



A Study of Traditional Oil Painters' Artmaking Experiences in Virtual Reality

Kajian Pengalaman Penciptaan Seni dari Pelukis Cat Minyak Tradisional di dalam Realitas Virtual

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ABSTRACT

Recent technological developments have brought back virtual reality (VR) as a new creative medium. This research investigates how artists with no prior VR experience perceive and employ immersive VR environments to translate their physical world creative concepts into the virtual realm. By bridging the gap between traditional and virtual reality art, this study contributes to a deeper understanding of affordance theory in today's context. Using a phenomenological approach, data was collected through immersive VR painting sessions, think-aloud protocols, and reflective interviews. Over three sessions, one selected participant utilized OpenBrush to explore the affordances of VR painting. Key findings reveal a transformative shift in artistic knowledge and practice. Participants adapted their understanding of materials and techniques to the unique affordances of VR, aligning with affordance theory and actor-network theory. The study's implications for artists are that by integrating VR into traditional art practices, artists can explore new creative avenues. Additionally for VR developers, the findings suggest potential improvements to VR tools, such as enhancing haptic feedback or developing more intuitive interfaces to better support artistic expression.

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ABSTRAK

Perkembangan teknologi terkini telah membawa kembali realitas virtual (VR) sebagai media kreatif baru. Penelitian ini mengkaji bagaimana seniman yang tidak memiliki pengalaman berkarya menggunakan VR dalam memahami dan menggunakan lingkungan VR imersif untuk menerjemahkan konsep kreatif dunia fisik ke dalam dunia virtual. Dengan menjembatani kesenjangan antara seni tradisional dan virtual, penelitian ini berkontribusi pada pemahaman yang lebih mendalam tentang teori affordance dalam konteks saat ini. Dengan menggunakan pendekatan fenomenologis, data dikumpulkan melalui praktik melukis VR imersif, think aloud, dan wawancara reflektif. Selama tiga sesi, peserta yang terpilih menggunakan software Open Brush untuk mengeksplorasi affordance lukisan VR. Temuan utama mengungkapkan perubahan transformatif dalam pengetahuan dan praktik artistik. Peserta mengadaptasi pemahaman tentang materialitas dan teknik dengan affordance VR yang unik serta selaras dengan teori affordance dan teori jaringan-aktor. Implikasi penelitian ini bagi

para seniman adalah dengan mengintegrasikan VR ke dalam praktik seni tradisional, para seniman dapat menjelajahi berbagai cara kreatif baru. Selain itu, bagi para pengembang VR, temuan ini menyarankan beberapa peningkatan pada perangkat VR, seperti meningkatkan umpan balik haptik atau mengembangkan antarmuka yang lebih intuitif untuk mendukung ekspresi artistik dengan lebih baik.

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Introduction

Recent technological developments and the availability of more compact and affordable VR devices have given rise to virtual reality (VR) as a new creative medium. Creative programs like Tilt Brush, Gravity Sketch, and PaintingVR, integrated into VR devices, enable artists to create an immersive virtual environment that mimics traditional painting, with an interface that emphasizes brush imitation, color palette selection, and stroke techniques (Mu et al., 2022). Artists can create and manipulate visual elements in mid-air thanks to the functional aspect of the VR program and the materiality of the immersive environment. Using existing physical and digital mediums, artists can freely move outside and inside the work they are creating, experimenting with size, perspective, and other impossible techniques. There is even a tendency for painting, sculpture, and animation to merge into a new type of artistic expression.

