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**Remixing Real and Imaginary in Art Education  
with Fully Immersive Virtual Reality**

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## **ABSTRACT**

This essay explores digital material/ism by examining student teachers' experiences, processes and products with fully immersive virtual reality (FIVR) as part of visual art education. The students created and painted a virtual world, given the name 'Greta's Garden', using the Google application Tilt Brush. They also applied photogrammetry techniques to scan 3D objects from the real world in order to create 3D models for their VR world. Additionally, they imported 2D photographs and drawings along with applied animated effects to construct their VR world digitally, thereby remixing elements from real life and fantasy. The students were asked open-ended questions to find out how they created art virtually and the results were analysed using Burdea's VR concepts of immersion, interaction and imagination. Digital material was created intersubjectively and intermedially while it was also remixed with real and imaginary. Various webs of meanings were created, both intertextual and rhizomatic in nature.

*Keywords:* virtual reality, digital materiality, art education, immersion, interaction, imagination

## **ABSTRAKTI**

Tässä artikkelissa tarkastellaan opiskelijoiden virtuaalitodellisuuden (VR) immersivisiä kokemuksia, prosesseja ja tuotoksia kuvataidekasvatuksessa digitaalisen materiaalin ja materialismin näkökulmasta. Opiskelijat suunnittelivat *Gretan puutarhan* virtuaalitodellisuudessa käyttäen Googlen Tilt Brush -ohjelmaa. Lisäksi he skannasivat VR-puutarhaansa reaali maailmasta valitsemiaan 3D-objekteja fotogrammetria-tekniikalla, lisäsivät mukaan 2D-valokuvia ja piirroksia sekä jatkoivat puutarhan 3D-muotoilua, veistämistä ja maalaamista (animaatio)siveltimillä. Gretan puutarha syntyi reaalityodellisuuden ja fantasian kohtaamisista. Avoimilla kysymyksillä selvitettiin, miten opiskelijat toteuttivat VR-taidetta. Tulosten tarkastelussa käytettiin Burdean VR-käsitteitä immersivisyys, vuorovaikutus ja

mielikuvitus. Digitaalista materiaalia syntyi opiskelijoiden vuoropuheluna, medioitten välisesti sekä todellisen ja imaginaarisen kohtaamisissa. Lukuisat merkitysverkostot olivat luonteeltaan intertekstuaalisia ja rihmastomaisia.

*Avainsanat:* virtuaalinen todellisuus, digitaalinen materialismi, taidekasvatus, immersio, vuorovaikutus, mielikuvitus

## Introduction

One of today's most interesting future trends is virtual reality (VR) (Dufva 2020: 38) because it offers new spaces for learning in the 21st century (Southgate 2020: 12). Virtual reality (VR) is defined as a computer-generated 3D-environment, a simulation that a subject can interact with in real time and create a realistic, immersive experience that is interactive throughout all our senses (Burdea and Coiffet 2003: 3). The most convincing VR experience is fully immersive (FIVR) and it is this that is dealt with here. For this experience, it is necessary to wear equipment such as a head mounted display (HMD) for tracking head movements that change the view in computer-generated virtual reality in real time (Alqahtani et al. 2017). A fully immersive experience creates a powerful illusion of actual presence in which VR feels as real as a physical reality that may even deceive the body (Linturi and Kuusi 2018: 179). See Figure 1, which shows Beisa Vilkmán, a textile student teacher on the author's Media course, working independently in FIVR (<https://vimeo.com/248276538>).



Figure 1: Beisa Vilkmán and Emmi Heikola, *Step into the Wonderland*, 2017. VR. © Vilkmán, Heikola.

This essay does not include VR environments that are semi-immersive, producing a visual experience on a computer screen that is controlled by a device such as a mouse, nor non-immersive system that is based on a monitor screen showing the virtual world without other devices (Alqahtani et al. 2017: 1-2). Instead, I aim to assess the significance of the fully immersive VR (FIVR) for art education. FIVR headsets had become commercially available in 2016 (Southgate 2020: 10) and media artists have been working in digital artist residences, such as Acute Arts or Google's Tilt Brush Artists-in-Residence programme (AiR), creating art using current technology. The appeal of FIVR is that it changes the concept of space from a two-dimensional canvas into an unlimited three-dimensional space for painting, sculpting and constructing where animated effects and video introduce a fourth dimension, described by the artist Tara Chittenden as a new timespace (Chittenden 2018). Furthermore, the laws of physics, time and causality can be expressed differently in VR from those in real life (Chittenden 2018). My view is that FIVR can enhance art education because visualising in the air with FIVR enables visual thinking in all dimensions requiring visual-spatial-kinaesthetic intelligence. Additionally, by mixing fantasy with reality, imaginative worlds that do not exist in physical reality in three dimensions can be produced and experienced.

