LuminAI: Embodied AI as a Catalyst, Constraint, and Co-Creator in Dance Improvisation Class

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Abstract

As co-creative AI systems gain traction in artistic fields, their integration into formal improvisational pedagogy remains underexplored. This study examines how LuminAI, an AI dance partner, mediates improvisational practices within a structured educational setting, investigating how it reshapes norms and contradictions between pedagogy and AI-mediated co-creation. Using Cultural-Historical Activity Theory as an analytical framework, we conducted a three-month diary study with ten dancers and one instructor in an undergraduate improvisational dance course, capturing student reflections and instructor interviews. Our findings reveal that LuminAI functioned as both a catalyst and constraint in improvisation, reshaping movement decision-making, spatial awareness, and collaboration. Dancers adapted strategies to accommodate AI tracking limitations, adjusting tempo, spatial positioning, and clarity of movements. While some students experienced frustration due to technological constraints, others reported increased self-reflection, creative expansion, and novel co-creation dynamics. From an instructional perspective, the AI disrupted class structures, requiring the instructor to navigate tensions between AI engagement and human improvisational flow. Key contradictions emerged—between spontaneity and constraint, autonomy and responsiveness, and pedagogy versus AI-mediated co-creation. By analyzing these adaptations, we contribute to discussions on AI in co-creative education, advocating for systems that enhance rather than restrict embodied pedagogy, fostering new movement possibilities within improvisational dance.

Introduction

The integration of AI into artistic and performative practices has expanded beyond experimental settings into real-world applications, particularly in dance improvisation, choreography ideation, and interactive performance. AI systems such as **LuminAI** (Trajkova et al., 2023) have been used to generate movement sequences, inspire creativity, and act as improvisational agents, augmenting human artistry in novel ways (Long et al., 2020; Jacob et al., 2019; Deshpande and Magerko, 2024a). However, most studies on co-creative AI focus on short-term evaluations in structured workshops or controlled settings, limiting insights into how these systems integrate into professional creative workflows

over time (Zhou et al., 2024; Maher et al., 2023; Deshpande et al., 2024; Chen and Tong, 2023; Kim and Maher, 2021; Lucas and Martinho, 2017). Research on AI-assisted dance (Liu and Sra, 2024a; Wallace et al., 2023), music composition (Ford et al., 2024; Suh et al., 2021), and digital art tools (Deshpande et al., 2024) typically relies on immediate task-based assessments rather than longitudinal studies of sustained artistic adaptation. Even multi-session studies (Davis et al., 2024; Deshpande and Magerko, 2024b) remain limited in duration, leaving a gap in understanding how AI tools evolve with user adaptation and influence creative processes over time. This study addresses this gap by examining how **LuminAI** (Trajkova et al., 2023) functions within a formal undergraduate improvisational dance course, focusing on its role as a catalyst, constraint, and co-creator in the creative process. Using Cultural Historical Activity Theory (CHAT) (Batiibwe, 2019), we investigate the research question: ***How does LuminAI, an embodied AI, reshape the system of an improvisational dance class, and what contradictions emerge between traditional pedagogy and AI-mediated co-creation?*** To explore this, we conducted a three-month longitudinal diary study involving ten dancers and one instructor, collecting qualitative data through student logs, written reflections, and instructor interviews. Our findings reveal that LuminAI significantly restructured improvisational norms, shifting students' focus from human-human interaction to human-AI collaboration. While some dancers adapted their movement strategies—modifying spatial awareness, tempo, and gesture clarity—others found LuminAI's tracking constraints frustrating, exposing tensions between AI-imposed limitations and the fluid, spontaneous nature of improvisation. Rather than serving purely as a creative aid, LuminAI acted as both an enabler and an obstacle, reshaping the way dancers approached improvisation. From an instructional perspective, LuminAI transformed classroom dynamics, requiring the instructor to navigate between AI engagement and traditional group improvisation. The system's constraints, while sometimes restrictive, also encouraged deeper self-reflection and alternative movement exploration. These findings align with (Deshpande and Magerko, 2024b), who advocate for adaptable AI that responds to human improvisation, and (Bown et al., 2020), who emphasize the importance of dialogue-based co-creativity in AI-driven artistic collaborations. Ul-

timately, this study highlights the dual role of AI in dance pedagogy—both as a disruptive force that challenges established improvisational methods and as a tool that fosters new forms of creative exploration. By identifying key contradictions and adaptations in AI-mediated dance education, we contribute to ongoing discussions on AI's role in co-creative learning environments. We argue that AI systems must prioritize adaptability, transparency, and intentional design to better support embodied pedagogical practices, ensuring that technology enhances rather than restricts artistic expression.

Related Work

Artificial intelligence (AI) has emerged as a powerful co-creative agent across artistic, educational, and design domains. Researchers have explored how AI systems collaborate with humans in generative processes, improvisation, and ideation. However, much of this research emphasizes short-term usability and immediate interactional effects, leaving gaps in understanding how co-creative AI tools evolve over time or embed within professional and educational workflows. This section reviews three key areas of prior work: co-creative AI in dance and choreography, thematic analysis methodologies in co-creative AI research, and classroom deployments of AI systems that support creativity.

