

Move, Enjoy, Interact: Virtual reality dancing for youth with motor limitations

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Abstract

Enjoyment, physical engagement, and social interaction are the experiences most valued by youth with motor limitations in dance contexts. Building on this framework, the present study examines whether immersive virtual reality (VR) dance can provide these core qualities. During a one-week camp, youth with motor limitations participated in immersive VR dance sessions. Through qualitative and quantitative measures, we investigated whether three dimensions central to dance practice (moving, enjoying, and interacting) were meaningfully experienced in VR. Results were broadly positive, suggesting immersive VR dance holds promise as a complement to dance practice for youth with motor limitations.

1. Introduction

Dance offers a unique combination of physical, cognitive, and psychosocial benefits for youth with motor limitations, making it valuable in rehabilitation contexts (May et al., 2021). It also integrates qualities that are especially meaningful: moving (being physically active and engaged in one's body), enjoying (having fun), and interacting (sharing meaningful experiences with others). These dimensions were identified as central to youth engagement in dance through a participatory study involving youth, families, and practitioners (Poncet et al., 2025), and can serve as a framework for what adapted dance practice should prioritize. Despite the well-recognized benefits of dance for youth with motor limitations, access to dance remains limited for many youth with motor limitations due to physical, environmental, and social barriers (McKenzie et al., 2021). As a result, opportunities to experience the full benefits of dance are often restricted.

Social immersive virtual reality (VR) has emerged as a promising tool to address some of these barriers (Phelan et al., 2023). By creating shared, embodied virtual environments, VR enables users to participate in activities that may be difficult to access physically. The feasibility of VR dance with youth with motor limitations has already been demonstrated (Houzangbe et al., submitted), yet it remains unclear whether VR dance can deliver the core experiential qualities that matter most to youth and practitioners (Poncet et al., 2025). The present study examines whether immersive VR dance can support enjoyment, movement, and meaningful social interaction during a one-week dance camp. Guided by the framework proposed by Poncet et al. (2025), we evaluate VR not as a technology in itself, but in terms of its capacity to foster what youth and practitioners identify as most important in dance. This is the first study to move beyond basic feasibility by empirically evaluating a VR intervention against these user-centered priorities to optimize engagement.

2. Methodology

2.1. Research Design

Using a convergent parallel mixed method design, this study combined quantitative and qualitative data to assess whether VR dance met the core dimensions valued in dance for youth with motor limitations: enjoyment, movement, and interaction (Poncet et al., 2025). This mixed approach allowed us to capture rich, meaningful insights from the participants' lived experiences.

2.2. Participants

To prioritize safety and operational practicality during VR dance practice, we intentionally limited recruitment to a convenience sample of ten adolescents with motor limitations (mean age = 13.3 years, SD = 2.3; 6 females, 4 males), including four manual wheelchair users. Inclusion criteria required participants to be aged 11 to 18, have a confirmed motor limitation diagnosis and be able to follow instructions. Those with severe intellectual disability, epilepsy, stereoscopic vision disorders, severe balance disorders (except wheelchair users), or planned botulinum toxin injections during the camp week were excluded. Two female dance instructors participated to offer a professional perspective. Both had experience teaching dance to youth with disabilities, one as a school instructor and the other as a physiotherapist trained in adapted dance. One had prior VR experience; the other did not. Before the camp, both received a best practice guide and completed a two-hour VR familiarization session led by the research team. Written informed consent was obtained from all participants or their legal guardians, assent from participating youth, and the study was approved by the CHU Sainte-Justine research ethics board.

2.3. Intervention

The one-week camp included both in-person and VR dance sessions; this paper focuses exclusively on the latter. VR sessions were conducted on VRChat using Meta Quest 3 headsets, consistent with our prior study (Houzangbe et al., submitted). Participants chose their virtual environment and avatars, fostering a sense of agency and ownership. The youth were divided into two groups of five that worked together throughout the week, alternating between group activities and whole-class sessions. VR experiences occurred exclusively in these group settings. Two environments were selected (outer space and an underwater setting), with each group selecting its preferred environment. Each session lasted approximately 45 minutes and was held three times throughout the week, in a dedicated room where each participant had a 4×4 m area to move freely. One dance instructor and one researcher were fully immersed in the virtual environment alongside participants, while an additional team member remained in the physical room to ensure safety and spatial boundaries.

