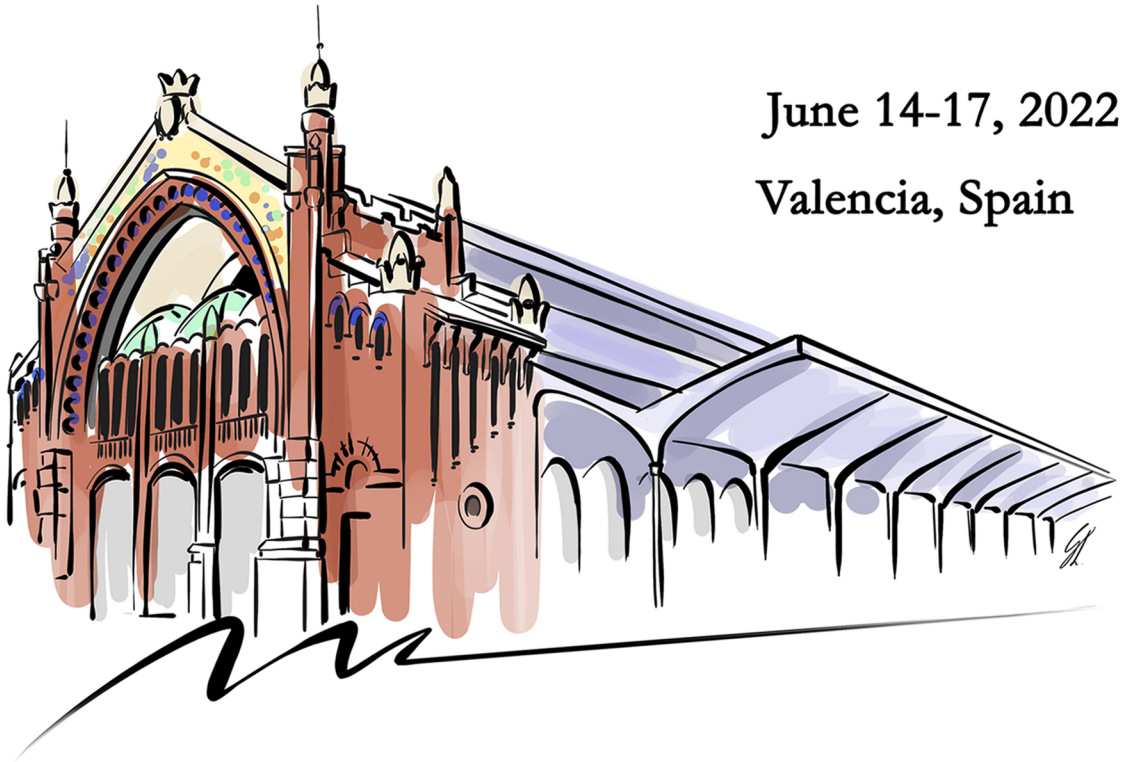




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A Jewelry-Tech Experience: Teaching and Learning Model for Academic Training

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Abstract

The paper aims to describe an innovative teaching and learning process in jewelry-tech design. First of all, the paper analyzes the contemporary and multidisciplinary context, underlining the growing presence of a close connection between digital technologies and the world of accessory design, particularly jewelry. The need to define learning models that aim to integrate different skills to train new professional figures successfully is outlined in this context. Secondly, the paper presents and examines the case study "Living Jewellery" held at the School of Design of the Politecnico di Milano, an international workshop conducted in academic training in collaboration with the Italian jewelry company Roberto Coin. The results obtained during this experience are presented and underline effective methodologies and critical issues in conducting the workshop.