FIVR also invokes questions of materiality and the focus is on painting objects instead of images (Chittenden 2018). *Digital material/ism* is understood as all processes and products including materials from multiple disciplines (Pink et al. 2020). FIVR is not limited to the software per se (e.g. Tilt Brush, Quill, Masterpiecestudio, A-painter) but it is also related to other fields. Additionally, it is considered intermedial (e.g., technological production systems), intersubjective (e.g., interaction between artist and viewer) and an intertextual junction of different fields, such as arts and other digital texts. Taking a broad definition of texts (re)mixes visual, verbal, auditive and kinaesthetic meanings, which requires multiliteracy skills (Paatela-

Nieminen and Itkonen 2017). As technology is embedded in everything, it changes our modes of perceiving, thinking and action (Dufva 2020: 38) and thus challenges art education.

In the research literature there are two studies on FIVR in art education, both focusing on creating basic shapes with 3D guides. Wendy Bolier et al. (2018) studied FIVR 3D drawing in elementary school art education. The art teacher developed FIVR 3D drawing exercises such as drawing basic shapes and combining them step-by-step for more complex figures. The children considered these exercises helpful in learning to draw 3D figures in 3D space (Wendy Bolier et al. 2018: 337-344). Simon So and Emma Lu (2019) studied FIVR in art education at a Hong Kong secondary school. The students were instructed to individually create a 3D snowman and then a crystal ball in small groups. The researchers evaluated the creativity, originality and aesthetic quality of the students' 3D outcomes, their aim being to develop criteria for virtual paintings (So and Lu 2019: 1485-1490). In the research described in this essay, I take a different viewpoint through focusing on university students and intermedial relations, while applying VR terms to appraise the students' FIVR experiences.

I applied FIVR in an Artistic Expressivity course (5 cr) in which student teachers created five different worlds for '*Liisa Ihmemaaailmoissa*', ('Alice in Wonderlands'), (<https://vimeo.com/244831247>) by experimenting with FIVR in Google's Tilt Brush (<https://www.tiltbrush.com/>). As an example of their virtual art works, one group of students painted and sculpted a magical garden with imaginary plants by using animated brushes (Figure 2). Another group of students scanned a 3D teacup using photogrammetry techniques. The elements inside the teacup made up the tea party (Figure 3). Additionally, they exported 'Alice in Wonderlands' to a 2D photo canvas and 2D video clips of these worlds in Tilt Brush. These products were presented at the InSEA 2018 Conference art exhibition, Art Interventions, at Aalto University in 2018.