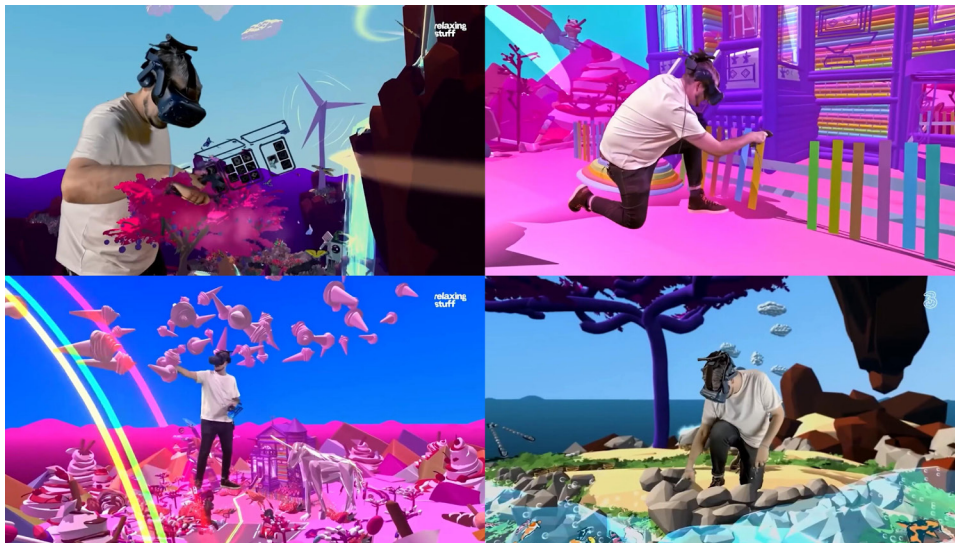


Figure 1 Immersive painting process in virtual reality by Anna Zhilyaeva.

Source: <https://www.youtube.com/@Annadreambrush>

The boundaries between structures and media surfaces in immersive VR environments become blurred. The materiality of VR-based works becomes a hypersurface, where materials and images are intertwined to form an architectural structure (Perrella cited in Brouwer & Hoekendijk, 1997). VR aesthetics are not only limited to the artwork's final form but also the artist's performance when they are creating it (see Figure 1). The representation of "brush strokes" in VR differs from paint strokes in the real world, involving the active movement of the artist's body. Viewers can immerse themselves in the work using VR devices or appreciate it through other platforms such as digital film, 360-degree video, or augmented reality (AR). However, the immersive features that make it unique may be lost. Immersive VR paintings challenge Kantian aesthetics that emphasize the need for distance between the viewer and the work of art (Ocvirk et al., 2012). Viewers can immerse themselves in VR paintings and become subject matter, making artistic sensations easier to obtain (Kim & Lee, 2022).

In VR, our mind can become a screen as well as a space where artworks are imagined and created (Piliang, 2008). Using a VR device to view "digital textures," such as paintings or other fine art surfaces,

stimulates the multiplicity of screens in a spatial and temporal context. Appreciation of physical works of art, such as oil paintings, relies on images on a physical surface (canvas) with boundaries (canvas edges or picture frames). In contrast, in VR paintings, these surfaces and boundaries blend into the environment in an immersive way. The relationship between VR painting and object vs image shifts (Bacon, 2016) because VR changes the pattern of using conventional painting frames and boundary characteristics in painting and object appreciation. This transformation and exchange of surface values influence how the work is viewed and appreciated.

Media materiality plays an essential role in the artistic process, including shaping and guiding it, creating specific affective and spatial experiences, and supporting intuitive and simultaneous manipulation that mobilizes tacit knowledge in creative contexts (Jacucci & Wagner, 2007; Chen et al., 2020; Leclair, 2023). Digital materiality influences the creative process of digital media, just as it does with physical media. Materiality in digital media includes various tools, software, and platforms that represent tangible and intangible artifacts (Leonardi, 2010; Dalsgaard et al., 2015).

Gibson (1979) coined affordance theory to analyze how the environment stimulates specific human actions through visual perception. Affordance can be defined as everything in the environment that offers a particular perception of affordability that influences individual behavior. According to affordance theory, the possibilities of artistic action that are made possible (or not possible) by the VR environment depend on how the artist directly and intuitively interacts with it. This theory can help analyze how traditional artists perceive and utilize immersive virtual environments, new tools and features in their work, and materials that have no equivalent in the real world. The latest development of Gibson's Affordance theory is "affordance switching" (Mangalam et al., 2023). This concept emphasizes dynamic switching between capabilities based on their current needs and context. This theoretical approach is very relevant in understanding the complex behavior of artists in facing new and different work media, where artistic affordances are available (Sidik et al., 2024) and artists must choose the most appropriate ones based on their goals and environmental context.