2.4. Quantitative Data

Primary measure. To assess whether VR dance sessions met their three intended objectives, participants completed a brief satisfaction survey after each session. Using an age-appropriate, anonymous pictorial scale with three response options (satisfied, neutral, dissatisfied) designed to minimize cognitive load and prevent choice fatigue (Mellor and Moore, 2014), a satisfaction rate was calculated for each objective per session by assigning scores of 2, 1, and 0 respectively. *Secondary measures.* Given that suitability and usability could influence all three objectives, both were evaluated alongside primary outcomes. Participants rated VR appropriateness using the Suitability Evaluation Questionnaire (SEQ; Gil-Gómez et al., 2013), a 14-item tool covering enjoyment, level of immersion, and cybersickness (score out of 65), administered after the first and third VR sessions. Instructors evaluated system usability with the French version of the System

Usability Scale (SUS; Gronier & Baudet, 2021), a validated 10-item measure on a five-point Likert scale (0 to 100), completed after their first VR dance session and at the end of the camp.

2.5. Qualitative Data

All 10 participants took part in the focus groups, with six sessions held in total (three per group, approximately 15 minutes each) were led by a research team member at the end of each camp day to document perceptions, satisfaction, and perceived facilitators and barriers to VR dance participation. Data were audio-recorded, fully transcribed, and anonymized for analysis. Both dance instructors also maintained a daily logbook, completed before sessions, during lunch breaks, and at the end of each day, to document program content, adaptations, and perceived facilitators and barriers.

2.6. Data Analysis

Quantitative data were analyzed using descriptive statistics and one-sample Wilcoxon signed-rank tests to assess whether the primary measures were significantly positive, with an expected median of 50%. The threshold for statistical significance was set at $p < 0.05$. Qualitative data were thematically analyzed using LibreQDA software by three members of the research team. Following the convergent design framework (Creswell & Plano Clark, 2018), quantitative and qualitative data were analyzed separately. Finally, both datasets were integrated during interpretation using a confirm-contradict-expand framework.

3. Results

3.1 Moving

Quantitative results: Participants reported significantly satisfying levels of movement in the second and third VR sessions ($p_{2,3} = .014$), while the first session was not deemed sufficiently physically engaging ($p_1 = .102$). Overall ratings were high, with no significant differences observed between sessions (see Fig. 1). *Qualitative results:* VR activities supported motor engagement, though movement varied by individual ability and context. Instructors documented physical engagement in their logbooks, including spontaneous transitions to standing among some participants who had been seated during the session: "Participant 406 is in a wheelchair and then stands up" (Dance instructors). Notably, this participant was ambulatory and had chosen to sit in a wheelchair to rest, yet chose to rise and engage more fully in the VR activity. Participants also self-reported feeling active: "we moved more in there" (Participant 403). However, movement in VR was perceived as qualitatively different from in-person dance: "the way we move there... it's not the same" (Participant 406), and motor participation was at times limited by fatigue, wheelchair constraints, and familiarity barriers such as joystick handling.

3.2 Enjoying

Quantitative results: Participants reported significantly high enjoyment across all three VR sessions ($p_1 = .002$, $p_2 = .003$, $p_3 = .005$), with no significant differences between them (see Fig. 1). *Qualitative results:* Sessions were broadly perceived as enjoyable, with positive appreciation expressed consistently across focus groups: "I loved VR" (Participant 403). Immersion, visual environments, avatars, and creative opportunities were identified as key contributors, and instructors noted sustained engagement throughout. Enjoyment was nonetheless reduced for some participants by technical difficulties (low sound, uneven avatar sizing, drained batteries) and

disorientation: "Participant 406 did not want to continue and mentioned that the environment was somewhat frightening" (Dance instructor).