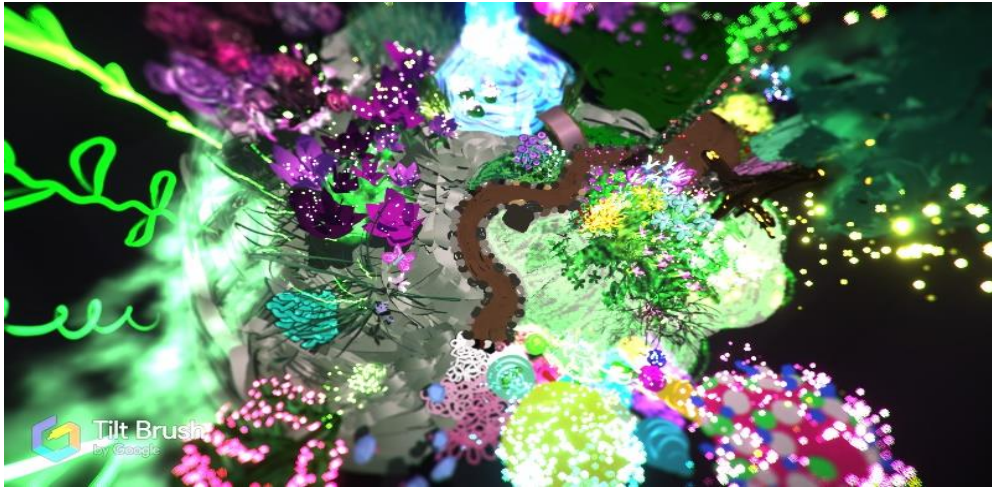


Figure 2: Salla Takamäki, Nina Valtter, Veera Vähä-Heikkilä, *Garden*, 2017. VR. © Takamäki, Valtter, Vähä-Heikkilä.

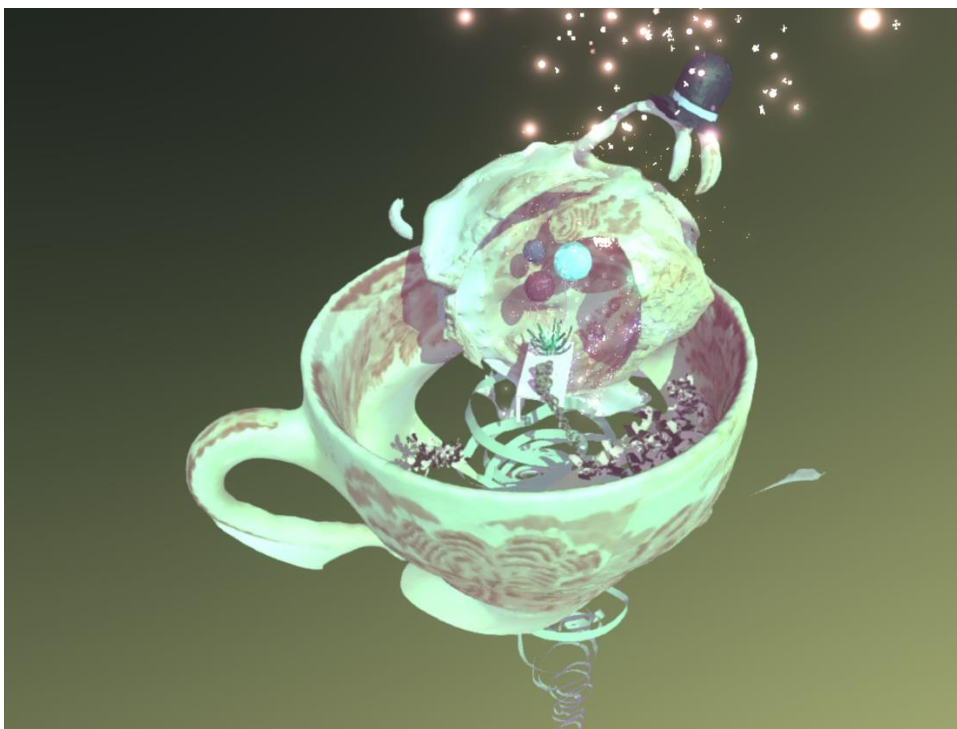


Figure 3: Johanna Heikkilä, Emmi Heikola, Jenny Renlund, *Tea Party*, 2017. VR. © Heikkilä, Heikola, Renlund.



In another instance, for my Art Didactics course (5 cr), I cooperated with an educational technology specialist, Mikko Halonen, two university lecturers, Seija Kairavuori and Hanna Niinistö, and, with the same student teachers, they developed a teaching project in which they let all 140 first-year students experiment with FIVR painting on virtual graffiti walls of actual size (<https://vimeo.com/551902572>). The student teachers taught 3D techniques to several small groups created out of the 140 first-year students so that every student had the opportunity to create a small part of a 3D graffiti wall (Figures 4–5).



Figure 4: *Art Wall* from above, 2017. VR. Courtesy of the students.



Figure 5: *Art Wall* detail, 2017. VR. Courtesy of the students.

