

CO-CREATING LEARNING SPACES: STUDENT AGENCY AND COLLABORATION IN THE METAVERSE

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Abstract

The objective of our study was to examine whether metaverse-based learning environments, when co-created by students, can enhance collaborative learning experiences in higher education. Specifically, the research investigated how co-creation influences engagement, social interaction, and collaborative effectiveness in virtual learning spaces. The study was implemented using the FrameVR platform across multiple higher education programmes. Twenty students used the platform to support group assignments and peer mentoring activities and eight of them were actively involved in co-creating their virtual environments. A mixed-methods research design was employed to evaluate the intervention. Qualitative data were analysed using thematic coding, while survey data were examined for usage and engagement patterns. Behavioural mapping of recorded sessions was used to analyse movement, interaction density, and patterns of collaboration. The results indicate that metaverse-based collaboration supported higher levels of engagement and interaction compared to typical videoconferencing practices. Embodied movement, persistent avatars, and interactive tools such as shared whiteboards and screens sustained participation. Co-creation practices were associated with increased student ownership, psychological safety, and willingness to contribute. The findings suggest that integrating co-creation into immersive learning design can enhance collaborative effectiveness and student wellbeing. The paper concludes with practical implications for educators and designers and identifies the need for longitudinal and cross-institutional research to assess sustainability and transferability.

Keywords: *Metaverse-based learning, student co-creation, collaborative learning, immersive learning environments, higher education.*

1. Introduction

As higher education shifts toward hybrid and online models, fostering meaningful student collaboration has become a significant challenge. Traditional platforms like Zoom and Microsoft Teams, while effective for lectures and one-to-one discussions, often fail to replicate the dynamic, informal interactions of in-person teamwork. This leads to disengagement, weaker social connections, and a reduced sense of togetherness, as students report feeling disconnected (Bergdahl, 2022).

The metaverse, a network of persistent, interactive 3D worlds, has emerged as a potential solution. Unlike conventional video calls, the metaverse allows users to interact via avatars, manipulate shared digital objects, and inhabit immersive spaces (Ritterbusch & Teichmann, 2023). Its unique affordances include spatial presence (a sense of "being there"), embodied interaction (non-verbal communication through gestures and proxemics), and student agency (co-designing virtual workspaces to boost engagement). These features are grounded in theoretical frameworks such as Social Presence Theory, Collaborative Learning Theory, Embodied Cognition, Media Richness Theory, and Flow Theory, all of which suggest that immersive environments, such as the metaverse, can enhance social connection, shared understanding, and motivation.

Practical applications of the metaverse in education are diversifying, including immersive ecosystem simulations, gamified learning platforms, and persistent virtual classrooms that foster a stronger sense of community than traditional videoconferencing (Jovanovic & Milosavljevic, 2022; Mistretta, 2022; Han et al., 2023). However, a significant research gap remains: most empirical studies have focused on technical feasibility or using the metaverse for lectures and simulations, rather than systematically investigating how its unique affordances enhance student collaboration specifically. Moreover, most

implementations are top-down, lacking participatory, co-creative approaches where learners help design their own collaborative spaces.

To address this gap, the presented work investigates whether the metaverse's affordances translate into measurable gains in collaboration, engagement, and wellbeing. It offers three key contributions: (1) a participatory design framework where students co-created their virtual workspaces with training and support; (2) empirical evidence from analysis of 14 recorded metaverse team meetings (~7 hours), survey data (n=54), and semi-structured interviews (n=9) addressing whether collaboration is effective in the metaverse and how students perceive engagement, wellbeing, and connection; and (3) practical insights and actionable recommendations for educators and developers. By combining student co-creation with mixed-methods analysis, the research bridges the gap between theoretical promise and practical application. The aim is to provide a balanced, evidence-based account to inform richer, more sustainable, and student-centred models of immersive learning.

2. Methodology

We employed a mixed-methods approach to investigate student collaboration in co-created metaverse environments, combining qualitative data (semi-structured interviews and behavioural observations) with quantitative data (post-surveys measuring engagement metrics such as collaboration frequency and self-reported satisfaction). This methodology is applied across three distinct academic contexts: undergraduate, postgraduate, and extracurricular settings, each involving student co-design of virtual spaces tailored to their collaborative needs.

