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VIRTUAL REALITY IN ART STUDIES: DIGITAL SCULPTING IN VR

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Abstract: *In recent research, evidence shows a growing interest in the study of the application of virtual reality (VR) in Higher Education Institutions (HEI). In this paper, we will explore application of the VR environment in Art studies; more specifically, we will explore the use of VR sculpting tools in the context of distributed learning. Digital sculpting has not been acknowledged as a specific art form since it was mostly connected to gaming, video, and animation production. In 2020 and 2021, because of the expansion of the NFT art market, more affordable 3D printers, and social media promotion, digital sculpture has gained more widespread acceptance.*

We wanted to explore the impact of the available VR sculpting tools on the existing 3D production workflows and all the prospects for their future implementation in Academic Art Studies. We will also review the ergonomics of VR headsets and controllers, and all the challenges that this immersive medium (VR) would impose on the digital classroom in terms of user experience (UX), collaboration tools, and accessible e-learning technology for the students and lecturers.

Keywords: *E-Learning, VR, 3D modeling, Digital Sculpting, Art Studies*

1. INTRODUCTION

Digital sculpting is a 3D modeling paradigm where free-form surfaces are manipulated with tools that mimic real-life sculpting of soft materials, e.g. clay. This paradigm is particularly effective when designing organic shapes, since artists do not have concerns about mesh connectivity and topology details, working always with high-resolution irregular meshes [1].

Digital sculpting / 3D modeling has been taught for more than 15 years in various Universities as a part of digital art studies, interactive and graphic design studies, multimedia studies, game art, and other various interdisciplinary studies. Many institutions have also begun offering an option for online studies, although (physical) studio-based learning is still the dominant education model in art related faculties. However, introducing Virtual Reality (VR) systems in the **E-learning systems** of the HEI that we are exploring in this paper is a new configuration for studying art. Most HE institutions have VR systems available on the premises (in laboratories and studios), but we want to explore the possibilities of future implementation of VR systems in the **online learning** model in the domain of 3D sculpting and modeling. 3D sculpting is only one part of the 3D Art curricula but since it mostly relates to simulation of traditional sculpting, we found it an interesting subject to explore.

As noted in [2], in Art and Design Studies we had a dominant **design studio education model** for a long time, but technological advancements and widening participation in Higher Education (HE) caused physical studios to evolve and blend with the virtual and online educational environment. The VR environment anticipates the evolution of the design studio education model, so this paper also examines the current state of collaboration and

participation tools that are offered as a part of the existing VR sculpting software.

The recent development of commercial VR sculpting software and fast advancement of VR technology resulted in growing development of the community that practices 3D sculpting in VR. Generally, there is a very large community of 3D artists connected through various social networks, so we used this potential to distribute our questionnaire to 3D artists.

We gathered anonymous responses from 54 people with backgrounds in 3D art. 80% of participants declared as professional 3D artists, 13% are Art teachers / professors in formal institutions, while 12% are other artists who work in 3D often (concept artist, graphic designer, technical artist, VFX artist, game designer, game producer). 11.4% of participants checked two or more positions that are overlapping with 3D artist: art teacher, researcher, art director, 3D printing, concept artist, graphic designer. Most of the participants had between 10-20 years of experience (35%) or 1-5 years of experience (30%) in 3D modeling. Furthermore, 18% declared 5-10 years of experience, 11% had less than one year of experience, and 6% noted more than 20 years of experience working as a 3D artist.

We will refer to this questionnaire and literature in order to explore opinions on all the aspects of the VR sculpting that are the subject of this paper.