Co-Creative AI in Dance and Choreography

Dance has become an important focus in co-creative AI research, where AI-driven systems assist with choreographic ideation, improvisation, and movement augmentation. Studies on systems such as LuminAI investigate human-AI improvisation, revealing the movement adaptations required for AI-mediated performance (Trajkova et al., 2024). Tools like DanceGen provide early-stage choreography support but face challenges in aligning AI-generated sequences with artistic intent (Liu and Sra, 2024a). Other projects, such as Kinetic Dialogues, use AI-driven avatars to generate motion feedback loops, encouraging dancers to break habitual patterns, though sometimes disrupting structured rehearsal processes (Berman and James, 2015). Robotic dance studies similarly highlight tensions in maintaining thematic coherence, underscoring limitations in AI's capacity to generate compelling, integrated performances (Filippo et al., 2023). Despite these advancements, most research focuses on short-term interactions, leaving unexamined how dancers refine their use of AI systems over extended periods.

Challenges and Gaps in Longitudinal Evaluation

Across artistic domains, co-creative AI tools face persistent challenges, including aligning outputs with artistic intent, maintaining real-time adaptability, and cultivating user trust. Numerous studies emphasize that AI-assisted creativity requires ongoing human intervention, as artists refine AI-generated outputs to meet their creative goals (Liu, 2024; Pataranutaporn et al., 2024). Technical unpredictability—while sometimes a source of inspiration—can also disrupt structured creative workflows, creating friction in prac-

tice (Wallace et al., 2023; Deshpande et al., 2024). Critically, most evaluations remain confined to single-session experiments, assessing usability and creativity at a moment in time, rather than exploring how human-AI collaboration evolves within sustained professional or artistic settings.

Use of Thematic Analysis in Co-Creative AI Research

To capture the complex, subjective dimensions of human-AI collaboration, recent studies have increasingly employed thematic analysis as a qualitative research method. III (2025) applied thematic analysis to tabletop role-playing game experiences, assessing how generative AI enhances narrative co-authorship. In professional design, Park et al. (2024) revealed that designers predominantly frame AI as a visual ideation tool rather than a verbal collaborator, emphasizing the need for modality-sensitive systems. He and Do (2025) investigated industry perspectives on AI attribution, highlighting challenges around authorship boundaries. Ethical concerns were central in the work of Rezwana and Maher (2023c), who used design fiction to examine user trust and agency in human-AI co-creativity. In educational contexts, Jonsson and Tholander (2022) and Fu et al. (2025) applied thematic analysis to uncover tensions between automation, learner agency, and collaborative creativity. Thematic analysis has also supported the development of design frameworks, such as COFI (Rezwana and Maher, 2023a), which models human-AI interaction in co-creative systems. Overall, this methodological approach has provided critical insights into the subjective, relational, and ethical dimensions of co-creative practice.

Classroom Deployments of AI Systems Supporting Creativity

Beyond artistic domains, the classroom has become an increasingly important site for AI deployments that aim to foster creativity. Rane, Choudhary, and Rane (2023) explored how Education 4.0 and 5.0 frameworks leverage AI for personalized, adaptive learning, emphasizing student-centered creativity. Marrone, Taddeo, and Hill (2022) examined student perceptions of AI in creative tasks, highlighting the need to design educational AI systems that actively support creative thinking. Southworth et al. (2023) advanced the AI Across the Curriculum model, showing how embedding AI literacy across disciplines can empower creative student engagement. Grassini assessed the cognitive and creative impacts of tools like ChatGPT, while Wang, Sun, and Chen (2023) demonstrated that institutional AI capacity correlates with students' self-efficacy and creative performance. Addressing ethical considerations, Akgun and Greenhow Akgun and Greenhow (2022) emphasized the importance of constructionist, agency-oriented approaches in K-12 AI deployments. Holstein, McLaren, and Aleven (2019) developed real-time classroom orchestration tools to enhance hybrid human-AI collaboration, while Dimitriadou and Lanitis (2023) provided critical evaluations of smart classrooms, underscoring the need for alignment between technological affordances and pedagogical goals. For the ICCC community,

these studies offer valuable insights into how AI systems can not only assist artistic professionals but also cultivate creativity among learners in formal educational settings.

Study Design

A diary study, a qualitative longitudinal research method, was used to capture real-time participant experiences (Bolger, Davis, and Rafaeli, 2003). We employed a feedback study approach, where dancers responded immediately to structured prompts, reducing recall bias (Czerwinski, Horvitz, and Wilhite, 2004; Hess and Wulf, 2009). This method provided rich insights into how AI influenced improvisational decision-making, collaboration, and creativity. This study was guided by the following research question: How does LuminAI, an embodied AI, reshape the system of an improvisational dance class, and what contradictions emerge between traditional pedagogy and AI-mediated co-creation? This study received ethics approval from the Institutional Review Board at Georgia Tech, ensuring that all procedures adhered to established standards for research involving human participants. Prior to participation in the dance improvisation class, all students were informed of the nature of the class and were provided with detailed information sheets explaining the purpose, procedures, potential risks, and benefits of the study. Written informed consent was obtained from all participants. Given the dual role of the instructor as both teacher and research collaborator, special attention was paid to mitigating potential power dynamics. Researchers clearly communicated that the study was voluntary if enrolled and would not affect students' grades, class standing, or relationship with the instructor. To further reduce implicit pressures, the instructor did not have access to raw data or identifiable participant responses during the analysis phase. Research team members maintained participant confidentiality by anonymizing all transcripts and observation notes, ensuring that reported findings reflected collective patterns rather than individual performances or identities.