Keywords: *Jewelry design; Fashion-tech; Learning models; Digital Technologies.*

1. Jewelry: from Physical to Digital

The world of jewelry is witnessing a progressive thinning of the boundaries between physical and digital (Cappellieri, 2022), hand-made and machine-made, traditional jewelry, and jewelry with integrated technology. The digital push that the pandemic period has given to the fashion field, including digital fashion shows, platforms for augmented reality, and virtual try-on (Business of Fashion, 2021), continues to advance, introducing digital stores, purchases in cryptocurrencies, and NFTs. The fashion giants are preparing to activate increasingly substantial investments in the metaverse (Business of Fashion, 2022) by replicating actions such as the Gucci Garden immersive event on Roblox and the Bulgari Colors application by Bulgari that allows you to immerse users in the brand's online exhibition. Fashion brands begin to dedicate internal work teams to develop digital experiences and products following this progressive dematerialization. The role of academic training thus becomes central to satisfying the market demand for increasingly multidisciplinary and interdisciplinary skills. As reported in the report "Education for Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era," there is an ever-increasing need to train professionals with heterogeneous skills ranging between different sectors and disciplines (Colombi & Tenuta, 2020) and that are configured as mediators between creativity and the scientific method (Tenuta & Testa, 2018). This becomes more and more relevant in the contemporary context, in which the dematerialization is ever-increasing, and the value of the object is not given only by its materiality but by the set of experiences that it can give to the end-user. The disciplines involved in the design of an artifact integrated with digital technologies range from those relating to the field of design, engineering, user experience, and business. As hybrid figures whose boundaries are increasingly dissolved (Bremner & Rodgers, 2013), designers are required to know how to juggle these disciplinary spaces, communicate in heterogeneous working groups, and understand how to interpret existing technologies, giving them value.

2. Applied Research: Living Jewellery Workshop Case Study

To verify an efficient teaching and learning model for the application of digital technologies in the world of jewelry, the workshop "Living Jewellery" was designed to emphasize strengths and opportunities in academic teaching. Therefore, the workshop was organized at the School of Design of the Politecnico di Milano within the Accessory Design Studio, part of the international Master's degree program in Design for the Fashion System. Furthermore, to make the experience more in line with market demand and to provide an accurate design scenario, the workshop was integrated with the collaboration of an Italian fine jewelry company, Roberto Coin.

2.1. Workshop's Aims

The workshop's objectives covered both subject-specific (technical) and soft skills. Regarding technical skills, the aims were: to practically verify the application of digital technologies in a project of a smart jewel for a well-established company in the Italian goldsmith sector; to test the quality of the work according to the proposed model and verify strengths and opportunities; to verify the modalities of transposition of the physical behavior of the jewel to its digital twin; to emphasize the future opportunities for teaching and learning in the field of jewelry design that the introduction of digital technologies can offer. About the soft skills, the aims were: to verify the quality of teamwork thanks to the definition of different creative profiles; to monitor and improve the soft skills of the learners such as team working, organization, and communication.

2.2. Teaching and Learning Model

The workshop was structured starting from a specific brief, designed in agreement with the company: design a capsule collection of "living" jewelry according to the stylistic principles of the company. The word "living" refers here to interactive pieces of jewelry "coming to life" thanks to the integration of technology. The project envisaged the creation of a collection of jewels and the design of their behavior: these items were meant to become means of interaction between the user and the context, between different users, between the user and the body, or between the user and other objects. The actors involved were: one company, Roberto Coin; three professors from the Politecnico di Milano with specific skills in jewelry design and the technologies to be integrated; thirty-three students divided into six groups, three groups with five members, and three groups of six members; one scientific committee of professors for the final evaluation of the projects developed. After the definition of the brief, the working groups were formed. Professors chose group members based on the results of the Adobe MyCreativeType online test, given to students to be taken before the start of the workshop. The test proposes multiple-choice questions that lead to the definition of eight different types of creative personality: The Artist, The Thinker, The Adventurer, The Maker, The Visionary, The Innovator, The Dreamer, The Producer. The formation of the groups was managed to have a homogeneous balance of creative personalities within the single group, to favor heterogeneity. The six groups were defined and communicated to students on the first day of the activity. The workshop took place over a month, from November 17th to December 22nd, 2021, for nine days, including the launch of the brief and the final delivery. The calendar (figure 1) was structured with: lectures regarding the company brand DNA, in-depth information about brief and technologies, practical exercises aimed at understanding opportunities provided by digital technologies, and reviews of different project phases. The calendar was previously shared with the students to allow the autonomous management of the time available and define specific time intervals for each group.