2. VR ENVIRONMENT

In 2015, several companies announced mass production of affordable VR headsets (also called Head Mounted Displays – HMD) and display devices, which are worn on the head with a display optic in front of the eyes. The most popular among them were the HTC Vive with optional hand controllers and the Oculus Rift. These devices require support of computers with powerful processors and graphic cards in order to render immersive 3D graphics and 360 degree videos, while simultaneously tracking the motion of the user. During the same year, we were introduced to even more affordable mobile VR headsets - Samsung Gear VR and Google Cardboard viewers that can be combined with compatible smartphone devices [3]. In 2021, stand-alone VR headsets are available for purchase, such as the very affordable Oculus Quest 2, the rather expensive 'all-in-one' Vive Focus, as well as the Sony PlayStation VR (PS VR), Valve Index and Windows Mixed Reality headsets.

In [4], VR can broadly be broken down into two main categories: desktop VR (D-VR), and immersive-VR (I-VR). D-VR is typically classified as non-immersive, in that a headset is not used, and the participant controls and manipulates the virtual environment on a computer screen with traditional keyboard and mouse hardware. On the other hand, I-VR is typically multi-modal in nature, providing a sense of immersion in the environment through 360° visuals by aid of an HMD, auditory stimulation through the use of earphones. The review defines an HMD as a device worn over the head which provides a stereoscopic computer-generated or 360° video image to the user. This includes tethered (connected to a computer), stand-alone (no computer needed), or mobile VR headsets (mobile/cell phone connected to an HMD.

Moreover, VR is also considered to be an immersive, interactive, multi-sensory, spectator-centered 3D environment, with the combination of the technologies necessary to build these environments, or that allow the navigation and viewing of a world in three dimensions and in real time, with six degrees of freedom. **VR is a clone of physical reality** [5].

In [6], we have found an updated breakdown of tools for painting, sculpting, and animating in VR. In **Image 1** we can see the list of available software tools as well as platforms that support them. In the Feature Focus column they are each marked based on the workflows they primarily cater to.

	Platforms			Feature Focus		
	Quest	PC VR	PSVR	Drawing	Modeling	Animation
Tilt Brush	✓	✓	✓	✓	×	×
Dreams	×	×	✓	×	✓	✓
Quill	×	✓	×	✓	×	✓
Adobe Medium	×	✓	×	×	✓	×
Kingspray Graffiti	✓	✓	×	✓	×	×
Gravity Sketch	✓	✓	×	×	✓	×
Tvori	×	✓	×	×	✓	✓
AnimVR	×	✓	×	✓	×	✓
Blocks	×	✓	×	×	✓	×
SculptVR	✓	✓	✓	×	✓	×
Masterpiece VR	×	✓	×	×	✓	✓
Adobe Substance 3D Modeler (closed beta)	×	✓	×	×	✓	×

Image 1: commercial VR sculpting in 2021.
Source: www.roadtovr.com

From the available tools we would like to point out Adobe (Oculus) Medium, Gravity Sketch, Kodon VR (not included in the table), Adobe Substance 3D Modeler, and Masterpiece Studio. These apps are concentrated on sculpting and "real feeling sculpting" in VR. Further development of these tools depends on their business model and commercial success, so at this phase we must conclude that there is still a long way to go before some of them become standard in producing 3D graphics.

Many respondents in our questionnaire included some VR tools in the list of their preferred 3D sculpting tools such as Adobe Medium, Gravity Sketch, and Kodon VR. The most dominant desktop sculpting tool is ZBrush (70%

respondents noted that they use it), followed up by Blender (41%), Maya (35%), and Mudbox (18.5%). It is interesting that some participants mentioned the mobile application Nomad Sculpt, which is mostly used on tablets, as well as the browser- based tool Sculpt GL.

Most artists (70%) that responded to our questionnaire checked 2-5 tools they use for 3D modeling. Considering that modeling is just one of the aspects of 3D art, and that artists use additional tools for texturing, lightning, staging the scene, animation etc., it is clear why the production workflow can be overwhelming for beginners and why HE institutions might have a difficult time deciding which software licenses they should buy in order to teach students 3D art.

3. USER EXPERIENCE AND ERGONOMY OF VR HEADSETS

Concerning the ergonomics of VR headsets and working in these environments, our survey resulted in the conclusion that 55% found the VR environment more dynamic, 33% found it more exhausting than the desktop environment, while only 12% found it to be the same as the desktop environment.