2.1. Participants

The study involved two key participant groups. First, the co-creators: eight paid student interns who designed metaverse spaces and conducted data collection and analysis. Six of these formed or joined a metaverse team and completed surveys and interviews. Second, the teammates: fourteen additional students who joined the four metaverse-using teams, bringing the total collaborating students to twenty (six interns plus fourteen teammates). This dual structure enabled insights into both the design process (co-creation) and implementation (student usage). Ethics approval was obtained, and all participants provided informed consent.

The participants came from three programmes. The first is a first-year undergraduate Chemistry programme, where teams of five students create a sustainability-themed poster and presentation. The second is a Master's module in Sustainable Management, involving client-based group projects in teams of four. The third is the "Fresher to Thriver" (F2T) peer-mentoring initiative, where six senior undergraduates mentor junior peers across London and China campuses. Ultimately, four coursework teams adopted the metaverse: Teams A and B (two five-student Chemistry groups), Team C (a four-student Business and Management group), and Team D (a six-student F2T mentoring group).

2.2. Platform selection: FrameVR

FrameVR was chosen as the metaverse platform due to its balance of accessibility, flexibility, and user-centric design (Pazakou & Mystakidis, 2025). Key advantages included: accessibility (runs on standard laptops and desktops with no headset or installation required), ease of use (low learning curve with drag-and-drop tools and no coding needed), customisation (teams could add branding, shared displays, and adjustable layouts), and avatar personalisation (students customised appearances to boost engagement and representation). These features supported a collaborative, equitable, and creatively empowering environment.

2.3. Data collection and analysis

Approximately seven hours of video material (14 recorded meetings) and nine semi-structured interviews captured student behaviours and perceptions. Recordings were distributed across teams (Team A: 5, B: 3, C: 3, D: 3), with occasional technical issues. The interview sample comprised six co-creators and three teammates, all voluntary. All six interns who were part of a metaverse team agreed to be interviewed, while only three teammates chose to participate.

In parallel, 54 post-session surveys were completed by 19 participants (several contributing multiple times). Surveys combined Likert-scale items with open-ended questions to assess engagement and satisfaction.

Analysis proceeded in three stages. First, thematic coding of interview transcripts was conducted in NVivo. Second, emergent themes were compared with survey patterns to identify convergence and contrast. Third, behavioural analysis of video recordings focused on movement, gestures, and interaction in relation to spatial characteristics. Interviews provided depth, surveys provided breadth, and videos

provided behavioural corroboration, enabling triangulation of not only whether metaverse collaboration was effective but also how and why.

An initial coding framework was developed collaboratively by researchers and all eight interns to establish a shared analytical foundation. Interview transcripts were first coded independently by two student interns to maximise thematic coverage, after which researchers met to resolve inconsistencies and refine the thematic structure. This rigorous approach ensured that findings were grounded in both student perspectives and systematic analysis.

3. Results

3.1. The metaverse spaces

Four distinct metaverse spaces were co-created by student interns, each reflecting diverse design preferences. Space 1 (Team A, Chemistry undergraduates) was a minimalist study lounge featuring whiteboards and a green plant echoing the sustainability theme (see Figure 1). Space 2 (Team B, Chemistry) adopted a corporate, functional style with labelled zones including a presentation area, feedback areas, and a resource hub (see Figure 2). Space 3 (Team C, Master's students) was a modern multi-level conference hub with open meeting areas and private pods (see Figure 3). Space 4 (Team D, mentors) featured an intimate, personalised design with dark tones, university branding, Christmas decorations, and outdoor elements like water and trees (see Figure 4).

Interns expressed strong enthusiasm for the co-creation process, motivated by novelty and the potential to transform online collaboration. They contrasted the metaverse favourably with pandemic-era Zoom fatigue, finding the building process accessible, enjoyable, and versatile for various academic needs.

