Where the Digital Meets the Physical: A Jewellery Design Approach

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ABSTRACT

Jewellery is a design practice heavily associated with traditional handcraft values such as labour, material and complexity. Such values are being challenged by the current use of digital tools and technologies in the industry. While the pandemic has exhilarated our immersion in the digital world, we have observed a change in the design field where individual designers of brands deliver to consumers a blend of experiential and entertainment values. The project Let's Get Phygital was set out as a response to the new reality we all had to get used to, exploring how jewellery could exist in different and unconventional realms. This paper presents the results of an experimental collaborative project between 22 jewellery design students from London College of Fashion (LCF) and Estonia Academy of the Arts (EKA). The students were given a brief and challenged with subverting conventional design and manufacturing approaches, to investigate how contemporary jewellery can exist in non-physical forms and develop digital jewellery related to their personal projects in response. The project's main objective was to support students develop a creative design approach while implementing digital technologies in their own practice. Using Augmented Reality (AR) filters for social media platforms as a tool to directly interact with their audience, the cohort explored digital possibilities and digital wearability within contemporary jewellery.

Keywords: *Augmented Reality, Creativity, Digital, Design, Jewellery*

INTRODUCTION

In the case of designer makers, tools are the embodiment of rules working alongside more conceptual rules and conventions, in order to transform a design problem towards a creative design solution (MacLachlan, Earl and Eckert, 2012). Thus, as designers it is our role to research and experiment with methods and tools available to us and uncover ways we can push our practices forward.

Through the years, jewellers have attempted to test the boundaries of the field by breaking new ground either by inventing new techniques, exploring different materials or simply by testing whether something is possible. Thus, this paper attempts to question how can AR aid the creative process of the jewellery designer. The Lets Get Phygital project was set to deepen our understanding of how the use of digital technologies influences jewellery designers and to learn more about the creative process of these designers while using this tech. The project hoped to support students develop a creative design approach while implementing digital technologies in their own practice. As this was a collaborative project between LCF and EKA, it was set up to support and share the participants' common experiences and envision potential future concepts within the field of jewellery design. The objectives advanced for this study were to:

1) Teach students new software applications (Meshmisxer and SparkAR),
2) Investigate and interrogate how these digital tools influenced (or not) the students' creative behaviour and design processes,

3) Evaluate students' perceptions when using AR as a design tool.

This paper presents the results of LGP collaborative project, which focused on an experimental approach investigating contemporary jewellery in a digital/non-physical form. This exhibition-oriented project dealt with learning about digital possibilities in the context of contemporary jewellery. All participating students experienced the reality of preparing for and taking part in an exhibition, which enabled them to familiarise themselves with the professional sector. Bonardel and Zenasi (2010), suggest that the democratization of the use of computers along with the internet development, have led and allowed a large number of people accessing and using these tools. Thus, LGP participation was free and did not require any technical skills prior to taking part. LGP encouraged students to start developing pieces related to their personal projects in order to subvert conventional design and manufacturing approaches. The students were invited to reflect on a more intuitive and freethinking approach, that implement digital technologies. They were also asked to analyse new product design interactions using Augmented reality as a tool. The project explored how AR could in theory enhance the potential for young designers in the jewellery field to advance their creative practice and enable them to reassess the contemporary value of jewellery. In an attempt to develop new methodologies of designing through making that integrate digital technologies, the project's intention was to contribute to the wider evolution of creative jewellery design.

As social media are universally accessible and part of our daily lives, the project used Instagram as a platform to disseminate the work of the students, due to its build in AR features. The technology company Meta, has developed a software named Spark AR, which is the tool the project uses to allow students to develop digital filters of their work. LGP project lasted 5 weeks (10th March - 5th May 2022) for about two hours each session and was divided into several phases. In the first of these, the students were introduced to the theory behind the use of technology and were presented with a series of examples of designers and content creators using such technology. In later phases, the students were introduced to some digital tools they could download and use for free for these sessions. The staff involved were then concentrated on giving the students feedback and support when concluding their designs. There follows a brief reflection on how they felt during this project via a written statement and a concept description.

Qualitative methodological approaches were employed in order to conduct a comprehensive analysis of how young designers perceive their creative practice while they experiment with new software such as Spark AR. As this was a project developed in an educational set up, reflective practice was at its core. A set of questions were given to the participants, through which we aimed to understand how they perceived their creative practice while they experiment with tools which they were not very familiar.

LGP reflected on students' intuitive design approach and most importantly invited viewers to try on digital jewellery products IRL. The project run from March to

May 2022, culminating in an exhibition, which took place between 6-10 July 2022, as part of the renowned Munich Jewellery Week (MJW). The study is significant for both educational and industry purposes as it focuses primarily on advancing knowledge about jewellery design practice and its outcomes, while integrating AR technologies.