VR sculpting tools assume the use of controllers, and we asked our participants how they felt about them. 72% responded that controllers were fine, while 18% found them complicated, or they thought there was a lack of tactile feedback and that the user experience could definitely be improved.

The **interface** is the bridge between the human and the effective use of their tools. In the beginning, the user interface for computers was text-centric, and later, two-dimensional graphical user interfaces (2D GUIs) using the WIMP (windows, icons, menus, pointer) metaphor have enabled many uses of computers in everyday life. Several post-WIMP interfaces operate outside these bounds, operating on human touch and voice modalities for multi-touch, tangible, sketching, and voice interaction. In addition, Reality-Based Interfaces incorporate the human's body and natural understanding of the world into the interface as exemplified by three-dimensional user interfaces (3D UIs) in Virtual and Augmented Reality (VR/AR) [7].

In [8], the authors presented a wearable augmented reality (AR) 3D sculpting system called AiRSculpt in which users could directly translate their fluid finger movements in air into expressive sculptural forms and use hand gestures to navigate the interface. Their premise was **that mediation via devices puts users at a visual and spatial remove** from the virtual content since most free-form 3D sketching or sculpting systems that had previously been implemented in a VR environment for 3D interaction research utilize input devices, such as the 6-axis SpaceMouse, sensors, physical props, or special VR gloves to track finger trajectory or hand movement. By removing the device, they reached more intuitive interaction with hand gestures.

Much of Virtual Reality (VR) is about creating virtual environments that are believable and successfully simulate reality, but in [9], it is argued that better immersive technology, however, does not necessarily provide a better VR experience. Asking "how much immersion is enough," Bowman and McMahan point out the possibilities, but also the limits, of simply investing more in improving the match between visual fidelity and reality. Their research showed that this does not always, for example, improve the results of learning. We can conclude that the development and UX design of VR sculpting tools can also be goal-oriented and content-driven. We can see this influence in [10], where the user experience design and features of the sculpting app are illustrated through production workflow. Most VR sculpting software developers recognized the importance of cross-device functionality and compatibility with other software. There are also some technical issues and functionalities that are important for improving VR sculpting tools, like mixing voxel and hard surface modeling in the same tool, including mesh modeling, cloth simulation, et cetera.

4. E-LEARNING AND COLLABORATION IN VR

In [11], authors have identified two distinct problems in implementing VR technology in HE institutions: technical and pedagogical. It is inevitable that **technical issues** will arise with any rapidly developing or complex technology, and 3D technologies are indeed both. Furthermore, institutions of higher education are often slow to adopt innovations, particularly innovations in pedagogy. Among the technical problems, we can distinguish hardware and software issues like powerful computer configurations and graphic cards with updated drivers, supported by fast internet connection if we want our teachers to use collaborative VR sculpting environments. After configuring the hardware and software to work correctly, next comes the learning curve for figuring out how to use it. In the innovation's theoretical framework, we always count on categories of *innovators* and *early adopters* who tend to enjoy experimentation and have the resources to expend on doing so. In the context of higher education, this often means faculty members and students with innovative projects who are comfortable with technology and are willing to devote time to learning to use it. **The pedagogical aspect** of implementing new technology requires faculty members to figure out how to integrate it in one's courses so that the technology provides clear benefits.

In [12], the authors examine the current crisis in physical art and design studio learning in higher education as a

consequence of the COVID-19 outbreak and the sector's response to the fast-track conversion of blended learning to a distributed model: "Universities are focusing on virtual community building where group work, 'crits' and presentations are being carried out online. Moving assessment and engagement to online formats has consequences for practice-based art and design courses: distributed learning changes how we teach and learn." This research concludes that there are different variables that would determine whether students would prefer blended (combination of studio-based learning) or online learning environments.

