

The EduSync Project: Exploring the Potential of Social VR for Online Collaborative Learning

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IN THIS FEATURE, we will try to describe the characteristics of current cyberpsychology research in Europe. In particular, CyberEurope aims to describe the leading research groups and projects running on the other side of the Ocean.

Social VR for Online Collaborative Learning

Today, there is growing interest in the potential of the metaverse for education, particularly in the context of online collaborative learning. Although the term “Metaverse” has become a widely used buzzword, the most adopted form of this concept in current educational practice is represented by social virtual reality (VR). Unlike the broader vision of the Metaverse, which envisions persistent, interconnected virtual worlds, social VR environments typically offer temporary, tailored spaces designed for specific learning activities. Yet, they are designed to support co-location and real-time multi-user collaboration through avatar-mediated interaction. This allows users to engage and interact with one another in shared virtual spaces, creating conditions that closely mimic face-to-face collaboration.¹ Social VR learning environments can be hosted on commercially available platforms such as Spatial or Engage, but researchers may also develop purpose-built platforms designed to meet the requirements of their specific studies.² As such, social VR represents a promising alternative to traditional tools for online collaborative learning, primarily referring to videoconferencing platforms such as Zoom or Google Meet. In these conventional online environments, the lack of co-location and the limited availability of non-verbal cues and the restricted use of the body,³ may hinder the emergence of the “we-mode,” a state in which individuals perceive themselves as integral parts of a cohesive group and act with collective intentions, supported by underlying neuropsychological synchronization mechanisms.⁴

In traditional face-to-face classroom settings, these synchronization processes are naturally reinforced by physical proximity, shared space, and full-body interaction, which facilitate joint attention and smooth interpersonal coordination. This is where social VR platforms reveal their potential. By offering more immersive and embodied experiences, they realistically simulate key sensory and interpersonal

aspects of in-person interaction, potentially activating the synchronization processes that underpin the “we-mode.”

Key Psychological Processes in Online Collaborative Learning

Given the increasing attention toward social VR and its adoption in educational contexts, there is a growing need to examine how the core psychological processes involved in online collaborative learning, including social, cognitive, and emotional processes, operate within social VR learning experiences in order to assess whether they effectively promote the emergence of the we-mode.

On a social level, one key construct is social presence, which refers to the degree to which individuals feel that others are “real” within a mediated environment. Social presence emerges from a combination of factors, including co-location (the sense of being spatially together), intimacy (the emotional closeness experienced with others), immediacy (the perceived availability and responsiveness of partners), and behavioral interdependence (the sense of being mutually responsive through coordinated actions and reactions).⁵

On a cognitive level, key processes include mutual cognition, the development of shared understanding among group members, and the emergence of group flow, a collective state of optimal engagement in which participants are deeply synchronized in focus, rhythm, and task execution.

On an emotional level, mechanisms such as emotional contagion, the transfer of affective states among participants through embodied and contextual cues such as tone of voice, gestures, facial expressions, and spatial proximity.

Together, these psychological dimensions strongly influence participants’ perceptions of team effectiveness and satisfaction with the collaborative experience. Understanding how these processes unfold in social VR is crucial for advancing theoretical and empirical knowledge regarding how immersive technologies shape the social, cognitive, and emotional dynamics of online collaboration.

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The EduSync Project

Given these premises, the EduSync project aims to investigate the psychological underpinnings of online collaborative learning in social VR environments. Adopting a multidimensional perspective, the project aims to: (1) analyze the psychological processes involved in collaborative activities within social VR and (2) explore strategies to promote more effective collaboration in social VR environments.

Theoretical contribution

The first EduSync project goal is to conduct a scoping review aimed at mapping the psychological processes underpinning learning in social VR environments within higher education. This review responds to the need for a structured synthesis of the emerging empirical evidence by examining how cognitive, affective, and social dimensions are conceptualized, measured, and reported in immersive collaborative learning contexts. The review pursues several objectives. First, it will clarify the conceptual landscape by identifying the principal psychological constructs investigated in studies of social VR and documenting the diverse ways in which these constructs are defined and operationalized. Second, it will provide a methodological overview by mapping the range of data types employed in this field, including self-report measures, behavioral indicators, physiological synchronization metrics, and qualitative approaches. Third, it will synthesize how these psychological processes are described as shaping collaborative learning experiences.

By providing a systematic overview of current knowledge, the scoping review will not only establish a solid theoretical foundation for EduSync but also highlight critical gaps that the project's experimental component will address.

Experimental contribution

Building on this theoretical groundwork, the project will adopt a rich multimodal methodology to examine the synchronization processes underlying collaborative learning in social VR. The methodological choices will be informed by the findings of the scoping review, which will provide an overview of how cognitive, emotional, and social dimensions have been examined in previous studies. Drawing on this foundation, the project will seek to analyze these processes by approaching them from complementary perspectives—self-report, physiological, and behavioral—thereby offering a comprehensive understanding of the psychological processes involved in immersive collaborative learning experiences.

On a self-report level, we will collect both quantitative and qualitative data to assess participants' subjective experiences.⁶ Quantitative data will be gathered through questionnaires assessing key psychological dimensions of mediated collaborative experiences. In parallel, qualitative in-depth interviews will be conducted to capture nuanced user perspectives, challenges, and reflections on the collaborative dynamics experienced in VR. These narratives will help contextualize and enrich the quantitative findings.

Second, we will examine indicators of physiological synchronization, particularly cardiac synchrony. We will assess this through the analysis of heart rate variability (HRV) and

the temporal alignment of HRV patterns among team members during interactions. Previous studies have suggested that cardiac synchrony reflects interpersonal attunement, whereby individual physiological rhythms coordinate in response to shared tasks or experiences. This phenomenon has been linked to increased group cohesion, higher mutual trust, and more effective collaborative performance.⁷ In the context of collaborative learning in social VR, analyzing cardiac synchrony can provide an objective measure of the quality of attunement among participants. This allows us to explore how physiological coupling contributes to the emergence of the “we-mode” and the coordination processes that underpin successful group work.

Finally, behavioral data will be extracted to examine how interactional dynamics guide teams toward or away from successful task completion. To do so, we will analyze moment-to-moment behavioral patterns, including interaction frequency, turn-taking, eye contact, and gaze following. These metrics can signal engagement and balanced coordination, but they may also reveal imbalances, such as dominance by certain members or a lack of contribution from others. By relating these dynamics to both task performance and physiological markers of attunement, we aim to gain deeper insights into the conditions that enable successful learning in collaborative tasks.

Conclusions

This study aims to deepen our understanding of the psychological processes involved in learning within social VR environments, with particular attention to how these experiences compare to face-to-face learning context and traditional online platforms. In doing so, it goes beyond simply describing students' attitudes toward VR in education,⁸ by examining the psychological, cognitive, and emotional factors that shape collaborative learning experiences in social VR. Through a multimodal approach, the EduSync Project aims to generate a comprehensive understanding of how collaboration unfolds in the metaverse and how it can be meaningfully improved.

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