LITERATURE

Digital technologies are among the most important driving forces in the economy today (Brynjolfsson and McAfee, 2012). Thus, an understanding of these phenomena in addition to a discussion of ways in which practitioners make use of digital tools and their impact on the creative process will enable better technology to be developed (Shneiderman et al. 2006).

Technology is deeply entrenched within the new era of fashion and accessories. For instance, digital printing, enable designers to test their design variations instantly, thus allowing more flexibility in conceptualizing prototypes (Parsons & Campbell 2004). Brown (2009), notes that one of the technologies that can be seen as an important innovation in this era is Computer Aided Design (CAD), which has revolutionised the creative capabilities available to designers and engineers worldwide.

Pullee (1990) addresses some major factors that have brought a revolution in the field of jewellery design: the first was industrialization and the growth of technologies, which has enabled jewellery to be mass-produced in order to satisfy a growing consumer market. As a second factor, the author mentions the rapid expansion of information technology and media, which has allowed new ideas to be shared worldwide, reflecting the taste and aspirations of a multi-cultural society. This is a very important factor for the purposes of this paper.

Radhika et al. (2016), note that while digital technology is in constant development, the display of 3D models in the real world has led to the creation of Augmented Reality (AR), gaining a wider importance in gaming and being increasingly used in the design industry. These developments are allowing us to view images of the real world and images of computer-generated worlds in the same field of view (Berry et al., 2006). Thus, we can define here AR as: 'An enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device (such as a smartphone camera)'.

According to Greengard (2019), a variety of software and hardware has been developed that deliver convincing images, sound, feel or other sensory elements to alter our perception and experience of physical things (AR) or create virtual imaginary or realistic worlds (virtual reality or VR).

During the pandemic, we have witnessed AR take off in major ways in response to retail. Clark, in an article issued by the drum, an online publisher for the marketing and media industries (2021), suggests that the growth of AR on mobile has been significantly accelerated by the pandemic and its associated effects. We have, indeed, observed how various companies attempted to connect with their customers using virtual

try-on experiences, including advertising sunglasses or previewing furniture in the home environment. We have had examples from luxury fashion labels such as Gucci, where Alessandro Michele designed a pair of digital-only trainers named Gucci Virtual 25, where people could virtually wear the shoes using AR. The renowned Sotheby's auction house collaborated with Poplar digital studio to bring a historic royal tiara to life via their social media platforms. The tiara was digitally recreated using CAD, ensuring that all elements were added and that the virtual filter was as close to the real object as possible. Technology allowed Sotheby's to reach a wider audience, who interacted with the object through this digital filter, thus propelling the promotion of the auction of the physical tiara in Geneva. Clearly, during this period, AR has proven to be an essential technology for retailers (H. Papagiannis in Clark, K article 2021).

AR has also proven to be a great tool for reaching wider audiences. Björk, the Icelandic music legend, alongside creative collaborator James Merry, have developed a series of AR filters, presenting sculptural iridescent and translucent face shields as digital wearable artworks that the audience could virtually try on themselves.

Some companies pushed the boundaries beyond the physical object. Recently, Balenciaga released a fashion collection (Fall 2021) in the form of a video game, where players walked through a futuristic environment, passing avatars dressed in repurposed style garments. This was an innovative way for the brand to present the line called Afterworld: The Age of Tomorrow. Instead of inviting their audience to attend an in-person runway show, anyone could access the video game via Balenciaga's website. This is in line with Lingel's (2016) thoughts on how the physical places are less important than the ability to establish connection with others. This presents a shift in power where the designer no longer needs a catwalk, a physical exhibition space, a gallerist or curator to present their new work to their audience.

METHODOLOGY

In this project, qualitative methodological approaches were used in order to conduct a comprehensive analysis of how digital tools (CAD) and AR influence the creative process of the jewellery designer. Based on Schön's (1991) work, reflection-on-action, is an approach which involves reflecting on how practice can be developed after the lesson has been taught. Schön recognises the importance of reflecting back 'in order to discover how our knowing-in-action may have contributed to an unexpected outcome'. Thus, the use of reflective process aids in obtaining new knowledge about practice Schön (1991). LGP uses reflection during the project, where we studied the shared patterns and behaviours of the young designers and explored their practice from their viewpoint in order to collect information regarding the role of digital design and AR in their learning and practice.