## Course background

This current investigation describes and explores student teachers' experiences with FIVR in Tilt Brush. It took place at the University of Helsinki in the Faculty of Educational Sciences and focused on 12 student teachers (class, kindergarten and textile: 11 females, 1 male) participating in an Artistic Expressivity course (5 cr) as part of a Visual Arts Education, Basic Studies Minor (25 cr). The student teachers experimented with different analogical media (e.g., acrylics, graphic arts), developed the works further digitally on iPads, applied photogrammetry techniques and painting with FIVR in Tilt Brush. The goal was to offer the students the possibility to experiment with various artistic techniques and ways of expressing themselves in order to develop their artistic interpretation, although aware that they couldn't necessarily apply all these techniques in schools. The assessment covered the students' processes and outcomes that had been collected in their digital portfolios.

None of the students had prior experience using FIVR. The half-year course included six, six-hour sessions and 100 hours of independent work. One session dealt with Tilt Brush and another with photogrammetry techniques by Trnio (<https://www.trnio.com/>). The author presented VR works by media artists and demonstrated ways of constructing 3D images/objects in Tilt Brush so that after the introduction the students were ready to use Tilt Brush. Additionally, Mikko Halonen provided instructional videos on Tilt Brush for students' independent work. Each small group spent approximately ten hours in Tilt Brush and four hours with Trnio.

The name *Gretan puutarha*, 'Greta's Garden' is a multifold metaphor for this study. It is an open-ended posthuman theme for the whole Visual Arts Education, Basic Studies Minor (25 cr) and for the course, name and subject matter of the students' art exhibition and digital material

for their VR environments. The inspiration behind Greta's Garden is Greta Thunberg, the Swedish environmental activist. The open-ended theme allowed the students to develop, express and relate their artistic ideas intertextually, to depict ideas from dystopia to glimmers of hope and to create awareness of critical themes through art, digital media and FIVR.

The course task was to construct Greta's Garden by mixing fantasy with reality by experimenting with Tilt Brush and 2D images. The students also imported 3D models after applying photogrammetry techniques using the Trnio application. Lastly, they produced a short Vimeo video of their VR environments in Tilt Brush (<https://vimeo.com/386242665>). At the end of the course the students held an art exhibition, entitled *Greta's Garden*, which included analogical and digital works of art as well as the launch of their virtual Greta's Garden, which the audience could interact with.

### **Research question and method**

This essay explores student teachers' experiences in visual art education when creating Greta's Garden from digital materials, in this case with FIVR and other digital tools. Based on my earlier courses, I had expectations that Tilt Brush's graphics would become more interesting and sophisticated if 2D photos and 3D models were included in FIVR. My hypothesis was that FIVR offers new tools for creating art and novel ways of thinking could include all dimensions and require visual-spatial-kinaesthetic intelligence. FIVR also allows work with intermedial and intertextual relations when multimodal images are transformed from other images and possible realities.

The research material consisted of a questionnaire with open-ended questions that each of the 12 students completed. These were subjected theoretical qualitative content analysis. The responses were arranged according to their four small student groups: Threat, Fish Tank, Worm

Disco and Winter Land. I applied the VR concepts of immersion, interaction and imagination, known as Burdea's 'three I's' (Burdea and Coiffet 2003: 3-4), to group the research material. Student responses were studied using these concepts and grouped to reveal the most obvious similarities. Next, I continued investigating these groups to discover differences in the students' experiences and to gain a better understanding of the digital material/ism and possible role of FIVR in art education.

### **Artistic expressivity class**

The 12 students were split into four small groups, the idea being that one group at a time would be in VR while the others worked with traditional graphics and painting in the other classroom. The equipment of the FIVR was rearranged so that two lighthouses with infra-red cameras were placed at opposite corners of an empty space to track motions and a computer was brought in that had Tilt Brush. One student at a time used the fully immersive HTC VIVE virtual reality head-mounted display (HMD) device. In the headset there are two screens that produce a separate image for each eye and these images create a 3D illusion of depth (Kelley and Tornatzky 2019). The headset has several sensors that update the user's virtual position based on their real-world location (Kelley and Tornatzky 2019). The user's body movements along with sensory feedback create the impression of immersion (Christou and Aristidou 2017: 432). However, a few students felt mild symptoms of VR sickness, so in these cases the spatial awareness was not felt in the same way as in the real world (Christou and Aristidou 2017: 432). For safety purposes, the students were asked individually to adjust the focus settings in the headset to prevent eye strain. Nevertheless, students who wore glasses had difficulties fitting the headset properly. The students were also encouraged to take turns or rest after 30 minutes to

prevent headaches or migraines. Headset would not have been recommended at all in cases of maladies such as epilepsy.