Moreover, the actor-network theory (ANT) viewpoint (Latour, 2012) underscores the active role of non-human actors within a network, a perspective that is particularly relevant in the context of VR. Here, the network includes the hardware (headsets, controllers), software (VR programs, game engines), and even the virtual environments themselves. These elements not only shape the user's experience but also actively co-create the artistic expression. In the context of new materialism, which highlights the significance of materiality in shaping experiences and knowledge, the materiality of VR technology (its physical presence and sensory feedback) assumes a crucial role in the artistic experience. New materialism challenges the human-centric view by acknowledging the agency of matter (France & Henaut, 1994) in VR artmaking, where the virtual environment itself can be perceived as an active participant in the artistic process, influencing the user's actions and perceptions. This theoretical framework presents a compelling argument for considering the potential for creative adaptation by artists when they are confronted with the material nature of the VR environment, a medium distinct from conventional physical work media.

Both affordance theory and ANT provide valuable frameworks for understanding the complex interplay between artists, technology, and the creative process in VR. By identifying the affordances of VR tools and environments, artists can better understand the possibilities and limitations of the medium and make informed choices about their creative approaches. ANT highlights the agency of non-human actors in the creative process, emphasizing the importance of considering the role of technology in shaping artistic expression. Together, these theories offer a more nuanced understanding of how VR can influence artistic practice and how artists can leverage the affordances of the medium to create innovative and meaningful works.

There is still limited research on traditional artists' experiences and creative processes in VR. Herman and Hutka (2019) investigates how 2D artists approach 3D creativity in a virtual environment. While this is a significant area of interest, it may overlook other aspects of VR artistry, such as the potential for entirely new forms of creative expression. A gap is evident in the lack of in-depth exploration of how

traditional artists, who are accustomed to physical mediums, adapt to the immersive virtual environment of VR. While previous research has touched on the technical aspects of VR artmaking and its impact on artistic expression, there is a need for a more focused investigation into the experiences and perspectives of traditional artists transitioning to this new medium.

This article also builds upon previous research (Sidik et al., 2024), emphasizing the artistic potential of VR affordance mainly from its virtual brushes and materiality. While prior research primarily relied on our own experiences with VR artmaking, this current study is focused on investigating deeper how artists who have never utilized VR can shed light on the significance of media materiality in artistic adaptation and creative expression. This research has the potential to significantly impact the future of fine art education, VR development, and the broader art world in several ways. Understanding how traditional artists adapt to VR can inform the development of VR-based curricula to bridge the gap between traditional and digital art forms. This could enhance student learning experiences by allowing them to experiment with new tools and techniques in a virtual environment. Examining the challenges and opportunities of virtual reality can help art educators prepare students for the evolving landscape of artistic expression. By understanding the affordances of VR, students can develop skills to adapt and thrive in this new artistic medium. This research can also inform VR developers about the specific needs and perspectives of traditional artists working in VR. We can use this information to design more intuitive and user-friendly VR tools specifically for artistic creation. Furthermore, by identifying the challenges faced by traditional artists, VR developers can focus on removing barriers and making VR a more accessible medium for artists of all backgrounds and skillsets. Lastly, the research on VR's impact on artistic expression can inform discussions about the future of art appreciation and audience engagement. By understanding how VR changes the relationship between the viewer and artwork, the broader art world can explore new ways to curate and exhibit VR-based art.

Based on the preceding analysis of the introduction, the following research questions emerge:

1. How do traditional artists adapt their creative processes and practices when transitioning to the VR environment?
2. How do VR affordances influence the artistic choices and outcomes of traditional artists working in this new medium?
3. What are the challenges and opportunities faced by traditional artists when using VR tools and techniques?

The study by Herman and Hutka (2019) investigates how VR environments can support 2D artists in translating their skills into 3D content creation. The study primarily focused on the transition from 2D to 3D creativity within a VR environment. The research concluded that VR painting alters engagement with the creative process, negating the anticipated user problem of transitioning from 2D to 3D. Participants identified specific points in their workflows where a virtual painting tool could be beneficial, suggesting novel multi-step creative processes for VR.