Figure 1. Space 1, used by Team A: a minimalist study lounge.

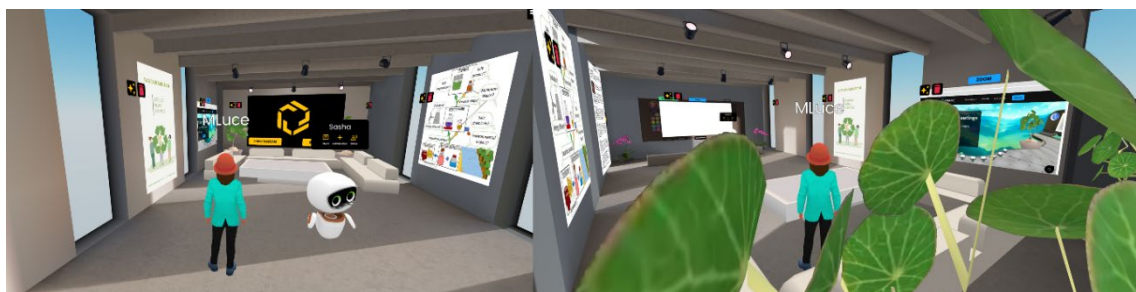


Figure 2. Space 1, used by Team A: a functional large convention centre.

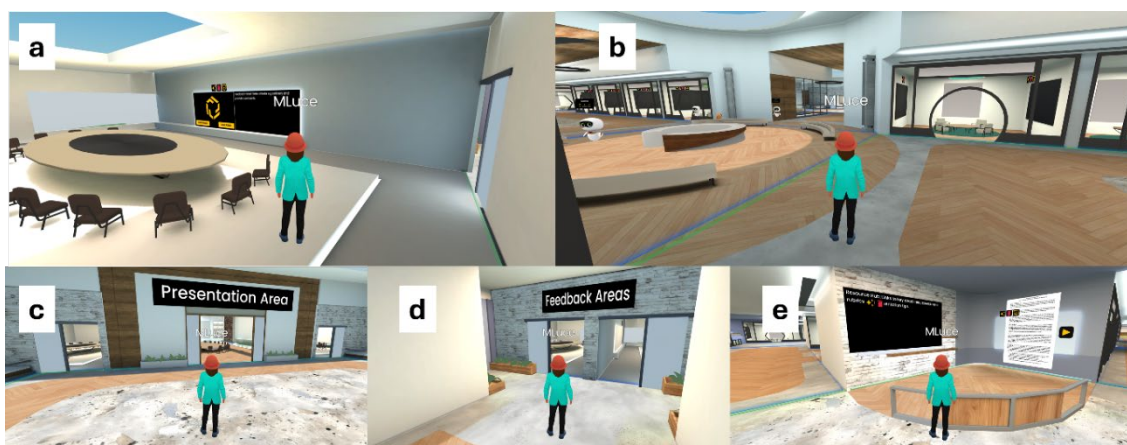


Figure 3. Space 3, used by Team C: a large conference hub.

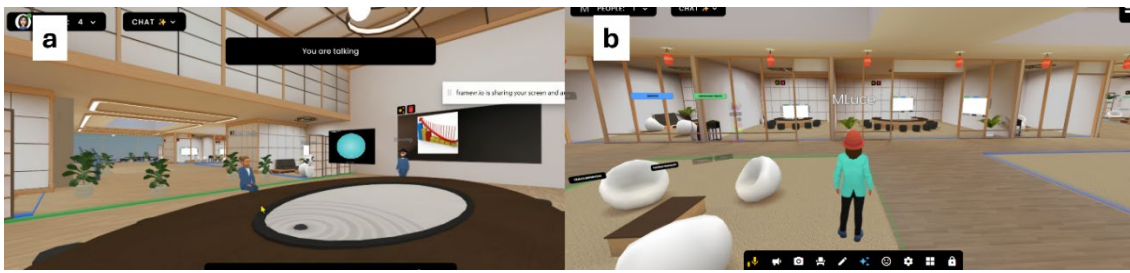


Figure 4. Space 4, used by Team D: a cozy multi-level meeting complex.