The students had two hand-held controllers, one for selecting a palette of colours, different brushes for 2D, 3D painting and special animated effects, as well as some special tools. The other controller was for choosing options from the palette and 3D painting/sculpting. The FIVR technology enabled the students to create the real 3D painting experience of being inside the painting. Chittenden (2018) observes that maintaining the perceptual distance when viewing a traditional work of art is different in VR in that the work of art is experienced from *within* the work itself. One can circle around the painted areas, walk through them and/or teleport oneself into the virtual space to study the painted areas from further away. The students could also shrink and enlarge themselves as well as elements in Greta's Garden. Painting and wandering in the VR space was a whole-body experience. One student at a time used HMD, while other members of the group watched how Greta's Garden was being created on a separate display attached to the computer. Because they saw the scene on the display as if through the eyes of the painter, although in 2D, they could take part in the group discussions.

The students also applied photogrammetry techniques to photograph physical objects and import 3D images of them into Tilt Brush. The Trnio application is available for iPads that were used for taking the photographs of the objects. The photogrammetry technique is a process of taking several photographs of an object by circling around it and maintaining the same distance from it in order to get the right proportions and depth for a 3D model. As the objects were quite small it was enough to photograph them from only one height and from above. Then Trnio stitched the photos together and created a realistic 3D model. However, it was found to be difficult to succeed in creating a flawless 3D model as the images often had imperfections, such as small holes that were then covered up in Tilt Brush. For example, in Figure 3, there is a teacup where the photogrammetry technique failed (at that time, the application Autodesk

Remake was used). However, despite, or because of that, the result became very interesting. The students were also encouraged to use reliefs because they succeeded more readily. For example, Figure 10 shows plaster model reliefs. A few students further refined their 3D objects by, for example, cutting off unnecessary parts using the Autodesk Recap Photo software that was available on the computer. Finally, all the models were imported into Tilt Brush.

## **Results**

### *Immersion in Greta's Garden*

The first questions in the research questionnaire dealt with immersion, which is one of the main features of VR. Although the students focused on visual immersion experiences, the bodily-kinaesthetic aspect became an important part of the visual-spatial experience. The students experimented in painting with the hand-held controllers and it was experienced as liberating to paint 'in the air' on a huge scale with the whole body.

The 12 students experienced Tilt Brush differently and three separate groups emerged: immersed, immersed eventually and not immersed. Three students were immersed in Tilt Brush from the very beginning and they thought that working with FIVR was new and exciting, although it felt similar to experiencing video games and movies. For example, Kerttu (students' names changed for confidentiality) thought that working in Tilt Brush was so interesting that there should be a specific course on VR art alone. The next quotation, from Tiina, reveals that Tilt Brush was experienced as easy to enter and work with from the very beginning:

'I was excited about everything digital at first, especially the VR world, which really intrigued me, but I assumed that my digital skills weren't enough. However, it was not true. VR is the gem of the course. Painting in the VR world, for example, gives an

experience of traversing our limited real world into another reality where one can make anything and live without worries in escapism for a moment.’

Four other students became familiar with Tilt Brush’s distinct functions and they slowly became interested and eventually immersed. These students experienced their imaginary VR world as if it were real and working there became addictive little by little. For example, Satu found VR burdensome because it reminded her of game worlds, but she challenged herself to paint with VR in Tilt Brush:

‘It’s unfortunate that I experienced the VR world as tedious and unpleasant for so long, because in the end, the experience was purely positive.’

However, there were also four students who did not find Tilt Brush remarkably interesting and for this reason they did not feel immersion. One of the four students had a strong personal attitude that prevented her from experimenting in Tilt Brush. She explained that she had ‘overdosed on ICT’ and had no interest in investing time in VR. Although she found Tilt Brush a new and crucial tool, for personal reasons she longs for nature and prefers simpler tools. Mari even found the application awkward to use. Hanna and Kiia wrote that they were extremely excited about the VR in the beginning but, however, not in the end. Kiia reveals one reason for her dislike here:

‘As fun as it was to paint three dimensionally it required completely a different kind of thinking than the traditional art methods.’