The scope of our attention was discussed during an initial meeting between Mala Siamptani (LCF) lecturer designer and researcher, Darja Popolitova (EKA) designer and researcher, and creative technologist, Mouhannad Al-Sayegh (LCF), which involved a consideration of own personal experiences in the

professional design sector. The team organised an outlook framework spanning across all five sessions. An open call invited students from Year 2-3 Barchelor lever and year 1-2 Master level from LCF and EKA. Prior to the beginning of the project and any data collection, a consent form and participation sheet was provided to those who agreed to take part. 22 students were recruited from LCF (15) and EKA (7), with two to four years of experience in the field of jewellery design. The participants were informed of their right to withdraw from the study up until the point of data analysis, which was two months from the project start date. The participants were also informed that the findings of the research may be published and used for future teaching purposes.

The project began with introductory practical and theoretical lectures on Meshmixer (Autodesk) and Spark AR (Meta) software, taught by Mala, Darja and Mouhanad. During these lectures, the students were presented with the theory behind using technology as a tool. Examples of digitally produced jewellery and other artworks were considered and discussed. The students were then given practical step by step sessions on the use of software. Meshmixer was selected by the teaching team as it is a 3D modelling freeform software, and Spark AR was selected as it is specifically designed to create (face) filters and is directly linked with Instagram and Facebook as showcase platforms. Both software are free to download which meant the participants did not have to endure any costs.

Each lecture and workshop was recorded via Microsoft Teams and shared with the students so they could return to it at any point. Thereafter, students were given time to work independently to produce digital designs based on their own original ideas and research. During the last sessions of the project, the participants were given the opportunity to present work in progress via the Mural sharing platform (Fig 2) and receive feedback from the teaching team. The outcomes, for each student, consisted of a digital presentation (3D & AR software) of an original design project (1-3 pieces). The students had to upload their final designs as filters on their professional Instagram page, in compliance with the criteria of AR Instagram filters set by Meta. Students submitted a reflective statement and concept description as a remaining activity of the project. The work was collected and presented online via Instagram, in addition to being presented at a physical exhibition, as part of MJW 2022.

The project's focus was to investigate particularly how the students felt about the experience of using new tools they were not familiar with in their creative practice. It was important to investigate what behaviours AR encouraged during this project. The students were asked to complete and upload their final designs online by the 26th of May. The submission was requesting not only the design outcomes but in addition, a 100-word description of their project concept and a 100-150 word reflective statement, in response to the questions below:

• How did you use AR technology in your project?
• What stumbling blocks arose and how were they addressed?
• Did you find the technology workable, interesting, challenging?

• Did the collaboration and solutions of the technology and your design work well or not?
• What lessons were learnt from successes or failures?
• Will you be using this technology in the future?

These questions were designed to facilitate investigation and interrogation of how the digital tools influenced (or not) the students' creative behaviour and design processes. With these questions we hoped for the students to respond as naturally as possible, while acknowledging the self-awareness involved in conditions where one knows they are being studied; hence participants were allowed enough time to respond and without any pressure. The students were aware of the impact they can have, and part of the analysis was to consider how people may be responding to the researcher. To limit bias the questions were indirect and open-ended, inviting the students to express their personal point of view. This was an attempt to allow students to introduce and reflect on issues and practices that they perceived as relevant to the project's topic.

The above questions resulted in rich perspectives on the diversity of design experience allowing us to contribute to design education. In analysing the students' responses, the Braun and Clarke's (2006) six-phase framework was applied in a systematic manner to describe and explain the process of analysis within the context of teaching and learning research.

FINDINGS

When building a case for craft practice in design for a digital age, Wallace and Press (2015), suggest three priority areas for research. First, the suggested practice centred digital craft research, and secondly embodying craft in product teams. The authors also suggested the need for pedagogical research that extends the breath of craft practice to engage with issues of culture and technology. This is where LGP comes in to support the future generation of jewellery designers in being aware and make use of tools such as AR allowing them to expand their knowledge and design skills.

All the students' reflective statements were gathered, allowing the researcher to engage themselves with the entire body of data. The analysis then helped in identifying how the students' experience in using AR and CAD corresponded to established literature. Upon data collection, thematic analysis was used as a method to identify, analyse and report patterns/themes among the data (Braun & Clarke, 2006). The researcher used their judgment to identify themes which capture something important about the data in relation to the project topic. An inductive analysis was used as it is a process of coding the collected data without trying to fit it into a pre-existing coding frame, or the researcher's own preconceptions, thus using a form of thematic analysis which is data-driven (Braun & Clarke, 2006). Coding was done manually, by writing notes and highlighting potential indicative patterns. Constant comparative method was used to explore each data source in relation to those previously analysed. There was a clear sense of which themes were of significance and which seemed to reflect the data best, before

analysing more texts and comparing them again. After reviewing and refining, five key themes were identified in relation to investigating the use of AR in Jewellery design:

• Challenging to learn a new skill yet the outcomes were fulfilling
• New perspectives in conveying concepts unreachable by traditional craft
• Efficient tool to connect and reach a wider audience
• Lower costs for dissemination/promotion of work via digital try-ons
• Willing to continue exploring this technology

CHALLENGING TO LEARN A NEW SKILL YET THE OUTCOMES WERE FULFILLING

What arose from the participants reflective statements was that learning a new CAD software was quite a challenging experience. Some of the students already knew how to use some software, such as Rhino or Blender, yet the majority were not familiar with Spark AR. Specifically, they found the low triangle count, which the software allows you to work with, very challenging, as many details get lost when trying to reduce the triangle count of a design.

