

MUSICOLOGÍA Y TICs

PROGRESSIVE PEDAGOGIES FOR INNOVATION AMONG ART, SCIENCE AND TECHNOLOGY: THE CASE OF MASTMODULE.EU

**PEDAGOGÍA PROGRESIVA PARA LA INNOVACIÓN A TRAVÉS DEL ARTE, LA CIENCIA Y LA
TECNOLOGÍA: EL CASO DE MASTMODULE.EU**

**P. Purg (a*) and N. Castillo–Rutz (b), S. Bermúdez i Badia (c), C.
Csíkszentmihályi (d), J. Krpan (e), F. Hedeer (f), D. L. Sousa(g), K.Širok(h)**

(a) School of Arts, University of Nova Gorica, Nova Gorica, Slovenia;

(b) Graz University of Technology, Graz, Austria;

(c) Madeira Interactive Technologies Institute, University of Madeira;

(d) Madeira Interactive Technologies Institute, University of Madeira;

(e) Kersnikova Institute, Ljubljana, Slovenia;

(f) Graz University of Technology, Graz, Austria;

(g) Madeira Interactive Technologies Institute, University of Madeira;

(h) Faculty of Management, University of Primorska, Koper, Slovenia.

ABSTRACT

Even if aiming at technical innovation, an interdisciplinary curriculum can and should include social values. The Master Module in Art, Science and Technology project attempted to do so by developing the innovation catalyst profile, a graduate who critically reflects on the creation process by combining art thinking and design thinking. Within a pilot of the MAST module students from three universities responded to timely challenges such as 'The Future of Work' and 'Solidarity,' through which the project staff tested progressive pedagogical solutions like cross-disciplinary mentoring and situated knowledge sharing. Introducing European social values in both artistic and technical education, the article presents models, experiments and inspirations discussed against discursive analysis and course evaluation data. In order to support not only inclusive but also sustainable teaching and learning approaches, novel methods and tools may become daringly innovative as well as critical of both their pedagogical and the wider social setting.

KEYWORDS

art thinking, curriculum design, social values, innovation catalyst, design thinking.

RESUMEN

Incluso cuando orientado a la innovación técnica, un plan de estudios interdisciplinario puede y debe incluir valores sociales. El proyecto del Módulo de Maestría en Arte, Ciencia y Tecnología intentó hacerlo desarrollando el catalizador de la innovación, un graduado que analiza críticamente el proceso de creación combinando el pensamiento artístico y el pensamiento de diseño. Durante un piloto del módulo MAST, los estudiantes de tres universidades respondieron a desafíos oportunos como 'El futuro del trabajo' y 'Solidaridad', a través de los cuales fueron prototipadas soluciones pedagógicas progresivas como la tutoría interdisciplinaria y el intercambio de conocimientos de carácter situados. Para introducir los valores sociales europeos en la educación artística y técnica, este artículo presenta modelos, experimentos e inspiraciones contrapuestos al análisis discursivo y presenta los datos de evaluación de los cursos. Con el fin de contribuir no solamente a una enseñanza y aprendizaje inclusivos, sino también sostenibles, las nuevas metodologías y herramientas propuestas pueden volverse atrevidamente innovadoras y críticas tanto de su entorno pedagógico como social en general.

PALABRAS CLAVE

pensamiento artístico, diseño curricular, valores sociales, catalizador de innovación, pensamiento de di-

ADDRESSING THE CLASH BETWEEN INNOVATION AND SOCIAL AGENDAS

Re-imagining innovation on European social terms is fundamental to increase the global economic competitiveness of the European Union while preserving its values. Often, technologies have political agency and produce social impact as they codify certain values into material culture. Unlike science, technology takes the form of a pseudo-legislation outside the traditional space of politics. Developed by corporations and governed by the private sector, technologies are rarely completely democratic, nor are they transparent. Interdisciplinary education is thus the key to generate consciousness for sustainable social values, fostering future citizen participatory practices and co-production challenging the technocratic status quo.