While Herman and Hutka's findings challenge some initial assumptions about VR's impact on traditional artists, a broader body of research reveals variations in which media materiality, specifically the shift from physical to virtual mediums, influences creative processes. Research exploring creative performance between physical and digital materiality produces mixed conclusions. Toh and Miller (2014) suggest that 2D media representations may enhance novelty in ideation while also interacting with a physical example, which could increase idea variety. Similarly, 2D media representations superior to 2D drawing in terms of efficiency and accuracy, while acknowledging the complementary value of 2D methods. However, research by Heiden and Moyer (2020) found that 3D reference materials can increase task completion time without hindering accuracy or mental effort. Sintonen (2020), using an autoethnographic approach, suggests that traditional analog materials may encourage experimentation in artistic creation, while digital methods foster a more playful approach. Bitu et al. provide findings on the connection between sensory feedback and creativity (Bitu et al., 2021). Using fingers on a tablet enhances

the uniqueness of drawings for children and teens, exceeding the effects of pen and paper. Surprisingly, a stylus did not lead to less originality; for older children, it surpassed the traditional method.

Some research also compares creative performance between digital media and immersive media. Lee et al. (2021) observed that an immersive VR design tool enhanced cognitive processes like problem-solving and idea generation in fashion designers. VR environments also seem to be particularly beneficial for creative inspiration compared to non-immersive 2D digital media (Rieuf et al., 2015; Houzangbe et al., 2022). Chai et al. (2023) found that designers working in 3D VR reported more positive emotions and produced more original and practical design ideas compared to those using 2D VR. VR may also promote a state of focused immersion conducive to creative thinking. Hagedorn et al. (2023) observed increased brain activity in areas linked to creativity when subjects were in a VR environment compared to a 2D screen.

Other publications addressed the creative performance difference between physical media and immersive media. Yang et al. (2018) conducted a study to investigate how VR could enhance creativity and induce a state of flow more effectively than traditional methods. Their findings suggested that the virtual reality system has positively influenced participants' creativity by providing a more immersive and interactive environment for idea generation. This aligns with Oti and Crilly's (2021) findings, which also found that users reported that their spatial ability and movement influenced the quality of their virtual reality sketches. Additionally, Yang and Lee (2020) conducted a comparison between the new method of drawing in 3D and the traditional method of drawing on paper and found that virtual reality sketching encourages designers to think creatively and work in a 3D space, ultimately leading to more creative and holistic design approaches. It's worth noting, however, that while VR sketching helps designers focus on the important parts of their design without making unnecessary sketches, it might have fewer details and representations of new ideas compared to traditional sketching methods.

Chaniaud et al. (2023) and Richesin et al. (2021) conducted a study that compared the skill sets required for traditional sketching and virtual reality sketching. Chaniaud's study revealed that users who engaged more actively in the immersive environment produced higher-quality sketches, particularly for more intricate shapes. Richesin et al. (2021) found that traditional art creation significantly enhances psychological well-being, including stress reduction and self-expression, compared to virtual reality experiences. This suggests that traditional art creation may offer unique benefits that virtual reality experiences may not completely replicate.

In conclusion, while the studies mention positive emotions and flow states in VR, there is a lack of detailed analysis of the overall user experience for fine artists. Additionally, the studies primarily concentrate on design and creative processes, neglecting the specific application of virtual reality and 3D tools to fine arts practices such as painting, sculpture, or performance art. While the studies highlight the positive impact of VR on creativity and cognitive processes, there is a lack of in-depth exploration of the qualitative aspects of artistic expression in VR. By addressing these research gaps, this study can contribute to a more comprehensive understanding of the potential of virtual reality in the context of fine arts, ultimately enriching artistic practices and enhancing experiences.

Method

This research used a qualitative phenomenological approach. Data collection methods used interviews, think-aloud, and VR artmaking observation. The artmaking experiments using OpenBrush software were carried out three times to obtain an overview of the adaptation and stages of the creative process from the participants. Observations were carried out directly while participants were working, and the observation was carried out after the practical activities were completed with the help of video recordings. Reflective interviews (where participants were asked to reflect on their experiences and the impact of the VR artmaking process on their creative practices) were conducted after participants had worked using VR.