For some students this has been a rich experience, as overcoming technical issues was a learning curve, as they have not used such tools in the past. A student mentions: 'through this project, I have a new understanding of AR technology. I think this is a very interesting, playful technology with a lot of future.'

Fig 1 Digital filter developed by Kiska Huang, 2022, Photo: Kiska Huang

This was evident in some student's work where they added playful animation elements to their designs, allowing movement and interaction with the audience. For example, the work of Kiska Huang (Fig 1) is a colourful bird-like mask with a pair of animated swinging wings. The student here applied various futuristic colours and textures to the design with the attempt to connect humans with nature. Thus, this indicates a shift in creative behaviour as it allowed the student to play with an animated element available due to the software's features.

Participants highlighted the value of combinational use of various software programmes, as each one has its own advantages. Kiska in this instance has used a combination of Nommad for creating the shape and Blender for adding the animated elements. Other students used Gravity sketch, which allowed again a very quick manipulation of forms on screen. This is evident in the work of student Urlika Paemurru (Fig2) where we can see all the quick variations of the designs the student tested before the final production of the piece. The ease in which the software allowed the student to test potential outputs have clearly been an important element of the creative process. These observations indicate that the use of the digital tools enabled a level of experimentation that was not normally present in the conventional design process. The consensus was that using AR technology in the students' work was at times extremely challenging, as this was unfamiliar territory, yet the results were rewarding. S4 'the switch from material to immaterial is a constant struggle for me, even though I find new technologies fascinating''. This challenging emotions were predicted when we started the project. Kay and

Fig 2 Design process of student Urlika Paemurru, 2022, screenshot from Mural presentation session.

Loverock (2008), when assessing emotions related to learning new software, they predication and proofed an increase in happiness and decreases in negative emotions while gaining new computer knowledge. The researchers proofed that participants who become more comfortable learning new software probably gained more knowledge. Thus, the students were constantly reminded that perseverance when using Mesh mixer and Spark AR would offer interesting results.

Mesh mixer is a fantastic free software developed by Autodesk which allows the user to generate, manipulate and sculpt 3 dimensional objects as if it were clay. The various brush tools available allow quick on screen visuals. Spark AR on the other hand is an ever-developing free software by Meta, which has new tools and updates coming out every few months. Pre-coded templates are available on the software allowing the user to import their digital 3D files and generate very quickly a filter for both Meta apps: Facebook and Instagram. The so-called patches of the software are pre-coded effects that the user can apply to their work. For example, you can add music and interactions to the filters generated. A blink of an eye can respond to a digital object appearing or disappearing. The user can also try out interaction patches to detect gestures from the person using their filter and make something happen as a result. The software also has body landmark patches, which means it can recognise the body and allow the user to place their objects on it with ease and no difficult coding. During the LGP sessions, the students were also introduced to 3D scanning apps (Trinio, Qlone etc). The reason behind this was to give the students the opportunity to reuse some of their