3.2. Empirical evidence on collaboration

3.2.1. Movement, presence, and atmosphere. Participants made frequent references to movement (52 references) and co-presence (40). Walking with avatars and exploring spaces transformed meetings into dynamic experiences, reducing the passivity of conventional video calls. Behavioural analysis showed that compact layouts (e.g., Team A) encouraged mobility, while expansive or partitioned spaces sometimes reduced movement and left peripheral zones unused. The atmosphere was consistently described as relaxed yet productive (31 references), with informal moments, laughter about avatars, small talk, and light games, setting a positive tone before focused work. This balance relieved stress, encouraged openness, and strengthened teamwork.

3.2.2. Tools, features, and avatars. Collaboration was closely linked to specific tools. Document sharing (23 references), screen sharing (20), and whiteboards (22) streamlined explanations and enabled interactive brainstorming, including playful uses like tic-tac-toe. Audio zones (23) were valued for potential subgroup work, though video data showed teams usually remained together. Avatars (50 references) were particularly salient, allowing professional representation or playful experimentation. Teams varied in their approach: Team A created avatars resembling their real selves emphasising authenticity, while others used preset options.

3.2.3. Comparisons with other platforms. Participants described the metaverse as a "middle ground", less formal than face-to-face yet far more engaging than Zoom or Teams, which were seen as "boring" or "impersonal." The persistence of virtual spaces (10 references) enabled continuity, though without moderation, distractions like spamming emotes could occur.

3.3. Survey evidence and team-level patterns

Out of 54 survey responses, 96% rated their experience as "good" or "very good," with no negative evaluations. Team-level patterns emerged clearly. Team A (minimalist design) reported the widest range of collaborative uses, team building, brainstorming, and exploration, with consistently positive ratings. Team B (corporate/functional) focused narrowly on presentation tasks and reported weaker engagement. Team C (modern conference hub) enabled multiple activities but produced mixed ratings. Team D (intimate/personalised) emphasised bonding, brainstorming, and exploration. These patterns suggest that minimalist, flexible designs may better support creativity and engagement, while overly formal or expansive spaces can limit interaction.

4. Conclusion and recommendations

In summary, participants found the metaverse highly effective. Screen sharing, whiteboards, and document sharing made teamwork more dynamic than conventional platforms. The same features enhanced engagement and inclusion. Informal interactions, avatar customisation, and playful rituals fostered bonding, reduced awkwardness, and motivated participation. Productivity arose not despite but because of the metaverse's socially rich, playful dynamics.

The findings align with and extend several theoretical frameworks. Supporting Social Presence Theory, avatars, shared spaces, and embodied gestures heightened perceptions of "being there together," addressing the fragmented interaction common to videoconferencing. From Collaborative Learning Theory, the metaverse enabled not just dialogue but shared practice, manipulating documents, brainstorming on whiteboards, and building trust through playful elements. Embodied cognition perspectives highlight how movement and gesture supported focus, while Media Richness Theory explains why the metaverse felt richer than Zoom through combined verbal, non-verbal, and spatial cues. Experiences of immersion and playfulness resonate with Flow Theory, where enjoyment sustained motivation.

Empirically, this study extends prior research that focused mainly on lectures or simulations, offering systematic analysis of teamwork effectiveness and wellbeing. Finally, the findings underscore the value of participatory, co-created environments. Students who configured their own spaces, experimented with avatars, and embedded bonding rituals demonstrated that agency in shaping environments was itself a driver of effectiveness. In line with socio-constructivist principles, productivity emerged from playful, socially rich dynamics, with informal interaction forming the basis for cohesion and teamwork.

Practical recommendations for educators and designers include: blending structure with informality (combining focused tasks with playful rituals), selecting and moderating features (prioritising whiteboards and avatars while managing distractions), facilitating with balance, empowering student agency through co-creation, and ensuring equity and access. Future research should pursue comparative and longitudinal studies examining how specific affordances shape collaboration and how immersive environments can be sustainably integrated into hybrid ecosystems.

Acknowledgments

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