CALENDAR	
17 november	10:00 - 14:00: Company presentation, // Brief launch and guidelines for the project, Prof. 15:00 - 19:00: Hands on technology, Prof.
18 november	09:30 - 11:00: Lecture, Prof. 11:15 - 13:15: Review: brand analysis, target ideas, inspiration/moodboard ideas, Prof.
24 november	11:30 -
25 november	09:30 - 13:30: Team review (brand analysis, product identity, target analysis, moodboard) and individual review (concept), Prof.
1 december	10:00 - 19:00: Review: concept development, Proff.
2 december	09:30 - 11:00: Lecture, Prof. 11:15 - 13:15: Lecture Comftech, Prof.
8 december	HOLIDAY!
9 december	09:30 - 11:00: Lecture, 11:15 - 13:15: Review (concept development),
15 december	10:00 - 19:00: Review: prototype and final presentation, Proff.
16 december	09:30 - 11:00: Lecture, Prof. 11:15 - 13:15: Review, Prof.
22 december	10:00 - 14:00: Final review, Proff. 15:00 - 19:00: FINAL DELIVERY

Figure 1. Course calendar and organization including lectures, exercises, and reviews. Source: Politecnico di Milano, Living Jewellery workshop calendar (2021).

Specific outcomes were defined and shared with the learners on the first day of the workshop and were divided into two parts: a team delivery and an individual delivery. The team delivery was focused on a content co-creation process and included: 1) brand analysis and product identity; 2) target analysis and lifestyle; 3) mood board and color palette; 4) capsule collection and name of the capsule collection. The individual delivery included: 1) concept board and sketches; 2) technical drawings and 3D renderings; 3) storyboard and/or technology usability; 4) advertising and/or shooting campaign; 5) prototype. Finally, the evaluation criteria for the work carried out were defined and communicated both for the teamwork and the individual part: understanding and visualization of the principle of brand identity; observation, analysis, and visualization of the target; visualization of the lifestyle; visualization of the mood board consistent with the brief; the capacity to work in a team; consistency with the theme; consistency with brand identity; innovation in concept (original in idea, inspiration, design, and aesthetics); visual impact (harmonious and desirable); creative and design autonomy; professional attitude (e.g., punctuality, precision, resourcefulness). Quantitative and qualitative methods were adopted to test the model and the effectiveness of the work. Quantitative methods were favored by questionnaires submitted to students during and at the end of the course. Qualitative methods consisted of observing and evaluating the work carried out by a joint scientific committee of professors at the end of the activity.

2.3.. Results

The quantitative results, as previously mentioned, were obtained thanks to self-assessment and course evaluation questionnaires submitted to learners.

The image shows a digital questionnaire form with three main sections:

- General Questions:** Contains five text-based questions with 5-point Likert scales or open text boxes for answers.
 - Question 1: "Was the programme coherent with the main topic of integration between jewellery design and digital technologies?"
 - Question 2: "What were your expectations from this experience?"
 - Question 3: "Please indicate any strength points related to programme planning, contents, activities you would like us to know about."
 - Question 4: "Please indicate any weaknesses points related to programme planning, contents, activities you would like us to know about."
 - Question 5: "Which is the most important lesson learnt that you took from the workshop and you will capitalize in your academic education and/or in your professional future?"
- TEAM WORK:** Contains three Likert scale questions (1-5) with "min" and "max" labels.
 - Question 1: "Was the division into groups before the workshop effective?"
 - Question 2: "Did you find Adobe's 'MyCreativeType' test useful?"
 - Question 3: "How much do you reflect in the creative profile that emerged from the test?"
 - Question 4: "How useful was the teamwork for the brand analysis and definition of the concept?"
 - Question 5: "How useful was the group work for the individual design part?"
- Acquired skills:** Contains a list of skills with checkboxes and three open text questions.
 - Skills list: Problem solving, Creativity, Planning and Management, Communication Skills, Teamwork, Independent work, Research ability, 3D modelling, 3D rendering, Jewellery Design, User Experience.
 - Question 1: "Select the skills you improved more"
 - Question 2: "What were the opportunities offered by the course for you?"
 - Question 3: "What were the limitations of the course for you?"
 - Question 4: "Are you interested in learning more about smart jewels?" (with 5-point scale)
 - Question 5: "Were you satisfied with the overall activity?"