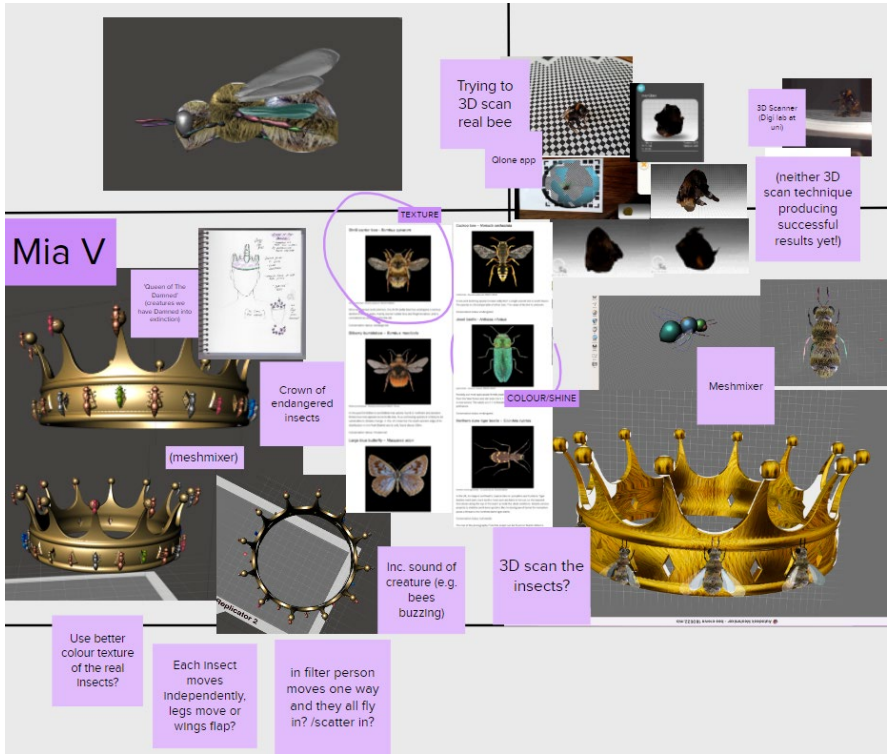

Fig 3 Design process of student Mia Vilkins, 2022, screenshot from Mural presentation session.

existing physical pieces by digitalising to further manipulate on screen. An example of such mixture of processes was evident in the work of student Mia Vilkins who has attempted to 3D scan real bees to add as elements to her digital filter (Fig3) allowing the student to design with a combination of digital and physical elements.

NEW PERSPECTIVES IN CONVEYING CONCEPTS UNREACHABLE BY TRADITIONAL CRAFT

AR technology allowed the participants to play with scale and digital material. This was evident in Dijun Shine Sha work (Fig 4,5) where the student experimented with scale and developed a virtual sash with added animation and a music soundtrack. These elements could be achieved by a click of a button, something that wouldn't be as easy to embed in a physical piece.

When asked to describe their experience, one participant stated S3 'Through this digital project, I had a good experience of the combination of various materials, and inspired my interest in trying various digital creations in the future.' Another participant noted S14 'I found AR can convey my concepts better than traditional formats and it's easy to extend digital to physical and make combinations afterwards'. S13 pointed out that 'Using AR I created an item I couldn't produce in the physical world, and through digital platforms raise awareness to a cause sharing with others.'

The participants agreed that this technology allowed more space for exploring intangible designs. This is already evident in the industry as mentioned above, where James Merry creates a dialog between the digital and the physical work, exploring animation in their virtual filters and creating different physical variations of them. Student Ellen Axberg (Fig 6) created pieces, which reflected on jewellery's purpose and origin, focusing on the feeling of being the jewellery rather than that of wearing it. The student here explored a concept that reverses traditional ideas on jewellery creation and wearability with the assistance of technology. A great quote from Greengard (2019) fits well here ''Make no mistake, the possibilities are limited only by our imagination''.

EFFICIENT TOOL TO CONNECT AND REACH A WIDER AUDIENCE

This type of technology was new to some students hence they found it challenging to design for a digital environment, although it was stated that it gave them the opportunity to rethink how they design and approach a wider audience. ''Through this project, I have a new understanding of AR technology. I think this is a very interesting, playful technology with a lot of future'' S11. Student Urlika Paemurru (Fig7) explored digital filters in forms which would be impossible to create in the physical realm. The students developed a 3D accessory passing through the face, thereby creating the impossible feeling of large and complicated structures being surgically attached to or growing directly out of the face. The model was paired with a fluid texture that reacts to the colour scheme it