Another reason for negative feelings was that Tilt Brush was not found to be aesthetically pleasing. Kiia even thought that it would be much more suitable for other school subjects than the arts. Her earlier observation about the change in visual thinking is apt. The western tradition of painting is filled with drawing techniques that explain how to render a 3D object on a 2D plane. However, in VR the situation is the opposite. One needs to develop a technique for

painting and sculpting freely with VR directly into 3D space. This requires a new way of visual-spatial thinking and bodily involvement.

According to Liu Yangli (2019), it is exhausting and time consuming to paint virtually with many flat strokes. Instead, she creates hollow models by lightly changing the angles of painting and adding a flat mask that folds the surface of objects (Yangli 2019: 30-31). In Tilt Brush there are 'Guides' (e.g., circle, ellipse) that are hollow, basic forms that one can add into each other and thus create more complex forms. When colour is added to these guides it sticks in the form. The guides are considered important when teaching drawing to children because forms and images can be constructed logically (Wendy Bolier et al. 2018; So and Lu 2019). However, the student teachers made little use of them because they constructed their FIVR garden with natural shapes and imported models and photos. There also exist some 'Brushes' for 3D sculpting with which one can directly create 3D forms.

Creating an object's structure by painting requires constructional thinking. However, the construction is not made from a fixed viewpoint, as is the case in 2D art on paper, because the viewer can walk in and through the object and study it from different viewpoints. Lighting can also be varied. There also exist 4D brushes for animated effects (e.g., bubbles flying in the air) that create a 4D illusion, in other words, space with time. As the FIVR canvas is a 3D space, artists need to learn to sculpt or set a stage as in the theatre (Chittenden 2018: 390).

### *Creating immersion*

In order to make Greta's Garden look more interesting and immersive than with painting alone, the students added 2D photos and illustrations and remixed them with 3D painting. For example, in the virtual Fish Tank there are fish illustrated and coloured by children (Figure 8). In Threat, there is an illustration of a huge giant who hovers over the 3D worlds (Figure 7). There are also



several photos that were used for the ground. For example, the students in the Winterland group applied photos of plastic packing material to create a path in their Winterland. Similarly, it is possible to construct objects and spaces with 2D illustrations to look like 3D constructions, but they would always remain flat.

Mixing 2D and 3D was considered interesting. However, all the students said that the process of taking photos with the photogrammetry technique was troublesome. Helena sums up the feelings:

‘Shooting 3D images was the ‘hardest’ part of the process and the most frustrating.’

They often had to take the photos several times before succeeding in getting an intact 3D model. A felt bullfinch was loaned from the biology class to be 3D photographed and situated in the Worm Disco. In the Fish Tank, there are 3D stones (Figure 8) and a flowerpot, while in Threat there is 3D material taken from real life, such as moss, mushrooms and leaves (Figure 6). However, the 3D models often had imperfections and sometimes only half of the objects were stitched. For example, the plaster sculptures in the Winterland were applied as reliefs (Figure 10). Although it took time to succeed in applying photogrammetry techniques, all the students thought that it was worthwhile. Satu explains:

‘3D models are important for the VR world, as they build a bridge between that world and the real world. Tilt Brush alone is not enough to make the world interesting but combining 3D models with world structures results in a more diverse and realistic world.’

Digital materiality emerged in the students’ visual-spatial and bodily-kinaesthetic experiences that were most often felt in the immersive connections when constructing the VR world.

### *Interaction in Greta's Garden*

Interaction in the process was found to be intermedial. The Tilt Brush application is primarily visual, although there are some reactive brushes that move the sketches to a rhythm. By adding music one can animate the images, for example, so that they pulse, bounce and move. However, the students had only added music to the final video in Vimeo. It was found that wider interaction was needed because the students required intermedial understanding when moving between the different applications (Trnio, Tilt Brush, ReCapPhoto, Vimeo), the hardware (iPad, PC) and networks (Internet, iCloud, OneDrive). This kind of navigating requires digital skills that were learned during the course. In the end, Greta's Garden was produced in Tilt Brush and video clips of it were published on the Internet in Vimeo.