The 'Master Module in Art Science and Technology' project (MAST, 2018-2020) situated itself within a value-driven framework of experimental pedagogy as increasingly supported by the European Union (European Commission, 2018). The project's knowledge sharing strategy considered five areas of emphasis: organizational context, interpersonal and team characteristics, cultural environment, individual, and motivational factors. Each consortium partner of MAST, consisting of three different universities (digital art, architecture, technology) and three different NGOs (production, networking, policy), contributed with different perspectives towards creating a joint program — a specific blend of activities that combined curriculum in co-design, mobility, partnering strategies, teaching methodologies development, and peer criticism.

MAST considered 'Social Europe' values based on the twenty principles of The European Pillars of Social Rights, reflecting current European priorities (European Commission, 2020) aspiring to new and more effective work-related rights for citizens. The goals of these twenty principles converge in fair working conditions, social protection and inclusion. Impacting a broad range of stakeholders, MAST pedagogical approaches thus sought to foster a novel and radical teaching and learning that would be both innovative and critical of itself. The main aim was to diminish the apparent clash between the industry's drive toward constant (yet incremental) innovation and labour-intensive, socially disintegrative progress on the one

hand, and the social values (including a range of sustainability issues) on the other.

INNOVATION PEDAGOGY AS A VEHICLE OF SECONDARY SOCIALIZATION

Social justice, labour rights, gender equality, and access to culture are hard-won European rights that must remain associated with digital innovations, governed, designed, and spread fairly and sustainably. Thus, the transformative potential of innovation in both social and technical realms takes priority; foremost technological progress must be based on the interest for a future-oriented, ecologically and culturally balanced social reform that is deeply collaborative. Such a reform should be "speaking with community members and groups" that can "shape the scope of the project and push the staff to embrace issues that they would have overlooked" (Hochtritt et al., 2018)

Following the functionalist sociological perspective of Émile Durkheim and Talcott Parsons (Haralambos & Holborn, 2008) and considering that education is the primary agency of secondary socialization (Carr et al., 2018), supporting innovation through education represents a key transformative potential for social engagement. In this context, art education is fundamental to innovation since art thinking does not only span different domains of academic disciplines and social realities but activates key creative and innovative processes such as critical thinking, materialized imagination, empathy and, not least, human willpower to both understanding and re-interpreting the world.

According to Sloterdijk (2017), thinking art, science and technology together has the potential to generate an expanded knowledge consciousness. While technology is very much about rational knowledge, art is operating with sensual, bodily knowledge; science, on its part, is mainly about factual knowledge. The creation in between them provides the possibility to generate better visions for our future society. Every creation and its design process is visionary because it entails emotional conditions, inner feelings, and non-rational matter, which find their expression particularly in operative interaction with the perceived world. To be open to these visions evokes the unforeseen and the unknown, raising more questions than giving answers. While design focuses on products or

services that respond to needs, art is a realm often integrating different kinds of knowledge and experiences. Thus, art does not respond to an order or a need, it is not only capable of creating a better truth, but it may induce radical and meaningful innovation. Hence, the assumption of the added value of Art in the otherwise predominant Science-Technology mix — which can have a positive impact only if art is considered to have an equal stake at the least — was placed at the core of the MAST project idea.

The MAST consortium created a trans-disciplinary international Masters-level study module through a two-year-long series of workshops and public events, co-funded by the European Commission. Students alongside cutting-edge engineers, scientists, social activists and artists produced both daring prototypes and radical thinking that addressed Europe's ambition towards meaningful innovation and social equity. Therein sustainable social innovation models were first tested in critical ways and then accredited within a cross-disciplinary syllabus presented in the following. MAST promotes a clear interdisciplinary vision and an academic practice that aims to integrate social values into the entire chain of technology creation.