Figure 2. The final questionnaire submitted to students on the last day of workshop.

In particular, during the performance of the group activity, three self-assessment questionnaires were submitted (at the beginning, in the middle, and at the end of the course) to highlight critical issues within groups and intervene if there were any incompatibility. The majority of the questionnaires of the six groups were positive: 90% of the results assigned a maximum score of 5 points to each member and found no problems in carrying out the activities. Furthermore, 80% of learners defined the division into working groups as useful both for brand analysis and the definition of the concept as well as for the individual development of the project. Moreover, 75% found the use of Adobe's creative test compelling and truthful. The most developed skills were jewelry design, teamwork, problem-solving, 3D modeling, and user experience. Regarding the qualitative analysis, the workshop produced six different collection concepts of smart jewels for the company Roberto Coin, for a total of 33 individual items, delivered with a physical prototype. Each presentation included brand analysis, target analysis, lifestyle definition, the co-created concept for the collection, and an individual part related to the jewelry design. The evaluating commission highlighted how the teamwork favored the discussion for the design of collections consistent with the brief. The initial analysis of the company's stylistic codes and the choice of references that groups were asked to follow were helpful in the definition of uniform and consistent aesthetic characteristics to be applied to the jewelry items. The same choice was applied to the use of technology: the dynamic behavior of the jewel was designed based on a common concept

and obtained through the application of different technologies. In particular, the integration between jewelry and digital technologies was declined in different ways. The concepts that emerged concerned the following topics: the reaction of the distance-dependent object with a particular user; the interaction between the jewel and the body (in detail, the user's state of mind detected by tracking sensors of vital parameters); the interaction with a digital twin through an augmented reality application as the interface of the jewel itself; the visual response of movement to stimuli coming from the user's body; the relationship between different users through the transformation of the jewel following an external output. The prototypes presented were not technologically functional; however, the technological behavior was described through a storyboard and the creation, in some cases, of two static prototypes that showed the state of the item before and after the activation. In particular, attention was paid to the app's design connected to the jewel, the interface, and the user experience. Below, in figures 3 and 4 two collection examples are reported.



Figure 3. "Blooming Gold" collection for Roberto Coin. The collection consists of two bracelets, a brooch, and two rings. Once activated, the technology gives life to the jewel that changes through movement or vibration. Politecnico di Milano, final delivery (2021).



Figure 4. "Inside Out" collection for Roberto Coin. The collection consists of a necklace, a bracelet, an earring, and two rings. In addition to giving life to the jewel, the technology allows you to connect the jewel itself to an augmented reality application through which to monitor and view the effects of the interaction between object and user. Source: Politecnico di Milano, final delivery (2021).

As observers, we also noticed that the individual design phase was autonomously and automatically supported by internal group communication, exchange of ideas, and advice between team members. Internal feedback allowed the projects' active evolution and improvement.

