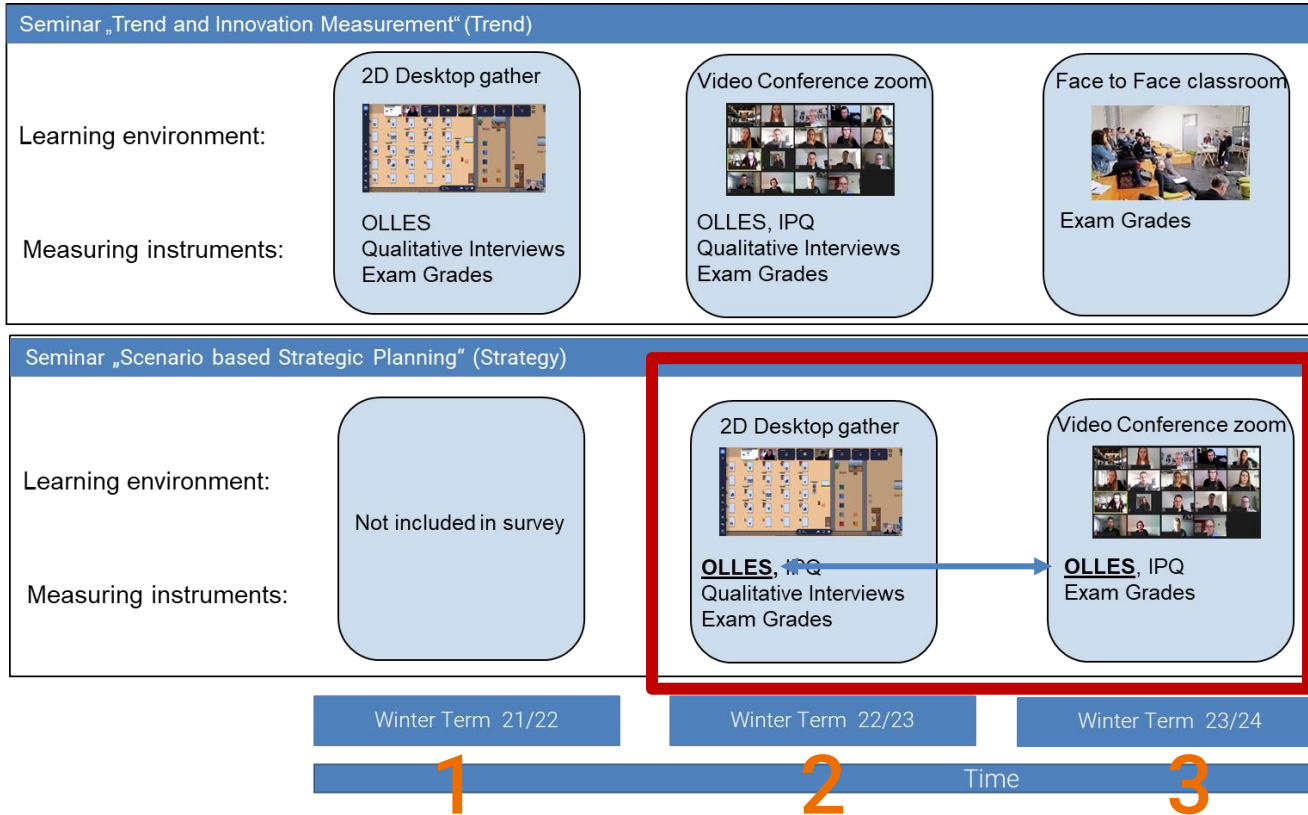


VIII. Conclusion second round

- This study shows that, according to the subjects, there is a hierarchy of teaching styles.
 - First classroom teaching, then VLE like Gather.town then Video conferencing tools like zoom
- This hierarchy, especially the preference of face to face personal teaching is confirmed by several other studies [18] [19] [20] [21]. Also the preference for gather as 2D Desktop VR to zoom as classical video conferencing can be explained and confirmed by several studies [22] [23] [24] [25].
- It seems to be important to use VLE that are some kind of innovative, social emotional and engage formerly and informally communication, which seems to be better solved within the Virtual 2D Learning Environment gather.town.
- Contrary to the statements of the qualitative interviews, the quantitative evaluation of the two online teaching formats therefore seems to make no or only a very small difference.
- In contrast, when exam grades were measured as a performance measure, subjects were found to perform better with Virtual 2D Learning Environments than with traditional videoconferencing systems.