Participants

The study involved ten college-level BA students and one instructor from Kennesaw State University, a university located in the southeastern United States outside of Atlanta, GA. Nine identifying as female and one as male were undergraduates pursuing majors in dance, theater, psychology and exercise sciences and had 4 to 18 years of professional dance and choreography experience across modern/contemporary, improvisation, jazz, tap, African/afrobeats, hip-hop, liturgical, lyrical, musical theater, acrobatic, ballroom, Latin: bachata, salsa, tango, heels, belly dance, Chinese folk, and flamenco among other dance forms. The students had also been involved in a dance performance between 1 to 10+ times in the past year. The instructor who self-identified as a female has 21 years of teaching experience. The instructor is a choreographer, filmmaker, and educator with expertise in dance technique, improvisation, pedagogy, and the integration of technology in dance.

Class Structure

Each 75-minute session followed a structured format: **Warm-up (15 min)** focused on attendance, announcements, and physical exercises. **Concept Exploration (20–30 min)** introduced improvisational techniques and compositional strategies. **AI Interaction (30–35 min)** involved engaging with LuminAI to explore movement qualities like weight, space, and time. **Group Collaboration (10–15 min)** refined movement sequences inspired by AI interactions. Finally, **Reflection (10 min)** consisted of journaling insights on creativity, expressiveness, and adaptation.

Data Collection

The diary study used a structured 15-point questionnaire designed to capture dancers' immediate reflections on their experiences engaging with the LuminAI system. This questionnaire included prompts covering emotional reactions (e.g., "How did you feel about your interaction with LuminAI today?"), perceived creative outcomes (e.g., "Give examples of any instances where the tool sparked new ideas or influenced your movement choices."), technical interactions (e.g., "Did you face any problems today while using LuminAI?"), and broader reflective themes (e.g., "How did LuminAI challenge you today?".

To respect the natural flow of the class, the questionnaire was not completed mid-session but administered during the reflection portion at the end of each class. Dancers did not stop dancing to respond; rather, the reflection phase was a designated time after the movement activities, intentionally structured as part of the class to allow for cool-down, discussion, and meta-level reflection. Such reflective practice is already a standard component of many improvisation and dance pedagogy contexts, so incorporating written diary entries aligned naturally with existing pedagogical rhythms and did not represent a major disruption. The instructor provided parallel logs, reflecting on student interactions and pedagogical shifts. Additional data included two student reflections (during the halfway point and at the end) and an instructor's written reflection, supplemented by a retrospective interview exploring AI's impact on improvisation norms and class dynamics.

Final Performance

The study culminated in a live improvised performance with **LuminAI**, marking, to our knowledge, the first human-AI collaborative improvisation in a formal dance setting.

Cultural-Historical Activity Theory (CHAT) as Deductive Analysis and Inductive Analysis

We employed an iterative coding process grounded in Cultural-Historical Activity Theory (CHAT) (Batiibwe, 2019), a framework that examines human activity as a dynamic system shaped by interactions between subjects, tools, community, rules, division of labor, and outcomes. Recognizing that these components are historically developed and continually evolving, CHAT allowed us to situate the dance class not as isolated events but as a broader, socially and culturally mediated system.

Our analysis combined deductive and inductive approaches (Braun and Clarke, 2006). Deductively, we applied CHAT's seven core elements—*Subject, Object, Tools, Rules, Community, Division of Labor, Outcome*—to organize and interpret interactions within the activity system, ensuring theoretical alignment. Inductively, we engaged in open, bottom-up coding to capture emergent, context-specific patterns beyond the CHAT categories, such as students' shifting emotions, adaptive strategies, and unanticipated improvisational practices.

This process produced a comprehensive codebook of 20 themes, 29 sub-themes, and 60 distinct codes, systematically grouped under the CHAT framework: students (**Subjects**), pedagogical aims (**Object**), the LuminAI system (**Tools**), governing norms and constraints (**Rules**), the class collective (**Community**), shared and shifting roles (**Division of Labor**), and the creative transformations (**Outcome**). This hierarchical organization enabled a nuanced understanding of the multifaceted interactions shaping the human-AI improvisational space. A link to the CHAT diagram and codebook can be found **here**.