Table I Specifications of The VR Device Used In The Experiment

Headset	191.5 mm x 102 mm x 142.5 mm (295.5 mm with fully unfolded strap), 503g; Color: white. Headset Battery: 3,640 mAh (14.0 Wh) lithium-ion; 10W (5V@2A) charging.
Controllers	90 x 120mm (per controller, including tracking ring with IR LED-based tracking), 126g (per controller, without battery), around 147g (with an AA battery); Around 30 hours of usage from one AA battery.
Display	IPS LCD, 1832x1920px per year resolution, 90Hz native refresh rate; around 90-degree field of view (estimated); adjustable IPD (three-position slider): 58mm, 63mm, and 68mm
Chipset	Qualcomm Snapdragon XR2 (7 nm): Octa-core (1x2.84 GHz Kryo 585 & 3x2.42 GHz Kryo 585 & 4x1.8 GHz Kryo 585); Adreno 650.
Memory	256GB 6GB LPDDR5 RAM.
OS	Oculus Mobile, based on Android 10
Tracking	Supports 6 degrees of freedom (6DoF) head and hand tracking through integrated Oculus Insight technology (inside-out tracking); 4 front-facing cameras for visual controller tracking, plus gyroscopes and accelerometers in headsets and controllers; Hand tracking.
Play space	Stationery and room-scale support, up to around 20m x 20m play area is mappable.
Audio	Built-in stereo speakers and microphone, 3.5mm audio jack, support for 3D audio.
Connectivity	Wi-Fi b/g/n/ac(5)/ax(6), 60 GHz Wi-Fi ay module; Bluetooth 5.0 LE; Type-C USB port; USB Host support; 3.5mm audio jack.

Participants in this research were selected using purposive sampling, with the main criteria being artists with no experience creating art using VR. The participants also must have more than ten years of professional experience and actively publish their work through exhibitions. This rigorous approach was designed to ensure that the participants brought their established creative processes and unique artistic expressions to the study. As a result, R. E. Hartanto, a 51-year-old male artist primarily working with oil paints, was selected.

The data was analyzed by thoroughly reviewing interview transcripts to identify emerging themes. Specific themes with a certain structure and the same or unique experiences of each participant, connected to the theoretical framework of affordance and MET, were then analyzed. Video recordings of artmaking practice were also analyzed alongside interview transcripts to explore the participants' creative processes' regarding their characteristics and meaningful actions. Visual data representing the characteristics and non-characteristics of participants' creative practices was extracted and selected. Additionally, this visual data was used in reflective interviews regarding participants' artistic practices.

Results

The following themes offer a rich and nuanced understanding of the artist's lived experience in VR artmaking. They highlight the complex interplay of embodiment, materiality, intuition, and technology in shaping artistic practice. Here are some key themes that emerge from the results:

Immersion Discovery and Materiality Reimagined

The artist vividly depicts the sensation of entering immersive VR as stepping into a different world, where traditional media boundaries vanished. He emphasizes that the most remarkable aspect of this creative process is the feeling of complete immersion. The artist vividly depicts the distinct experience of immersing oneself in and interacting with visual elements. The artist expressed, "I wasn't prepared for the ease with which I could envision space when using this VR device." "It's like drawing, but in 3D, so it's like sculpting," the artist said. The experience of entering the canvas and engaging with the artwork evokes a profound sense of joy. The artist's depiction of entering another world implies that VR not only introduces a new medium but also a new phenomenological space. This space fosters exploration and experimentation, where conventional limitations dissolve and fresh creative opportunities come to light.

The artist, an oil painter with training in traditional painting techniques and familiarity with the physical materiality of pigment and canvas, instantly recognized and applied virtual brushes that replicated the same strokes in reality. The artist explained, "This is because my background is in painting." I always look for (similar) connections to physical media. The artist's familiarity with physical materials translates into an intuitive understanding of virtual brushes and gestures, highlighting the fluid connection between body and tools. The artist's seamless transition from traditional to virtual tools speaks to the embodied nature of artistic practice. Even in the virtual realm, participants were as engaged with the virtual brushes as if they were physical materials. This reveals the persistent role of materiality in artistic experience, even when the materials themselves are digital. Regarding the use of virtual technology as a creative medium, the artist expressed that, in their opinion, VR is simply an extension of traditional art tools. So, the *modus operandi* is still the same. There is still a distance between me as an artist and the object; only the approach is different now." It also suggests that VR can offer a new way of understanding and interacting with materials.