third round 2024

Decision for third round



V. Procedure & Sample third round

- Experimental Procedure
 - Short Introduction to zoom environment, which was quite common,
 - Introduction to OLLES questionnaire (used in original English language)
 - Both seminars were held over 4-5 days each
 - One time measurement time only after the seminar due to the results of the previous rounds, that there are no
 - No qualitative interviews were collected assuming similar results as in previous rounds
 - No OLLES and IPQ questionnaires for face to face seminar because these are questionnaires especially for online learning environments
- Sample
 - 10 valid subjects, only students from the Technical University of Applied Sciences Würzburg-Schweinfurt within the seminars “trend analysis and innovation assessment” (Trend) and “Scenario Based Strategic Planning” (Strategy) of the master study program “Integrated Innovation Management”
 - Average age of 24.3 years, with a minimum of 22 years and a maximum of 26 years.
 - Of the n = 10 subjects, 6 are female (60 %) and 4 are male (40 %)

VI. So far Results third round

- Analysis of the OLLES Questionnaire between gather.town and zoom:

<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

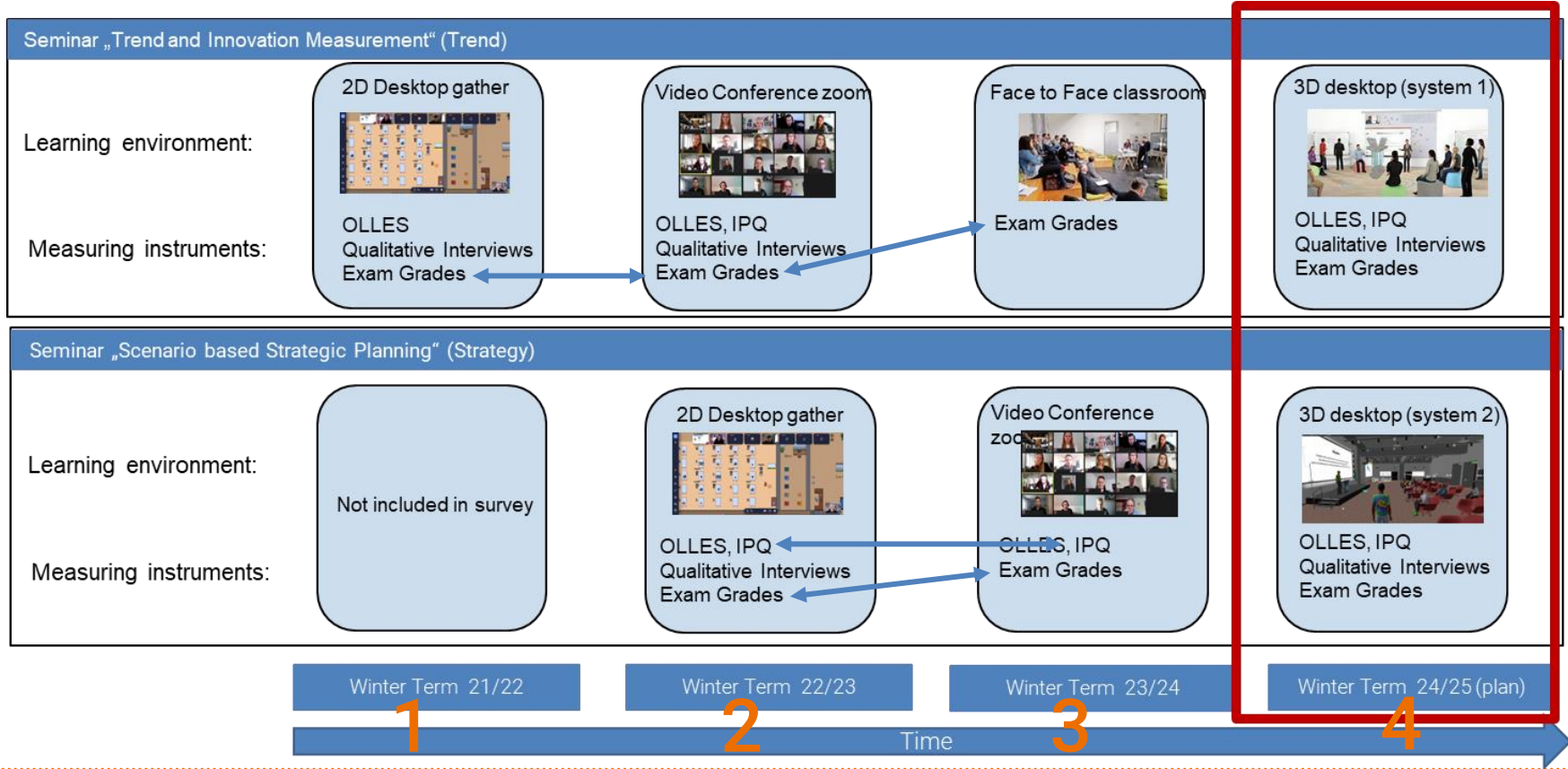
VII. Discussion third round

- 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) [10].
- 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

VIII. Conclusion third round

- 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.
- 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 [26] [27].

IV. Future Work





**Many thanks for
your attention**

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