On the other side of the distributed learning model, we have students who need to provide their own VR units along with powerful computers and internet connections in order to be able to create and share their 3d models. 65% of respondents in the survey think that VR station is a big investment, and 35% disagree. We did not include students in the survey, but since they mostly do not have personal income, we could assume that they might perceive it as a big investment, although a Game-ready PC is usually considered to be a solid configuration for VR as well (VR ready).

If we assume that collaborative VR sculpting environments can simulate studio-based learning, VR technology should in that case be implemented in the distant learning model. In a virtual studio, students could learn the basics of sculpting and modeling, practice figurative sculpture, human and animal anatomy; they could analyze and copy works of old masters, and so forth. However, not all the content of traditional sculpting classes should be transferred from the physical into the virtual studio—as we noted in the previous chapter—since there are many other aspects of 3D art, and we should adapt the content of the classes and include those aspects as well.

Collaborative Digital Sculpting in VR has already been featured in many VR sculpting tools, such as Gravity Sketch, VR Art Studio, and Masterpiece VR. Adobe Medium provides studio share for only two users and they cannot share models, they can work only on their own models.

Nevertheless, our questionnaire showed that 52% of participants did not try collaborating in VR, but the 40% who did try it were rather satisfied.

Collaborative systems are not well established in computer graphics, compared to software development. Usually artists work alone and share their final models by sending files [1]. Collaboration does not necessarily mean working on the same file, but for students, it is important to learn how to collaborate.

In an E-learning environment we should find ways to **motivate students** to finish their studies, since they often have feelings of isolation, lack technology support, lack clarity in instruction direction or expectation, and lack social interaction [13]. Collaborative VR environments could likely provide tools to overcome these downsides of distant learning.

Accessibility is also a subject that needs to be addressed in the context of implementing VR sculpting in HE institutions. Technology has to be accessible for teachers as well as for students. There is also the question of accessibility of existing interfaces and controllers that has not yet been addressed. In [14], the authors want to adapt Web Content Accessibility Guidelines (WCAG) to fit VR. Some Universities, like The University of Melbourne [15], have already made accessibility guides for VR environments.

5. NFT MARKETPLACES AND OTHER EMERGING TECHNOLOGIES

NFTs are blockchain-traded rights to any digital asset; this includes images, videos, music, and even parts of virtual worlds [16]. The most popular cryptocurrency for NFT trading is Ethereum. These markets opened new possibilities not only for 3d artists, but for all digital media creatives, since they can now sell their digital art works more easily and their career and employment won't be solely directed towards the gaming and film industries. In our survey, we got rather even results on the question of if they thought that the NFT market would change the way we perceive, make, and teach art: 54% said Yes, and 46% said No.

We also asked respondents if they thought that technologies like 3D scanning and AI are threatening for 3D sculptors. 50% of respondents found them quite helpful, 26% did not find them threatening, 13% found them threatening, and 11% found them "a little" threatening.

The final question asked whether we should teach 3D art students to code. 46% said No, 19% said Yes, and 35% said 'a little'.

6. CONCLUSION

The current review found that the technology advancements and pedagogical frameworks for 3D sculpting in VR environments can be implemented in HEI E-learning systems by using some of the available VR software tools. Implementing VR systems in HEI could be challenging from the economical and technological point of view, but the most important aspect is that technology provides clear benefits.

Content of Digital sculpting classes in the VR environment could be perceived as new studio-based learning that follows the teaching methodology of traditional sculpting

classes, but with additional features that are necessary for the education of 3D artists. Collaborative VR environments could also help in motivating e-learning students to finish their studies, since they drop-out more often than traditional students.

Many of the respondents in our survey added some personal comments on the subject of Digital sculpting in VR and the future of Art studies. Many commented that VR creation tools will be essential in 5 years, as well as more Augmented, Extended or Mixed reality tools, since they provide less detachment from the real environment and do not provoke dizziness and nausea as VR headsets tend to. Over the coming years, technological advancements and more accessible interfaces will contribute to the implementation of VR sculpting tools in online Art Studies, but it is essential to ensure that they are used correctly and to their full potential.

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