Adapting Intuition and Expanding Creative Boundaries

Despite not experimenting with all the virtual brushes in the OpenBrush program during the first stage of experiments, the artist expressed that he is able to manifest his ideas into recognizable visual forms based on some brushes. He described visualizing the desired form and character primarily through the visual appearance of virtual brush strokes. The artist explained, "I'm still experimenting, so I can't imagine I could make something, but I know it could be something." I can imagine the potential."

Exploring animated brushes, a unique feature of the OpenBrush program in VR, highlighted the potential for technology to expand artistic possibilities. This underscores the transformative influence of VR in pushing the boundaries of traditional art forms. The artist's adeptness at quickly adapting to the VR environment reflects the power of intuition and prior experience in navigating new creative landscapes. His intuitive grasp of artistic principles facilitated the swift integration of new tools and techniques.



Figure 2 Some of the artist's artwork in the first experiment showed natural and intuitive adaptation.
Source: Author's documentation

While the artist found the intuitive nature of the VR interface, he admitted that the wide availability of brushes was confusing. In addition, the optical lenses on VR devices do not facilitate further personalization and modification to suit different levels of vision. The artist's vision necessitates the use of glasses, which presents a challenge as he must remove them when using VR devices. The participant's experience with the optical limitations of the VR headset underscores the significance of considering the human-technology interface when designing VR experiences for users with specific needs.

Artistic Knowledge Transformation

VR materiality encourages the transformation of factual knowledge through new information or understandings. The artist gains a concrete understanding of how to translate and extend traditional

art tools and techniques within VR through the concept of VR affordance. This includes manipulating virtual brushes, using layering, and incorporating animation. His new understanding of materiality in a digital space also contributes to the formation of factual knowledge. The artist experienced the unique affordances of digital "materiality." While the brushes were not physically tangible, they still held properties like texture and responsiveness that could be manipulated and understood through embodied knowledge. "I can't say whether physics is physical or not, but I believe it exists in a different way." I can't find the similarities. Painting is highly sensory, yet it has significant limitations. Apart from that, artists directly feel the absence of feedback. Lastly, the artist actively blends static and dynamic visual elements, like brushes, with animated effects. According to him, this is a unique combination that is not found in real-world or physical media.

VR materiality also forms new ways of thinking or framing art. The artist had to reconceptualize his physical relationship with the artwork, learning to navigate and interact within a 3D virtual space. The artist instinctively navigates around the work, but his intensity decreases once he understands the scale and teleport features. The artist witnessed the merging of traditional and digital media, potentially altering his perception of "art" and its creation process. The artist holds no concern for the ontological context of the VR-created work; he asserts that the viewer's experience holds greater significance than the distinction between tangible and intangible elements. He asserts that the use of immersive VR as a creative tool will necessitate this viewer experience. Recognizing the immersive nature of VR as a distinct and powerful aspect of the artistic process, it opens up new conceptual possibilities for interacting with and experiencing artwork.

Lastly, the artist demonstrates mastery of new procedural knowledge, artistic skills, and techniques. The artist learned to effectively translate existing skills in oil painting to the VR environment, demonstrating procedural knowledge transfer. In the first and second experiments, the artist demonstrated an increased fluency and mastery of gesture control. The artist's wrist and hand movements feel natural, and he is familiar with the palette placement, icons, and tools, which makes it easy to translate artistic intentions into the virtual world. The artist also commented on the fluidity and responsiveness of the digital brush, with its ability to capture subtleties of pressure, angle, and speed, like a brush. As an artist who works with oil paint as a medium, real-world creative techniques such as layering emerge during this stage of the creative process. The artist acquired new technical skills specific to VR artmaking, such as using the teleport function and manipulating animated brushes. The artist gained new procedural knowledge about workflow and problem-solving in a VR context, including strategies for addressing visual disorientation and brush selection challenges.

Discussion

The findings of this study illuminate the complex interplay of affordances, materiality, and networks within the context of VR artmaking for traditional artists. The participant's initial experience, characterized by immersion and the blurring of traditional media boundaries, aligns with Gibson's concept of affordances (Gibson, 1979). Not only was the virtual environment novel, but it also presented familiar tools and interactions that the artist could readily grasp and utilize. This implies that the artist can translate and extend the affordances of traditional artmaking within a radically different medium, fostering a sense of continuity and creative flow.