3.3 Interacting

Quantitative results: Participants rated the level of interaction across all VR sessions as significantly positive ($p_1 = .008$, $p_2 = .008$, $p_3 = .002$), with no significant differences observed between sessions (see Fig.1). **Qualitative results:** Social interaction was a salient feature of the VR experience, taking primarily playful and spontaneous forms facilitated by avatar embodiment: "I love it when my hand goes through her head... it's really funny" (Participant 409). These exchanges elicited enjoyment and amusement, but also occasional frustration: "she won't leave me alone!" (Participant 405). Instructors independently observed similar patterns of spontaneous interaction across sessions.

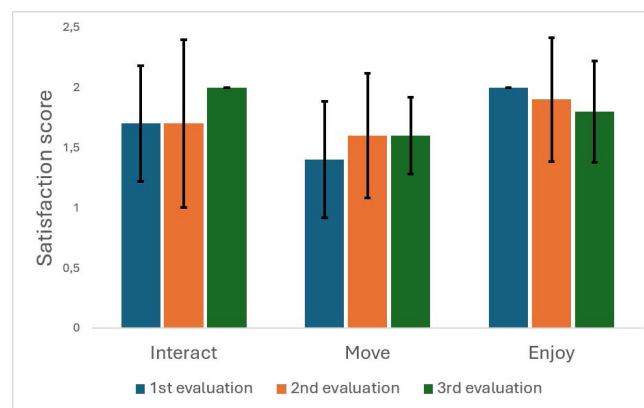


Figure 1: Satisfaction scores for the Interacting, Moving and Enjoying objectives across the three evaluation sessions. Error bars represent standard deviations.

3.4 Secondary measures

SEQ scores indicated high perceived suitability across both sessions ($M_1 = 56.3/65$, $SD_1 = 6.38$; $M_2 = 57/65$, $SD_2 = 6.02$), with a small, non-significant increase over time. Instructor-reported usability was similarly high, with both instructors showing a slight, non-significant, improvement between sessions (Instructor 1: $SUS_1 = 77.5$, $SUS_2 = 80$; Instructor 2: $SUS_1 = 62.5$, $SUS_2 = 75$).

4. Discussion and conclusion

Using a convergent parallel design, this study examined whether immersive VR dance could support the three qualities most valued in dance (moving, enjoying, and interacting) as identified by Poncet et al. (2025), among youth with motor limitations. Quantitative results were largely positive across all three dimensions, while qualitative findings expanded upon or confirmed these data by providing essential contextual information. Movement scores reached significance only from the second session onward, likely reflecting a familiarization effect. These high scores were corroborated by qualitative evidence of physical engagement. However, differences between VR and real-life movements, fatigue and technical difficulties negatively impacted the experience. This suggests that initial familiarity with the technology is necessary for participants to move as intended. Enjoyment was the most consistently positive dimension, driven by immersion, avatar embodiment, and creative engagement, though technical difficulties and occasional disorientation tempered the experience for some participants. While the quantitative data were overwhelmingly positive, qualitative insights provided nuance, revealing that the high degree of immersion

was potentially overwhelming for certain participants. Consequently, careful selection of virtual environments and situations is essential to optimize experiences for youth. Quantitative results regarding interaction were also consistently positive, and were confirmed by qualitative findings, which demonstrated that avatar-mediated exchanges fostered spontaneous peer contact. As a minor caveat, some interactions caused frustration, specifically the inability to reject certain interactions or limit intrusions into one's personal space. These interaction features can be disabled within the software settings and should be tailored to participant preferences. Secondary measures further supported these findings, with high SEQ and SUS scores. Taken together, these results suggest that immersive VR dance can meaningfully deliver the experiential qualities that youth and practitioners identify as central to dance practice. Rather than positioning VR as a replacement for in-person dance, these findings support its potential as a viable complement, particularly for youth who face physical, environmental, or social barriers to participation.

Some limitations should be noted. First, the study relied on self-reported measures, an effect we sought to mitigate by using a simplified three-level response scale for our primary objectives. Second, the relatively small sample size limits the generalizability of the findings; however, this constraint was necessary to ensure participant safety and maintain intervention quality. Finally, as an exploratory study, unforeseen technical difficulties altered the experience for some participants, which will be addressed in future iterations. Future work will examine home-based immersive VR dance, inviting children to join shared virtual sessions from their own homes, to test whether enjoyment, physical engagement, and social connection can be sustained without physical co-presence, thereby broadening access for youth with motor limitations.

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