A central analytic focus was on identifying **contradictions**, or tensions within and between system components, which CHAT views as key drivers of change. We traced primary contradictions (within single elements, such as students' conflicting expectations), secondary contradictions (between elements, such as tool limitations versus creative goals), tertiary contradictions (between old and new practices), and quaternary contradictions (linking the activity to larger institutional or cultural contexts). By analyzing these tensions, we illuminated how integrating LuminAI reshaped pedagogical practices, creative processes, and social dynamics, offering critical insights into the evolving nature of human-AI co-creation.

Positionality

We recognize that in thematic analysis, researchers' backgrounds and interpretative frameworks significantly influence the data analysis process (Camurri et al., 2016). To enhance transparency and contextual understanding, we provide background information on the authors. The first author, who holds a Ph.D. in HCI, has a background as a professional ballet dancer. The second author is a dance professor with 34 years of dance training and has worked extensively with most of the students involved in this study. The third author is a Human-Computer Interaction (HCI) researcher with professional dance experience. The final author, who holds a Ph.D. in Computer Science, has expertise in computer science and cognitive science, with extensive experience in co-creative AI, museum and art installations, and creative computing education. By outlining these backgrounds, we aim to provide the reader with a clearer perspective on how our interpretative lenses may have shaped our thematic analysis.

Results

This section presents the findings of our study on integrating LuminAI into an improvisational dance class using Cultural-Historical Activity Theory (CHAT) as an deductive analytical framework as well as inductive analysis. The results reveal how LuminAI influenced creative collaboration, pedagogical dynamics, and movement generation, as well as how students and instructors adapted to its presence. Our analysis is informed by the daily student and instructor logs, two written student reflections in the middle and at the end of the study, instructor post-study questionnaire responses, and a retrospective interview with the instructor, highlighting key contradictions, emerging patterns, and the evolving perception of LuminAI over time.

Subject: Student and Instructor Perspectives

Student Experience: From Skepticism to Adaptation

When first introduced to LuminAI, many students viewed it as an unnecessary or even frustrating addition to their improvisational practice. Some felt that AI lacked a clear purpose in dance, with Dancer 3 admitting, *"I didn't really get why we need to integrate AI into dance and I don't really like it."* Others were initially disappointed by the system's glitches and lack of responsiveness, with Dancer 5 remarking, *"I was expecting more, but the AI kept glitching and wasn't picking up what I was doing."* The perception that LuminAI failed to recognize or reflect the nuance of their movements caused some students to disengage entirely. Dancer 4 candidly shared, *"I did not really pay attention to the AI, it doesn't really pick up what I'm doing anyways. . . I got my inspiration from other dancers much better."* Over time, however, many students adjusted their expectations and learned to work within the system's constraints. Some began to see LuminAI as a tool for creative exploration rather than as a direct co-creator. Dancer 5, who had initially resisted the AI, later acknowledged, *"With every session, I began to see improvement. . . The movements of LuminAI were starting to look like actual dances."* Another reflected on their gradual shift in perception, saying, *"At first, I was really skeptical, but by the end, I was more comfortable and confident to try new things and branch out with my improv with the AI"* (Dancer 10). By the end of the semester, students had developed a range of responses to LuminAI. Some continued to question its artistic purpose, while others found it useful for breaking habitual movement patterns and discovering new possibilities. Dancer 9 described this realization, stating, *"When dancing with LuminAI, I realized that my improv is very repetitive. The AI encouraged and inspired me to branch out."*

Instructor Perspective: Mediating AI in the Classroom

The instructor initially struggled to determine how best to incorporate LuminAI into an improvisational curriculum, which traditionally prioritizes spontaneity, human connection, and embodied feedback. She acknowledged that integrating AI into the classroom was both an exciting opportunity and a pedagogical challenge, explaining, *"It takes a lot of focus and doesn't seamlessly integrate into many ideas – you have to be very specific about how you want to use it and*

design experiences to meet those goals." As the semester progressed, the instructor observed growing student engagement, which shaped her own perception of LuminAI's role in the classroom. She reflected, *"My perception is much influenced by how my students are receiving the tool. In the past few weeks, I have seen some excitement emerge, which lifts my perception as well."* While she recognized LuminAI's potential for prompting new movement choices, she also noted its inability to replicate the depth of human connection that is fundamental to dance improvisation. Comparing LuminAI to traditional duet improvisation, she remarked, *"LuminAI does not compare to improvising with a real partner at this point."* Despite these limitations, she saw value in LuminAI as a creative stimulus, particularly in encouraging students to approach movement with greater intentionality and to rethink their relationship with technology in dance.

Object: Goals of AI Integration

The goal of integrating LuminAI into the course was to expand students' improvisational learning by introducing an AI system as an interactive dance partner. The instructor hoped that LuminAI would challenge students to develop adaptability, generate unexpected movement ideas, and explore new choreographic possibilities. At first, students struggled to understand the purpose of working with AI in a dance context. Dancer 3 admitted, *"I was confused about the point of a dance AI."* Others were intrigued by the intersection of technology and dance, with Dancer 6 stating, *"I was interested in how science and something like dance could come together to create something really cool."* As students continued engaging with LuminAI, many recognized its potential as a tool for movement reflection rather than as a replacement for human collaboration. Dancer 11 described this shift, explaining, *"To me, the AI was a reflection of myself. Not a direct mirror, but a reflection of the emotion and general ideas of my movements."* Another saw LuminAI as an unbiased movement generator, noting, *"It can show you your movement vocabulary while also showing you modified or new ways to move"* (Dancer 12). By the end of the course, most students had adjusted their expectations and found ways to engage with AI creatively, even if they did not see it as a fully autonomous improvisational partner.