Interaction was also a question of the narrative relations between the students' VR worlds. When the first group had created the Threat, the others decided to create their worlds next to it. For example, the Giant in the Threat is hovering above the peaceful landscape, but it can also be seen in the other students' worlds. This creates a narrative experience that suddenly changes the mood in the virtual worlds. According to Christian Roth and Hartmut Koenitz (2016), it is typical that virtual projects create narrative experiences in the digital medium that can be seen at the intersection of artistic approaches and new media as well as other applications. The students' digital narrative story continued in their art exhibition opening, when the audience could enter Greta's Garden to experience the students' worlds as well as to experiment with their own 3D painting.

Interaction was also understood as intersubjective teamwork. All the four small groups succeeded in creating their environment in Greta's Garden. The students got to know each other well and working in small groups ran smoothly. The positive team spirit increased while curating the art exhibition. The most challenging part for the interaction was finding common

time to meet as a group. However, all the students communicated actively in small groups and discussed what kind of a world they wanted to create. They also let each member work individually during group time. Tiina takes the view that the group work was considered especially important and instructive as well as creative:

‘Working in a group removed the tension of getting to know the new software, and I think that working with the group was the most important thing in working with VR.’

However, the most vital issue was the members’ support when the group confronted challenges. According to Henna:

‘Teamwork helps when you need to solve problems. Together we can make more, and we also taught each other.’

Digital materiality occurred in the multiple intersubjective and intermedial relations, connections and spaces.

### ***Imagination in Greta’s Garden***

All the students remixed material from reality and from their imagination in order to create assemblages. Eril Baily (2006) distinguishes three variations of virtual reality. First, VR can be understood as being as authentic as reality, including variations of it. The participants’ experiences resemble those in physical reality. They may purposefully lose themselves in the VR but, nevertheless, they never mistake it for reality. Second, VR can also stimulate affect and feel like reality, but it remains a fantasy world. Third, VR is an image, being either a representation, replication, reflection or a copy of reality (Baily 2006: 127-128).

The students who created the Threat strove to rebuild an authentic reality from natural pieces of 3D material. They used the Trnio application to import mushrooms, for example, into

their virtual world. They created a natural looking 3D environment by adding, transforming and copying pieces of moss and other natural material (Figure 6). When their world was ready, they added an illustration of the giant character, Threat (Figure 7), in order to mix fantasy with the otherwise natural-looking world that felt as if it were real. Henna explains the group's process:

‘We started from the idea of a fairly free forest landscape and realised it through various available elements. We made a valley where a scary and huge giant threatens the valley's serenity.’ (Figures 6–7).



Figure 6: Herta Donner, Fredrik Paul, Anni Vakkilainen, *Threat*, 2019. VR. © Donner, Paul, Vakkilainen.



Figure 7: Herta Donner, Fredrik Paul, Anni Vakkilainen, *Threat*, 2019. VR. © Donner, Paul, Vakkilainen.

The Fish Tank group also mixed reality with fantasy. The students applied photogrammetry techniques to create realistic 3D stones (Figure 8) and 3D pottery that lie at the bottom of the Fish Tank. The fish are children's 2D illustrations that swim in the virtual aquarium (Figures 8–9). The students mirrored and copied the fish in a double-sided way so that they look more interesting when viewing Greta's Garden from behind the fish (Figure 9). They also painted plants for the fish tank in Tilt Brush. Sanna explains their aim:

‘We wanted to produce something surrealistic and focus on the underwater world. The idea was to dive into another world. The Fish Tank (Figures 8–9) preserves life to maintain it and the idea of excluding nature to be looked at in a fish tank clashes with posthumanism.’



Figure 8: Reetta Furustam, Kirsi Heino, Vanessa Virmajoki, *Fish Tank*, 2019. VR. © Furustam, Heino, Virmajoki.



Figure 9: Reetta Furustam, Kirsi Heino, Vanessa Virmajoki, *Fish Tank*, 2019. VR. © Furustam, Heino, Virmajoki.

The Worm Disco group focused on painting in Tilt Brush. They applied photogrammetry techniques to a felt bullfinch to make a digital 3D bird that was copied into a tree with birds and worms. Their focus was on humour. Tiina illuminates the choices the group made:

‘Also, inside our garden gate was a secret wormhole, which we thought was really wonderful! It was nice to be allowed to use humour. We therefore built a worm disco inside the bush arch to make the VR world surreal and surprising (Figure 10). In some post-apocalyptic dystopia, worms live in their own disco world.’