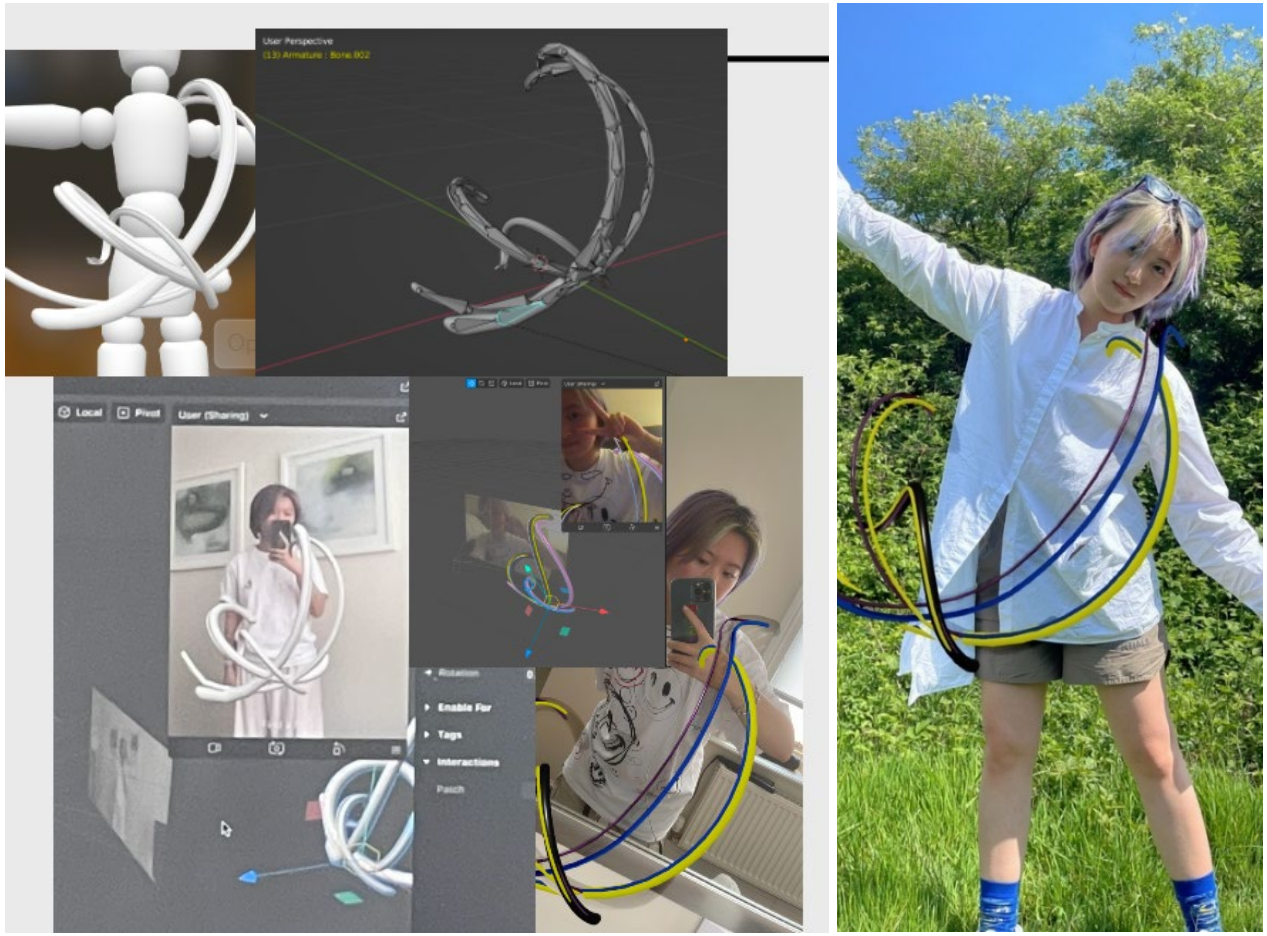

Fig 4-5 Design process and final outcome of student Dijun Shine Sha, 2022, screenshot from Mural presentation session.

Fig 6 Digital filter developed by Ellen Axberg, 2022, Photo: Ellen Axberg.

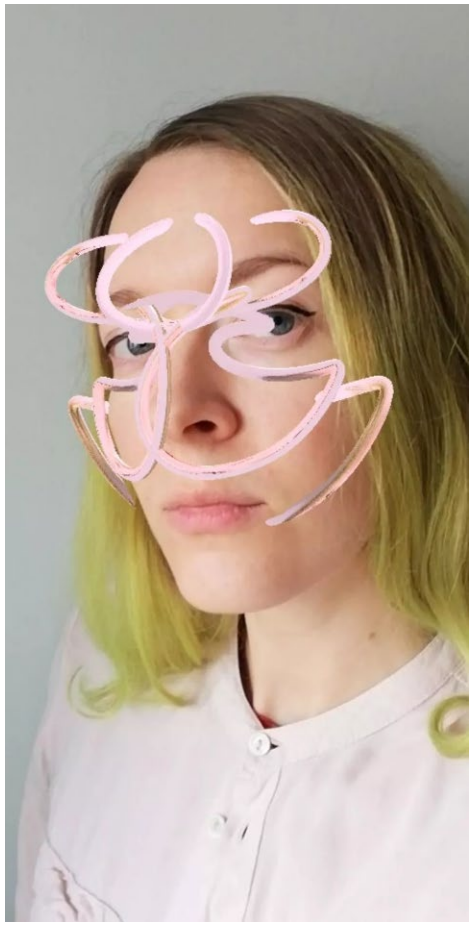

Fig 7 Digital filter developed by Urlika Paemurru, 2022, Photo: Urlika Paemurru.