Tool: AI as a Movement Mediator

LuminAI functioned as both a creative prompt and a constraint. Some students found inspiration in its responses, with Dancer 11 saying, *"Sometimes it would give me ideas that I could add into my improv."* Others, however, found its lack of real-time interaction limiting, describing it as *"cold"* compared to human partners (Dancer 4). Technical limitations shaped how dancers engaged with AI. Dancer 5 noted, *"I had to alter my way of thinking with my improvisation and be more creative with it,"* explaining how AI's inability to track floorwork or quick movements forced students to adjust their approach. Despite its limitations, some students appreciated LuminAI's capacity for iteration, seeing its evolving movements as a source of feedback. Dancer 9 said, *"At times, I get a little scared at how good the AI [can] dance and remember what the class has taught it."*

Rules: Adapting to AI Constraints and Changing Classroom Norms

Unlike traditional improvisational classes where dancers move freely, LuminAI imposed spatial and technical constraints. Students had to remain within a designated range for the AI's motion-tracking to function correctly and adjust their movement style to be readable by the system. Dancer 12 reflected, *"Even if I was inspired by something the AI did, it wasn't as easy to execute the movement if it was something larger than the space could accommodate."* Similarly, some had to slow down their movements for the AI to register them, which unexpectedly altered their movement quality. The instructor noted that students gradually learned to negotiate these constraints, explaining, *"It took a while for students to realize that the AI doesn't pick up everything they do, and so they started adapting their movement to what the AI could actually read."* Rather than responding spontaneously to a human partner, students had to strategize their movements to maximize engagement with LuminAI. Beyond technical adjustments, LuminAI reshaped behavioral norms in the classroom. Improvisational dance typically relies on immediate embodied feedback from peers, but because AI lacks emotional expression, students had to develop patience with miscommunication. At first, some reacted with frustration. Dancer 6 remarked, *"Trying to interact with the agent, while also interacting with my fellow dancers, while also having a stage presence... snuffed out my expression."* Over time, however, students adopted a more experimental mindset, reframing LuminAI's errors as opportunities for improvisation rather than failures. The instructor encouraged this shift, stating, *"I told them to stop expecting the AI to be a perfect partner. Instead, they needed to see what new ideas it could bring into their movement."* This change in classroom norms was evident in how students responded to LuminAI's occasional glitches. Early in the semester, they would pause or disengage when the AI failed to respond correctly. Later, many learned to continue moving despite system errors, treating technical disruptions as moments of creative discovery. Dancer 8 noted, *"At first, I would just stop when the AI froze. But later, I realized I could actually incorporate its pauses into my own dance."*

Community: Redefining Group Dynamics in an AI-Augmented Class

Initially, some students felt isolated by the individual nature of dancing with AI. In previous improvisation exercises, dancers moved freely, responding to each other in real-time, nonverbal dialogue. However, LuminAI required dancers to take turns interacting with the system, creating a sense of division in the class. Dancer 7 shared, *"At first, I felt that we were thriving by creating a semi-sacred space... sans technology. Then suddenly, we were being observed, and the AI was this third presence in the room."* The instructor also noticed that LuminAI initially disrupted the sense

of vulnerability and trust that is critical to dance improvisation, explaining, *"It felt like some students withdrew when the AI was introduced. It was like they were waiting to see how others handled it before engaging themselves."* Over time, students developed new ways of supporting each other while working with LuminAI. They began observing each other's interactions with the AI, offering feedback and reflections on how different movement styles influenced the AI's responses. Dancer 10 observed, *"Seeing how my classmates interacted with the AI helped me recognize my own movement habits."* Students also started sharing strategies for engaging with LuminAI, treating it as a collective learning tool rather than an isolated dance partner. Dancer 2 explained, *"At first, I thought it was just me who couldn't get the AI to respond well. But when we started talking about it, I realized we were all figuring it out together."* By the end of the semester, students described being part of an experimental, AI-integrated dance community as both challenging and rewarding. Dancer 11 reflected, *"We started as a dance class, but by the end, it felt like we were part of a bigger conversation about how AI and movement can coexist."*

Division of Labor: Shifting Roles Between Humans and AI

The instructor's role shifted from being the primary guide of improvisation to a mediator between students and AI. Traditionally, an improvisation instructor provides real-time feedback, guiding students through movement explorations. However, with LuminAI in the classroom, the instructor's role became more about structuring engagement with AI. She described her experience as, *"Not dancing with the AI as much as designing experiences for the dancers to interact with LuminAI."* Students were not simply dancing with LuminAI; they were also teaching it. Dancer 1 described the experience as, *"Teaching an AI like teaching a child to dance."* Many noticed that over time, the AI seemed to retain movement characteristics from their previous sessions, creating a sense of co-evolution between human and machine. This role reversal—where students were both improvisers and AI trainers—created new opportunities for reflection. Dancer 11 remarked, *"At times, I get a little scared at how good the AI [can] dance and remember what the class has taught it."*

