International Conference on Artificial Reality and Telexistence
Eurographics Symposium on Virtual Environments (2023)
A. Campbell, C. Krogmeier, and G. Young (Editors)

Poster

VRMeta-REG Tool to Support Student's Collaboration in Social VR

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Figure 1: *(left) individual tablet with item options, (middle) individual student with tablet in front of the group awareness tool, and (right) group awareness tool next to students' shared group screen with group results during the learning task*

Abstract

This study delves into the potential benefits of immersive virtual realities (VR) in augmenting collaborative learning processes. Social VR allows students to work collaboratively on tasks with extended interaction possibilities and interactive environments. These additional possibilities and the resulting increased sensory and cognitive input impact the often already-existing deficits in the learning regulation of students. There is a lack of research on supporting students' individual and collaborative learning regulation in VR learning environments. Our study addresses this gap by introducing a group awareness tool to support students' regulation of learning process in a collaborative VR setting. We report the preliminary results of our study regarding embodiment, learning gain, and change in metacognitive perception over the span of the learning task due to the tool.

CSS Concepts

- ***Human-centered computing*** *-> computer supported cooperative work;* ***Virtual Reality****;*

1. Introduction

Immersive virtual realities (VR) hold the potential to enrich learning processes, not only because of the possibilities of learning situations but also due to the opportunity to enable students to be embodied and present as avatars in collaborative group settings in VR, which is rarely explored by research so far. In this regard, collaborative learning facilitates the learning achievement of the individual group members, whereby (learning) regulation is needed for a fruitful interactive learning process to evolve [RB17].

Interactive, collaborative learning involves self-regulation of learning (SRL). Learners with good self-regulation skills can strategically plan, monitor, and evaluate their cognitive, affective, and motivational processes. They do this individually and collaboratively, reflected in more successful learning outcomes. The successful regulation of a collaborative learning process requires a balanced combination of self-regulation of learning, support of learning regulation by group members (co-regulation), and shared group regulation (shared regulation). In addition to the need to regulate one's learning process, the learners must constantly regulate the group process [HJM18].

However, learners often have deficits in regulating their learning process effectively and spontaneously, as well as with other group members [PDH*21, RB17]. Complex learning environments, such as VR in collaborative settings (social VR), particularly challenge learners due to the large number of cognitive and sensory inputs to be processed. Learners are confronted with the social presence evoked by, e.g., being represented by an avatar and interacting with group members' avatars, feeling of immersion, and different technical interaction possibilities. Hence, in VR learning environments, learners are especially in demand to successfully regulate the learning process individually and collaboratively.

In order to support the group members' shared regulation of learning, prompts should be introduced, enabling learners to gain a greater awareness of their own learning process and, thus, to find a common understanding of the group's learning process while working on a group task in VR. Our study aims to address the lack of research to support learners' regulation of learning in VR environments through the implementation of a group awareness tool.

1. VRMeta-REG tool and Implementation

Based on the design principles of *Awareness* (learning of one's own and others' process), *Externalization* (making the process visible), and *Prompting* (activating the regulatory processes) [JKP*15], we developed a Group Awareness Tool '***VRMeta-***

DOI: 10.2312/egve.20231331

REG tool' (adapted from S-REG [LMJ*15], which was implemented in the projects' social VR learning environment.

Students in small groups are asked to individually answer three items about their metacognitive state on a virtual tablet each student has access to in the VR (Item1: I understand the task and its purpose; Item2: I know what the goal of the task is; Item3: I know the next steps to work on the task). The group is shown the group state as a green (high agreement), orange (moderate agreement), or red (low agreement) traffic light (one light per item) next to each small group's big shared screen. The lowest value of the group members is displayed on the group tool, e.g., One student indicates in the individual response low agreement for Item 1, and all others moderate agreement: the light for Item 1 turns red on the tool. To further prompt the students, the item's name (Item1: Task Understanding; Item2: Goal Setting; Item3: Next Steps) is visible next to each light (see Figure 1). The learners are encouraged to discuss where the deficit lies, especially with the VRMeta-REG tool indicating orange and/or red lights, to work on the group task with a pronounced shared understanding. [JKP*15]

2. Evaluation of the VRMeta-REG tool

We expect that learners show a learning gain due to the group task in VR supported by the VRMeta-REG tool (H1). Further, we assume a positive change in the perception of their metacognitive state with regard to the learning task (H2).

The data collection took place in one session of two similar university seminars for pre-service teachers, with a total of $n = 42$ participants ($Mage$ = 21.48, $SDage$ = 2.27, 60% female). The students were randomly assigned to groups of two to three people to work together on a group task in the VR learning environment. Before the students entered the VR, they were asked to complete a pre-test on demographic questions and prior content knowledge.Each student was given an HPReverb G2 Omnicept, with two controllers to enter the VR environment, and were calibrated to their assigned groups. The environment allowed, inter alia, the students to work with an individual virtual tablet and a shared big group screen. After introducing the group task, students answer the three metacognitive items on their tablets. Subsequently, each group's traffic light and the prompt were displayed on the left next to the group's big screen (s. Figure 1). The group task took 30 minutes, followed by a post-test, which, besides the repeated questioning of the three metacognitive items and content knowledge (to measure the knowledge gain), also asked about transfer knowledge and embodiment.

3. Results and Conclusion

As expected, our preliminary analyses (see Table 1) reveal significant learning gains for content knowledge about the learning task (H1) and deep knowledge (transfer). Students indicate to have felt embodied in their avatar and thus immersed in the environment. Regarding the metacognitive assessment before the group task and afterward, it is noticeable that the learners developed a more positive sense of their task understanding, goal setting, and next steps (H2). In particular, they have achieved a significantly clearer understanding of the next septs to complete the task as a group over the task period. These first insights are indicators that the VRMeta-REG tool supported the learners of the groups to engage in a more shared learning process conducive to learning. We aim to verify these assumptions in further analysis of the students' and groups' regulation of learning and interaction processes. For this purpose, video recordings of the 30-minute group task are available, allowing us to code and analyze the interactive student behavior and regulation in VR in more depth. To better understand how to improve and individualize the VRMeta-REG tool in the future for different learner types.

Based on the preliminary findings and the lack of research, the importance of supporting learners to develop learning regulation skills when exposed to challenging new learning environments like social VR by implementing valuable scaffolds is clearly apparent.

	M	*SD*	Min	Max
Change in Metacognitive Perception				
Task understanding	0.21	0.34	1	6
Goal Setting	0.31	0.03	1	6
Next Steps	**0.71**	**0.20**	**1**	**7**
Learning Gain	**9.60**	**2.40**	**0**	**75.00**
Transfer Knowledge	44.8	18.7	0	87.50
Embodiment	4.09	1.14	0	6

Note: Maximum score of tests: content knowledge pre/post and transfer task (100%); learning gain and change in metacognitive perception = post-test score – pre-test score

Table 1: *Descriptive Statistics of Change in Metacognitive Perception, Knowledge Gain, Transfer and Embodiment, n = 42*

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Acknowledgment
This work is part of the research project ViLeArnMore, funded by BMBF (16DHB2111) and realized in close cooperation with JMU and HCI Würzburg.