The participant's immediate recognition and adoption of virtual brushes analogous to those in the physical world exemplify the persistence of materiality in VR artmaking. The artist's embodied knowledge of oil painting techniques transferred seamlessly to the virtual realm, underscoring the significance of prior experience and material engagement in shaping creative practice. This observation resonates with the new materialism theory, which emphasizes the agency and entanglement of materials in creative processes.

The artist's increasing fluency and proficiency over the three experiments demonstrate the dynamic nature of adaptation and learning in VR artmaking. The OpenBrush program's intuitive design, in conjunction with the artist's pre-existing artistic knowledge, expedited the assimilation of new techniques and tools. The actor-network theory, which sees technology as an active participant in shaping human behavior and knowledge, can interpret this progression. The VR environment, the digital brushes, and the artist's embodied skills formed a network of actors that co-evolved and mutually influenced each other, leading to new creative possibilities. The participant's exploration of animated brushes, a feature unique to the virtual medium, illustrates the potential for VR to expand the artist's repertoire and challenge traditional artistic conventions. This finding suggests that VR artmaking is not merely a replication of traditional practices but a platform for innovation and experimentation.

However, the artist's experience also highlights the limitations of VR technology. The optical constraints of the VR device posed a challenge for the participant, whose vision required glasses. This issue reveals the friction between the materiality of the human body and the technological affordances of the VR interface. It also points to the importance of considering diverse user needs and tailoring VR experiences accordingly. To address this limitation, VR hardware manufacturers could invest in developing more advanced optical systems that are compatible with various prescription lenses or even incorporate adaptive optics technology. This would allow users to enjoy immersive VR experiences without compromising their vision. Additionally, software developers could explore options for adjusting the virtual environment to accommodate different visual needs, such as offering customizable text sizes, contrast levels, and color palettes. The participant faced another technical challenge due to the overwhelming number of brushes available in the OpenBrush program. While having a wide variety of tools can be beneficial, it can also be overwhelming for artists who are new to VR artmaking. To mitigate this issue, software developers could implement features that allow users to filter or categorize brushes based on their function or style. This would help artists find the tools they need more efficiently and focus on their creative process.

To further explore the implications of VR artmaking, future research could focus on investigating the impact of VR on various artistic disciplines, such as sculpture or performance art, to understand how different mediums respond to the virtual environment. Future research could also conduct in-depth longitudinal studies to track the long-term effects of VR on traditional artists' creative processes, identities, and professional practices.

Conclusion

The study contributes to ongoing conversations in human-computer interaction and creative technologies by demonstrating the dynamic nature of adaptation and learning in VR artmaking. This study elucidates the intricate dance between affordances, materiality, and networks in VR artmaking for traditional artists. Actor-Network Theory offers a valuable lens for interpreting the interplay between the artist, the technology, and the creative process. The participant's journey, marked by a seamless transition from traditional to virtual tools, highlights the adaptability of artistic practices and the persistence of embodied knowledge. While the virtual environment offers novel affordances and expands creative possibilities, the material constraints of technology and the human body remain influential factors. The artist's evolving proficiency demonstrates the dynamic nature of learning in VR artmaking and the potential for co-evolution between humans and technology. Ultimately, this research underscores the importance of considering both the continuity and the transformative potential of VR as a medium for artistic expression.

For artists, the findings suggest that VR offers new creative possibilities; traditional skills and knowledge remain invaluable. Artists can leverage their existing expertise to navigate VR tools and techniques more effectively. Additionally, understanding the limitations of VR technology can help artists make informed decisions about their creative process and potential workarounds. For VR developers, the research highlights the importance of designing tools that are both intuitive and inclusive. By addressing

challenges such as brush selection and optical constraints, developers can create platforms that better cater to the needs of traditional artists and foster a more seamless transition to the virtual realm.

Finally, the small sample size and focus on a single artist may limit the generalizability of the findings. Future research should include a larger and more diverse group of participants to explore the broader implications of VR artmaking for traditional artists. Additionally, the relatively short duration of the experimental sessions may not fully capture the long-term impact of VR artmaking on traditional artists. These constraints could potentially influence the results, and future research with larger sample sizes and extended experimental periods may be necessary to provide a more comprehensive understanding of the subject.

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