Outcome: Transformations in Improvisational Practice and Learning

Students found that engaging with LuminAI pushed them beyond habitual movement patterns, fostering creative exploration and adaptability. Some discovered new movement possibilities, noting that the AI encouraged them to change tempo, break habitual rhythms, and expand their improvisational vocabulary. Others experimented with structured co-creation, building phrases iteratively with AI responses. While initially constrained by technical limitations, students adapted their strategies over time, improving their problem-solving skills and self-awareness of movement. The final performance reflected these transformations, as students successfully incorporated LuminAI, with some recognizing

that its movements became more readable and expressive. Although skepticism about AI's role persisted, many students gained an appreciation for its potential in choreography, research, and movement analysis. However, LuminAI did not fully replicate the depth of human improvisational partners, as some dancers felt it lacked emotional reciprocity, limiting expressive engagement. The instructor acknowledged that while LuminAI contributed to the final performance, it remained an effortful integration rather than a seamless component of improvisation. Some students remained unconvinced of AI's artistic value, expressing concerns about its inability to replicate the primal, reflective nature of dance. While LuminAI demonstrated the potential for AI-assisted improvisation, refining its responsiveness, adaptability, and emotional sensitivity will be essential to ensuring that it enhances rather than constrains artistic expression.

Contradiction Analysis

Contradictions—internal tensions that drive change—emerged throughout the LuminAI dance class, shaping how students and the instructor navigated AI integration. Using the CHAT framework, we analyze primary (within a single component), secondary (between two components), tertiary (between old and new practices), and quaternary (between the activity and external contexts) contradictions.

Primary Contradictions (Within Individual Components)

Within Students Many students wrestled with conflicting feelings about AI in dance. Dancer 3 expressed, *"I still don't really get why we need to integrate AI into dance and I don't really like it. . . I am still trying to keep an open mind though."* This tension between skepticism and curiosity marked a key internal contradiction. Another common struggle was between creativity and inhibition. Dancer 6 admitted, *"The AI put a lock on my expressiveness because I felt like I couldn't work with it."* Initially, many students hesitated, unsure whether to simplify movements for the AI or stay true to their style. Over time, they reframed their approach, seeing LuminAI as a tool rather than a judge.

Within the Instructor The instructor balanced excitement for AI's potential with the challenges of preserving improvisation's organic nature. She described the process as both *"interesting and challenging"*—a tension between her traditional teaching philosophy and the structured demands of AI interaction. Additionally, spontaneity clashed with the need for careful planning: *"You have to be very specific about how you want to use it."*

Within the Tool (LuminAI) LuminAI itself contained contradictions between its intended purpose and actual performance. It was meant to act as a co-creative dance partner, yet students noted it *"just wasn't human-like whatsoever"*. Glitches, freezing, and limited responsiveness underscored the gap between concept and reality.

Within Rules Improvisation typically prioritizes freedom, yet AI required restraint. Dancer 4 expressed frustration: *"I had to transform my dancing into AI, which was very frustrating because that's not what dancing is about. . . I really think it should be AI cooperating with me, instead of me having to fit my dance into AI."* Even when students followed AI-friendly rules (staying within the tracking zone, simplifying movements), the AI sometimes failed to respond, undermining the system's logic.

Within Community LuminAI's solo interactions disrupted the collective energy of group improvisation. The instructor noted, *"It influences the sense of community by pulling individuals out of a group experience."* Initially, some students disengaged when it wasn't their turn, leading to fragmentation. Over time, community investment was rebuilt through shared reflections and feedback.

Secondary Contradictions (Between Two Components)

Tool vs. Object The goal of the class (Object) was to foster improvisational creativity, yet the tool (LuminAI) initially limited expressiveness. Dancer 5 observed, *"Compared to before we started with AI, I think I was more expressive than after the sessions began. . . trying to interact with the agent. . . snuffed out my expression."* However, students adapted by using repetition and smaller movements to find creative strategies within the AI's constraints.

Subject vs. Tool Students expected an intuitive, responsive dance partner but instead encountered an impersonal system. Dancer 8 reflected, *"I like to incorporate [a partner's] feelings. . . although LuminAI is cool, I don't get that same personal connection. . . with other people."* The absence of emotional reciprocity clashed with dancers' need for human connection, requiring them to redefine their expectations of collaboration.

Subject vs. Rules New AI-based constraints, such as staying within a fixed area, conflicted with dancers' instincts to move freely. Dancer 7 commented, *"Even if I was inspired by something the AI did, it wasn't as easy to execute the movement if it was something larger than the space could accommodate."* The tension between artistic impulse and imposed limitations remained an ongoing challenge.