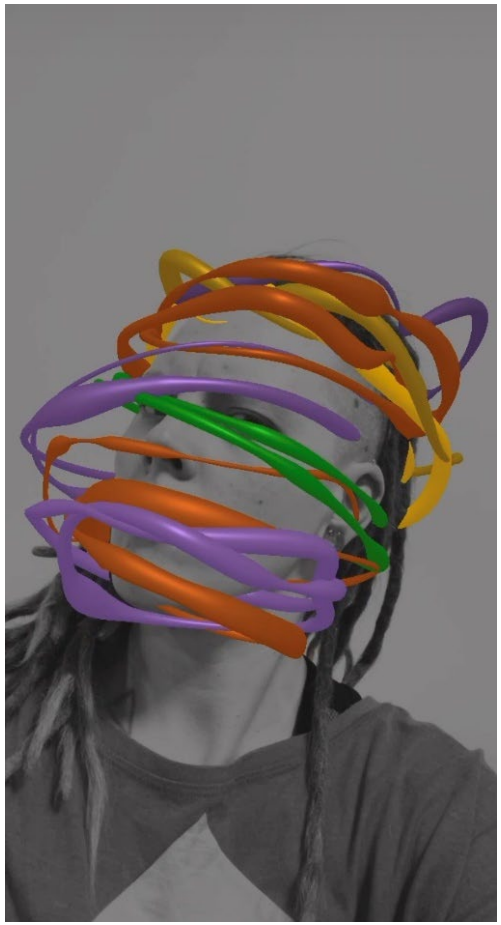

Fig 8 Digital filter developed by Katrin Maria Kteras, 2022, Photo: Katrin Maria Kteras.

detects on the screen; another impossible element to achieve in a physical piece. Thus, interacting with the filter user and their garment in a way not imaginable in conventional jewellery. 'Being able to make your objects transform and adjust because of some simple gestures is really enjoyable. No need to know complicated coding or anything to end up with usable material' S1.

Spark AR is a software that allows immersive possibilities for interaction, using animation, sound effects or even colour changes.
Katrin Maria Kteras (Fig8) is a student who explored the potential of changing the color of the filter depending on the head movements, again something that would have been very difficult to achieve in a physical piece and it allowed a playful interaction with the wearer.

LOWER COSTS FOR DISSEMINATION/PROMOTION OF WORK VIA DIGITAL TRY-ONS

The students participating in LGP, mentioned the lack of costs attached to virtual try-ons: 'For the audience, digital jewellery enables people to try different styles which they probably won't wear on the street anytime, anywhere with less or zero cost so that people can see more possibilities in themselves.' S15 Digital try-ons were very successful in the work of some students who were working on a physical collection for their course. In line with the industry input in the introduction of this paper, the students mention that Covid had an impact on their learning: 'Schedules changed due to the pandemic, which offered me more opportunities to self-study 3D modelling software like C4D and Blender, I enjoyed using AR technology to design Jewellery pieces.' s14.

When discussing audience participation, S2 observed 'it makes me feel fulfilled and willing to continue exploring 3D technology, which will make it easier for more people to see my work and understand what I'm trying to say'. This is in line with Oladumiye et.al (2018), who stated that design presentations have been enhanced with me virtual reality features in CAD and designers now have efficient environments to communicate their design thinking and express their creativity. The authors continue by mentioning that developments in technology and computer science have modified the creative potential of each individual. Robertson and Radcliffe (2009), also agree that CAD impacts creativity in design through an enhanced communication and visualization features allowing the designer to realize an communicate their work.

WILLING TO CONTINUE EXPLORING THIS TECHNOLOGY

Finally, the majority of participants expressed their will to continue to explore this technology in their practices. 'Although creating the filters was new to me, the process was fun and it was very rewarding to be able to experience my own filters in real time and finally succeed. Having a virtual counterpart to the physical product has made my work more accessible to a wider audience and I will continue to try to develop it in the future.' S20.

THE PHYGITAL EXHIBITION

Munich jewellery week (MJW) is considered one of the most significant international events of contemporary jewellery and is the meeting point for collectors, gallerists, curators, and jewellery designers from around the world. It is a contributor in setting the pace for the entire field of jewellery. Thus, LGP was selected to participate during MJW, and was designed as a community building exercise. LGP was set to reach new audiences, and raise awareness for the use of technology in such a traditional field as jewellery. The term Phygital is used in this project as it refers to the integration of digital elements (the student's outcomes) in a physical exhibition space using the physical body. Having created digital interactive artefacts, students who participated in LGP had the opportunity to present the outcomes in the form of an online and in person exhibition, facilitating dissemination to a much wider audience than that of a physical exhibition. The exhibition also tested whether social media platforms could be used as a digital exhibition platform to attract visitors/viewers' attention during a physical exhibition at MJW.

The physical exhibition during MJW, consisted of digital designs, presented on iPads, as well as looped videos being played on TV screens and wall projections. Instagram was used as a platform to present the outcomes due to its AR filter function. This allowed the audience to interact not only online but also in the exhibition physical space via the iPads. Using technology and social media platforms in this way,

Fig 9 Daniel Ramos and Mala Siamptani in conversation during MJW, 2022, Photo: Nicole Chahrokh.

prompted us to explore new relationships between the wearer and the designer and to explore how new product design processes interact with digital technologies.