2.4. Strengths, Limits, and Opportunities

The questionnaires and observations conducted by the scientific committee of the professors along the workshop's duration revealed strengths and opportunities. Practical exercises on technology and the visualization of the components contained within commonly used devices contributed to understanding objects' functioning. In particular, the teaching model with practical experiments on technology made learners understand their role as designers, underlining their ability to connect existing technologies and elements to produce innovation: designers are mediators between different skills, producing new languages by mixing known elements. Equally influential was the division into work teams obtained thanks to the students' creative skills profiling: they actively collaborated for the group and their individual goals. Thanks to this division, learners could develop soft skills such as interpersonal communication, organization of work, and exchange of ideas. A further strength was the company's presence as a design constraint that gave the brief consistency with the current market's demands, demonstrating interest in wearable technologies. The used design methodology proved to make up for the lack of working prototypes in an effective way. The creation of two different prototypes showing the evolution of items and the presentation of a storyboard visually telling the activation of the technology were essential for conveying the project concept. The workshop also highlighted future opportunities for young designers. Even if, as previously stated, the storyboard was a valuable tool for understanding the behavior of items, students found a practical limit in visualizing it. The brief request to effectively show the behavior of the pieces of jewelry became a stimulus for students to expand their knowledge of 3D rendering and animation software, approaching different skills previously little explored. Furthermore, the limited time available and the significant workload allowed the students to improve their organization, both as a group and individually.

3. Conclusion

The strengths and opportunities of the "Living Jewellery" workshop highlighted the importance of implementing collaborations between different skills and experts in academic training. In the case study presented, the coexistence of different sectors, such as design, engineering, and business, allowed learners to integrate multidisciplinary skills and deal with heterogeneous limits. The company's presence was essential to carry out a project with actual market limits, especially avoiding integrating technology with results that were too avant-

garde and hardly achievable. Comparing the company's needs and respecting stylistic criteria was fundamental to making students face actual working mechanisms. Furthermore, the composition of complementary groups from the point of view of creativity proved to be a valuable and effective tool for building balanced and heterogeneous teams and promoting interpersonal communication between group members. The exchange of information and peer evaluation became helpful tools for personal and professional growth and promoted better design outputs. The evaluation of each learner's work through peer evaluation was necessary for constant and constructive monitoring of the activity and stimulating self-analysis and self-regulation within groups. The workshop also underlined the importance of structuring learning models for designing physical and virtual worlds. Indeed, young designers, increasingly inserted into the digital context, used embedded technology to connect physical objects to virtuality. In particular, knowing how to transfer the brand's identity into a digital dimension without losing the stylistic features of recognizability of the company becomes central in the training of jewelry designers. The overall workshop experience is positive: the need for more significant heterogeneity and interdisciplinarity of the skills involved in the design process of smart jewelry is constantly growing. The opportunities found in the visualization of jewelry's behavior, in 3D renderings, and the integration of technology show how the coexistence of disciplines can contribute to the implementation of the final project. In particular, it becomes clear that product design skills should be integrated with those competencies related to the user's experience. Therefore, the digital experience project coherently linked to the physical product becomes considerable interesting in contemporary. The world we live in sees the boundaries between the real and the virtual (Maldonado, 1994) increasingly thin, and designers are committed to creating for both dimensions. The case study presented fits into the broader context of the digital shift and underlined the importance of continuing the discourse on the impact digital technologies have had on the interaction between objects and users. The solid symbolic, communicative, functional, and aesthetic value that fashion and jewellery have had in their interaction with the body (Cappellieri, 2014; Barthes, 2006; Polhemus, 2005) is further fragmented with digital transformation (Tenuta, 2020; Testa, 2019; Koulidou, 2018; Moller & Kettley, 2017; Ugur, 2013; Seymour, 2008). Current evolutions of body equipment such as objects with embedded technology, digital filters, virtual objects worn by avatars, and NFTs open the space for new design possibilities around their static or dynamic relationship with the body (Testa, 2019). This leads to the formation of new languages and symbols, which focus not only on the aesthetics and form of the product but rather on its behaviour and relationship with the user experiencing it. Digitalization and virtualisation also impact the spaces in which interaction takes place: "humanity is now living in a hybrid existence between the virtual and the actual world and consequently all our cultural activities will be transformed, evolving into new kinds of expressions and existences." (Santos et al., 2020). While in the past interaction with body equipment took place in the physical sphere of human experience,

today, with the advent of the digital, physical boundaries are being broken down to explore hybrid territories between the virtual and real worlds. The case study explored the discourse around the real and digital to define the spaces of interaction between body equipment and user and inform methodology, considering how “design of experiences is now the ‘central and explicit’ object of design” (Atkinson, 2019).

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