Figure 10: Kaisa Koskenkorva, Anni Rautiainen, Ilona Oranen, *Worm Disco*, 2019. VR. © Koskenkorva, Rautiainen, Oranen.

The Winterland group started with photogrammetry techniques and applied the Trnio application to some famous plaster models from Greek and Roman art history that they had found in the art class. However, the 3D images of white plaster models failed as statues and so were applied as reliefs and embedded in the virtual mountain in front of the Threat (Figure 11). Jaana describes the scene:

‘Our garden looked at the snowy winter landscape and a certain kind of village idyllic (Figure 11) built around the garden, built on natural architecture.’



Figure 11: Roosa Laaksonen, Jasmin Ristoja, Jonna Etelämäki, *Winterland*, 2019. VR. ©

Laaksonen, Ristoja, Etelämäki.

All the groups mixed reality into fantasy. The imagined was added to the real and Greta's Garden became ambiguous. Greta's Garden is produced from visual texts (3D objects, photos and illustrations), material found in media and reality as well by digital painting/sculpting. It is a digital remixture of intertextual and intercultural material realised in rhizomatic (non-linear off shots) relations and combinations.

### **Discussion and conclusion**

Burdea's (2003) concepts of the three I's were very suitable for studying digital material. However, here, these concepts were enlarged with new meanings and contents for art education. Immersion was experienced through visual-spatial and bodily-kinaesthetic thinking when constructing and producing 3D environments in Tilt Brush. The students felt the experience of creating art in Tilt Brush when they let themselves get absorbed in the FIVR world. Painting dispelled suspicions about 3D painting and overcame initial discomfort. Tilt Brush was considered to be easily approachable and fun, and it required spatial, timely and bodily ways of thinking visually. On the other hand, the aesthetics of FIVR painting are new, and one student did not find Tilt Brush's visual palette for image-making pleasing enough for visual expression. Both photogrammetry techniques and importing 2D photos and illustrations extended the FIVR graphics and made it more interesting and appealing.

Interaction was experienced and expressed in intermedial networks. Interaction, which was also found to be intersubjective, took place in small groups where teamwork was valued and experienced as fun and instructive. Their work became narrative when the students created their FIVR environments in relation to each other and opened up the FIVR world to the art exhibition



audience. Interaction also meant a re-evaluation of the roles of the creators and the viewers as the latter began creating art in Greta's Garden in the exhibition.

Imagination was experienced and interpreted in remixed combinations of real and imaginative assemblages that took place in intertextual and intercultural webs of meanings. Greta's Garden was composed of digital material and it illustrates the students' meaning-making process and outcomes. Digital materiality has power in the real, the fantastic and their combinations. On the one hand, it is tied up with an individual's socio-cultural and physical environment, including matter and tangible objects that create memories and a sense of experience. This can be seen in the 2D photographs and 3D models that the students imported into Greta's Garden. On the other hand, digital materiality was imagined and produced in Greta's Garden in Tilt Brush when digital objects and forms were produced, copied, transformed and played with. Digital material was also remixed and edited with fantasy and illusory elements and finally these different worlds were narrated together in Greta's Garden. Digital materialism studied through these concepts suggests that digital material is experienced, transformed and re-mixed endlessly between the multiple relations and networks that are rhizomatic in nature.

According to Adele Flood and Anne Bamford (2007), art education should apply technologies that are part of young people's everyday worlds. However, as much as FIVR may interest the young, there are age restrictions placed by manufacturers as they do not recommend headsets for youngsters (under 12–14 years). In teacher training it is important to investigate the latest technology (such as VR art, movies and games) because it can help with understanding contemporary art and visual culture. It also offers new ways of thinking and creating in art education that could be extended to other forms of transversal competences, such as ICT, multiliteracy and cultural competence that interconnect several school subjects. Moreover, FIVR offers an important research topic in relation to young children's art engagement and learning as well as to high school art education.

The synergy between music and visual art is another interesting area for future investigation with VR. Paintings becoming alive with music makes an appealing theme for art education. Also, applying VR in animations and videos in order to study the concept of time would be another area for follow-up research. Experiencing an imaginary world that is as real as reality offers scope for productive study. All of this indicates that FIVR has opened up opportunities that could enhance the field of art education in the future.

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