Tool vs. Community LuminAI's one-at-a-time interaction model disrupted the communal nature of the class. Initially, some students lost engagement when not directly interacting with the AI. Dancer 2 reflected, *"Integrating the avatar was wonky."* Over time, students adapted by observing and providing feedback, creating a sense of shared investment.

Tertiary Contradictions (Between Old and New Practices)

Traditional improvisation relies on human responsiveness, spontaneous energy flow, and full spatial freedom. AI-mediated improvisation introduced interruptions—students had to focus on being visible to the sensor, adjust their movements to fit AI constraints, and wait for responses. Dancer 9 reflected, *"Before AI, we had a semi-sacred space to build trust and human connection. . . sans technology."* The integration of AI felt like a return to self-consciousness, requiring adjustments in mindset and pedagogy. The instructor also had to shift from open-ended improvisation to structured AI-based exercises.

Quaternary Contradictions (Between the Activity and External Contexts)

A key quaternary contradiction was between the class's experimental nature and traditional dance education norms. Students questioned AI's relevance to their professional development. Dancer 10 shared concerns, *"My only concern would be AI taking jobs from dancers in an already challenging environment."* This highlighted a broader conflict between artistic innovation and industry concerns. Institutionally, bringing AI into the studio required additional resources and technical support, revealing tensions between creative ambitions and logistical constraints. Contradictions in the LuminAI dance class initially created resistance and frustration, but over time, they drove adaptation and learning. Students and the instructor negotiated tensions between freedom and structure, emotional connection and technical constraints, and traditional improvisation and AI-mediated practice. While challenges remained, the process demonstrated that even unresolved contradictions could foster growth, prompting new strategies for AI-integrated improvisation.

Discussion

LuminAI as a Disruptor of Spatial Containment in Improvisation

LuminAI disrupts traditional spatial boundaries in improvisation, transforming dance spaces into dynamic, adaptive environments. Unlike static studio or stage settings, LuminAI creates a permeable spatial system where dancers continuously renegotiate movement boundaries. As observed in the results, dancers noted that their spatial awareness shifted in response to the AI's cues, requiring constant adjustment to maintain engagement. This aligns with research on AI-human territoriality in dance, where AI not only exists in space but actively reshapes movement environments (Long and Magerko, 2017; Gemeinboeck and Saunders, 2017). LuminAI's responsiveness leads dancers to fluidly step in and out of engagement, challenging conventional distinctions between participation and non-participation (Zhang et al., 2024). Rather than removing containment, LuminAI transforms it into an elastic, responsive framework. While AI introduces new spatial possibilities, dancers continue to impose learned spatial structures on their movement, even when improvising with AI (Trajkova et al., 2024). Prior research suggests that some level of spatial stability enhances dancer autonomy by providing a reference point for movement exploration (Long and Magerko, 2017). LuminAI's ability to shift spatial expectations highlights the evolving relationship between AI and improvisation, demonstrating

how technology can act as both a constraint and a catalyst for movement adaptation.

LuminAI as a Learning Partner, Not an Autonomous Improviser

Rather than an independent co-creator, LuminAI functions as a learning partner that requires human guidance. One dancer described, *"It wasn't really making its own choices—I felt like I had to teach it how to dance with me."* This supports the distinction between AI as a tool versus a creative partner (Jacob and Magerko, 2015; Ciolfi Felice and McDonnell, 2016). LuminAI reacts to dancer input rather than generating movement independently, forming an iterative process of co-regulation. Similar patterns appear in AI-assisted music and theater, where performers develop strategies to shape AI responses (Deshpande and Magerko, 2024b). However, recent work in computational creativity suggests AI could move beyond pure reactivity by incorporating anticipatory movement intelligence (Deshpande and Magerko, 2024b). Research on AI turn-taking in improvisation shows that dancers prefer systems that alternate between following and leading (Winston and Magerko, 2017). While LuminAI currently operates as a follower, future iterations could introduce moments where AI takes initiative to challenge the dancer.

LuminAI as a Reflective Mirror, Not a Generative Creator

A key finding is that LuminAI primarily functions as a mirror for movement reflection rather than a fully generative improviser. While it introduces variations, it does not generate novel choreographic material. *"It made me think about what I was already doing, but it didn't really push me in new directions,"* one dancer noted. This aligns with previous research on reflective AI improvisation, where systems echo and transform human input rather than producing original movement (Long and Magerko, 2017; Jacob and Magerko, 2015). AI-assisted choreography tools similarly function as lenses for movement inquiry rather than independent creators (Liu and Sra, 2024b). However, this reflective quality presents limitations. Some dancers found LuminAI's lack of unexpected variability restrictive, prompting the question: Should AI primarily serve as a tool for movement analysis, or should it act as a generative partner? Research suggests effective improvisation depends on balancing predictability with spontaneity—AI that is too repetitive is unstimulating, while excessive randomness disrupts coherence (Kantosalo and Toivonen, 2016). Future designs could incorporate adaptive spontaneity, allowing AI to introduce calculated risks in movement generation.