In the studies of Amabile et al. (2011), the researchers demonstrated that although creativity in a product may be difficult to characterize in terms of specific features, it is something that people can recognize and agree upon when they see it. And this was the case during the LGP exhibition, where we had a lot of discussions with the audience who visited and received very positive feedback on the creativity of the students outcomes. The audience found the use of digital objects an innovative approach to jewellery and enjoyed the virtual display in a physical space.

During MJW we extended our invitation to professional designers from the jewellery industry who have deployed some form of digital design in their practice (Fig 9). Daniel Ramos is a Columbian designer who exhibited activities such as those identified in our project framework. The designer developed a series of works, before creating digital filter versions of them allowing a bigger audience to experience the work (Fig10). Another guest was award-winning designer Silvia Weidenbach, who has extensively tested different tools and methods in her work (Fig 11). Live discussions were hosted with the two designers in an online and in person set-up. This strategy helped open up the conversation to colleagues and industry professionals, who we were physically and digitally present during MJW.

Fig 10 Bracelet by Silvia Weidenbach, 2022, Photo: Sylvain Deleu.

Fig 11 Digital filter by Daniel Ramos, 2020, Photo: Lukasz Przytarski.

CONCLUSION

The LGP project resulted in rich new perspectives on the diversity of design experience as revealed by the participating students' responses. All students who participated and contributed to the exhibition have been enriched with new experience on using augmented reality as a design tool and new reflections on their own work, in addition to new approaches on connecting to their audiences. This is in line with Oladumiye et.al (2018) study which concluded that CAD could enhance students' creative behaviour. When researching the effects of CAD on the creative behaviours of design students the authors suggested that integration of CAD related courses could lead to higher competency for future designers.

In summation, the consensus between the students was that using a new digital tool, such as AR technology, could be extremely challenging yet the results were very rewarding. At times, the participants experienced the lack of CAD knowledge as an obstacle, which they tried to overcome during this project. When designing for a digital environment, students stated that it gave them the opportunity to rethink how they design and how their work interacts with the digital and physical body thus enriching their creative capabilities. Findings of this study indicate that when used as a design tool, AR allows the user to explore new potentials in design, which would not otherwise be possible. The patch editor of Spark AR allowed the introduction of different performing elements such as animations, music/sound or body interactions. This resulted to the student's creativity to unleash in ways conventional physical designs are not able to.

The students also recognized that this technology could be a current trend in fashion and they intent to make more use of it in the future, as it allowed them to approach a wider audience than that of a physical exhibition. AR in this instance gave the opportunity to the young designers to have a play with scale of the work, experiment more and enrich their design practice. If creativity, innovation, discovery, and exploration are potent concepts in academic communities (Shneiderman, B et al., 2006), then collaborative projects such as this should continue to develop in order to advance knowledge on the use of open source software and their implications on the creative process. Experiential knowledge, combined with findings from literature review and the themes that emerged from the analysis of the qualitative data will inform the future editions of this project.

We observed that some of the project weaknesses was the time spend learning the software. Learning a new tool can be consider as learning a new language and mastering it as such takes time. Thus, future editions should allow more time to generate results.

Fig 12 QR code directing to @let_get_phygital and all students work.

It was apparent, through LGP, that communicability of digital designs on social platforms enables designs to be shared in unconventional ways and with a broader audience. Thus, further research should investigate what behaviours AR technologies encourage and what new cultural responsibilities they may bring along with them.

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IMAGES

Fig 1: Digital filter developed by Kiska Huang, 2022, Photo: Kiska Huang

Fig 2: Design process of student Urlika Paemurru, 2022, screenshot from Mural presentation session.

Fig 3: Design process of student Mia Vilkins, 2022, screenshot from Mural presentation session.

Fig 4-5: Design process and final outcome of student Dijun Shine Sha, 2022, screenshot from Mural presentation session.

Fig 6: Digital filter developed by Ellen Axberg, 2022, Photo: Ellen Axberg.

Fig 7: Digital filter developed by Urlika Paemurru, 2022, Photo: Urlika Paemurru.

Fig 8: Digital filter developed by Katrin Maria Kteras, 2022, Photo: Katrin Maria Kteras.

Fig 9: Daniel Ramos and Mala Siamptani in conversation during MJW, 2022, Photo: Nicole Chahrokh.

Fig 10: Bracelet by Silvia Weidenbach, 2022, Photo: Sylvain Deleu.

Fig 11: Digital filter by Daniel Ramos, 2020, Photo: Lukasz Przytarski.

Fig 12: QR code directing to @let_get_phygital and all students work.

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