Cognitive and Cultural Implications of AI Improvisation

Beyond individual movement analysis, the integration of AI into dance raises broader cognitive and cultural questions about how technology reshapes artistic traditions. While prior research has explored how some AI systems encode and transform movement vocabularies — preserving certain stylistic features while introducing novel variations (Zhu and Tan, 2024; Pataranutaporn et al., 2024) — it is important to clarify that LuminAI was not explicitly designed with such goals. Rather, LuminAI's improvisational interactions primarily reflect real-time responses to dancer inputs, without underlying models aimed at learning or preserving specific dance styles. Nonetheless, its presence in the improvisational space prompts dancers and instructors to renegotiate choreographic norms, reconsider the boundaries of co-creative agency, and reflect on how digital partners might influence the evolution of embodied practices over time. However, concerns about algorithmic bias persist. If AI models primarily reflect Western contemporary dance aesthetics, they risk marginalizing diverse movement traditions (Crnkovic-Friis and Crnkovic-Friis, 2016). One dancer questioned, *"What happens when AI only recognizes certain styles? Are we training it to forget other kinds of dance?"* Future research should explore culturally diverse datasets and adaptive movement filters to ensure AI systems remain inclusive.

Contradictions and Challenges in AI Improvisation

- **Predictability vs. Novelty** – AI must balance predictability with creative surprise. If too repetitive, it becomes uninteresting; if too random, it disrupts coherence (Kantosalo and Toivonen, 2016). The challenge is designing AI that maintains dancer engagement while introducing occasional variation.

- **Control vs. Responsiveness** – Negotiating leadership is complex. *"Was I leading the AI, or was it leading me?"* one dancer asked. Research on AI turn-taking suggests that alternating roles fosters better engagement (Winston and Magerko, 2017). Future AI systems should dynamically shift between leading and following to maintain improvisational flow.

- **Choreographic Authorship and Dancer Agency** – The introduction of AI complicates authorship. If AI influences movement creation, does it share choreographic credit? While most choreographers still see AI as a tool rather than a co-creator, live improvisation blurs these boundaries (Ciolfi Felice and McDonnell, 2016; Pataranutaporn et al., 2024).

- **Ethical and Philosophical Considerations** – Some argue AI lacks the embodied intuition necessary for true improvisation (Jochum and Derks, 2019). Others see improvisation as a learnable AI behavior. Additionally, concerns arise about AI replacing human dancers or diminishing emotional investment in movement creation. The challenge remains ensuring AI empowers rather than diminishes human creativity (Zhou et al., 2021).

Future Directions in AI-Augmented Dance

AI dance partners are advancing from reactive responses to predictive engagement, anticipating movement and co-creating in real time (Alexanderson et al., 2023). AI tools increasingly assist choreographers by generating movement from prompts like "fluid" or "sharp" (Liu and Sra,

2024b), with future systems integrating natural language and gesture-based controls (Rezwana and Maher, 2023b) to enhance workflows while maintaining artistic oversight. Rather than imitating dancers, AI will complement human movement with unique stylistic tendencies, improving ensemble interactions (Rezwana and Maher, 2023b). Visual cues, such as color shifts signaling movement changes, could support intuitive collaboration. AI also holds promise in education and therapy, refining movement styles, providing structured improvisational guidance, and aiding rehabilitation (Long and Magerko, 2017). AI's interdisciplinary applications continue to grow, integrating dance, music, and visuals into interactive performances (La Delfa et al., 2020). Additionally, AI could preserve dance traditions, though algorithmic bias must be addressed to ensure inclusivity (Crnkovic-Friis and Crnkovic-Friis, 2016).

Limitations

This qualitative study offers in-depth insights from a specific undergraduate dance context but does not aim for broad generalizability. While perspectives from professional dancers or those trained in diverse cultural dance traditions (e.g., non-Western, Indigenous, or culturally specific movement systems) could provide valuable additional viewpoints — particularly regarding different movement vocabularies, improvisational norms, and interpretations of AI-mediated interaction — exploring them was beyond this study's scope. The reliance on self-reported reflections may introduce bias, which future work could address through observational or video data. Additionally, the study's short duration and LuminAI's technical constraints limited insight into long-term integration, highlighting areas for future research and system improvement.

Conclusion

This study offers, to the best of our knowledge, the first longitudinal analysis of how an embodied AI system, LuminAI, integrates into a formal improvisational dance class, revealing how it reshapes creative practices, pedagogical dynamics, and movement decision-making. Using Cultural-Historical Activity Theory (CHAT), we examined the evolving interactions between students, instructor, and AI, finding that LuminAI acted both as a catalyst for creative exploration and a constraint that required dancers to adapt their strategies and expectations. While some participants remained skeptical of AI's artistic value, others reported increased self-awareness, expanded improvisational vocabulary, and novel collaborative experiences. Importantly, the instructor's role shifted from facilitating human-only improvisation to mediating human-AI interactions, underscoring the need for intentional pedagogical approaches when integrating AI into creative education. By identifying the key contradictions and adaptations that emerged, this research advances understanding of co-creative AI's role in embodied learning and argues for the development of future AI systems that prioritize adaptability, responsiveness, and transparency to meaningfully enhance, rather than limit, human improvisational practice.

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