A CURRICULUM DEVELOPMENT PROJECT BASED ON SOCIAL VALUES

MAST may be interpreted as a response to the existing clash between innovation and social agendas, assuming that progressive Social Europe values can, and should, be coded into innovations. Social groups and movements use media and digital technology to promote social values embedded in the political discourse. MAST graduates – as European ICT, creative media and applied arts or design creators – should be able to consider the social costs within a design as readily as they can do that with power, efficiency, or the ergonomic aspects of a prototype. They do this by applying art thinking along and ahead of design thinking, which is to be explained in more detail further below.

The project as a whole lends itself as a case study for specific curriculum development across disciplines, seeking future-oriented technological innovation that essentially rests on art thinking and artistic methodologies at large (Jacobs, 2018). It represents a hybrid approach that combines principles from art, design, sociology, philosophy, politics, and

other key social sciences and humanities disciplines that have been increasingly entering dialogues and collaborations with engineering and technology. The project also explored how the Art, Science, and Technology crossover may be socially impactful in various enterprise organizational forms, including business, non-profit, free/open software, collaborative platforms, and others. MAST developed an intellectual framework and a concrete repertoire by which responsible research and innovation generate new technologies with the best qualities of the European social model (European Commission, 2018).

THE INNOVATION CATALYST: A NOVEL PROFILE FOR INTERDISCIPLINARY COLLABORATION

In 2011, the Harvard Business Review published Roger L. Martin's essay 'The Innovation Catalyst' (Martin, 2011), describing a transformation process in a marketing company based on participatory problem-solving. It showed that, to a great extent, group work combines design thinking with pain-storming, brainstorming, fast prototyping, experimenting, and quick tests, which provide fast feedback in the field. Not focusing on the profile of the innovation catalyst as such, Martin explains the effects of guided design thinking processes facilitated by a pivotal moderator role within the innovation process.

In MAST, the term describes a module graduate with the capacity to critically analyze their environment through an interdisciplinary lens and respond — through design and art thinking combined — to any given innovation challenge. The innovation catalyst profile understands and experiences creative imagination, emotional or corporeal intelligence, and has a deep understanding of aesthetics along with critical thinking; a conception well in line with the core elements of artistic thinking as devised by Buschkühle (2019) emphasizing that:

sensitive perception, personal imagination, and critical reflection – inspire each other but can also conflict each other. In this dynamic constellation, they push the creation process forward. In addition, the quality of will and manual skills are important factors in developing artistic thinking into creative results. (p.5)

An innovation catalyst systematically develops innovative culture by orchestrating the most

creative individuals, who will critically analyze, intuitively and systematically research and create at the very limits of the possible. The innovation catalyst is thus not seen as the most enthusiastic or extrovert employee within the company, but as being on a subtle mission of combining professional ethics with theoretical and practical coordination that leads to a more thorough, sustainable, secure, and ethical innovation. Through interdisciplinary pedagogy and a processual take on innovation management, the MAST module educates the 'innovation catalyst' as someone who is consciously proactive and comfortable in transversal thinking. The paradigmatic MAST module graduate can change perspectives and mix input from different disciplines, meaningfully translating different expert languages across collaborative practices and between the fields of applied arts, humanities, technology, and science.

The underlying assumption is that the future of electronically supported, digitally dominated work should belong to people with competen-

cies and personal attitudes that allow them to think about the future independently and freely, creating radically new scenarios. The multi-skilled and cross-knowledgeable MAST graduate switches among different professional realms, interconnecting and developing new paradigms, finding unconventional, art-thinking-based solutions, as well as providing necessary translations within a creative team.

THE FORCES OF MAST AS A CHALLENGE

In the case of MAST, the applied function of artistic practice in such a hybrid model among Art, Science and Technology is not only critically reflected but also positively applied to improve the quality of life and offer sustainable yet techno-optimistic models for both the industry and everyday life. This is supported by the 'three forces' of MAST that may roughly be aligned with broadly known political concepts as follows:

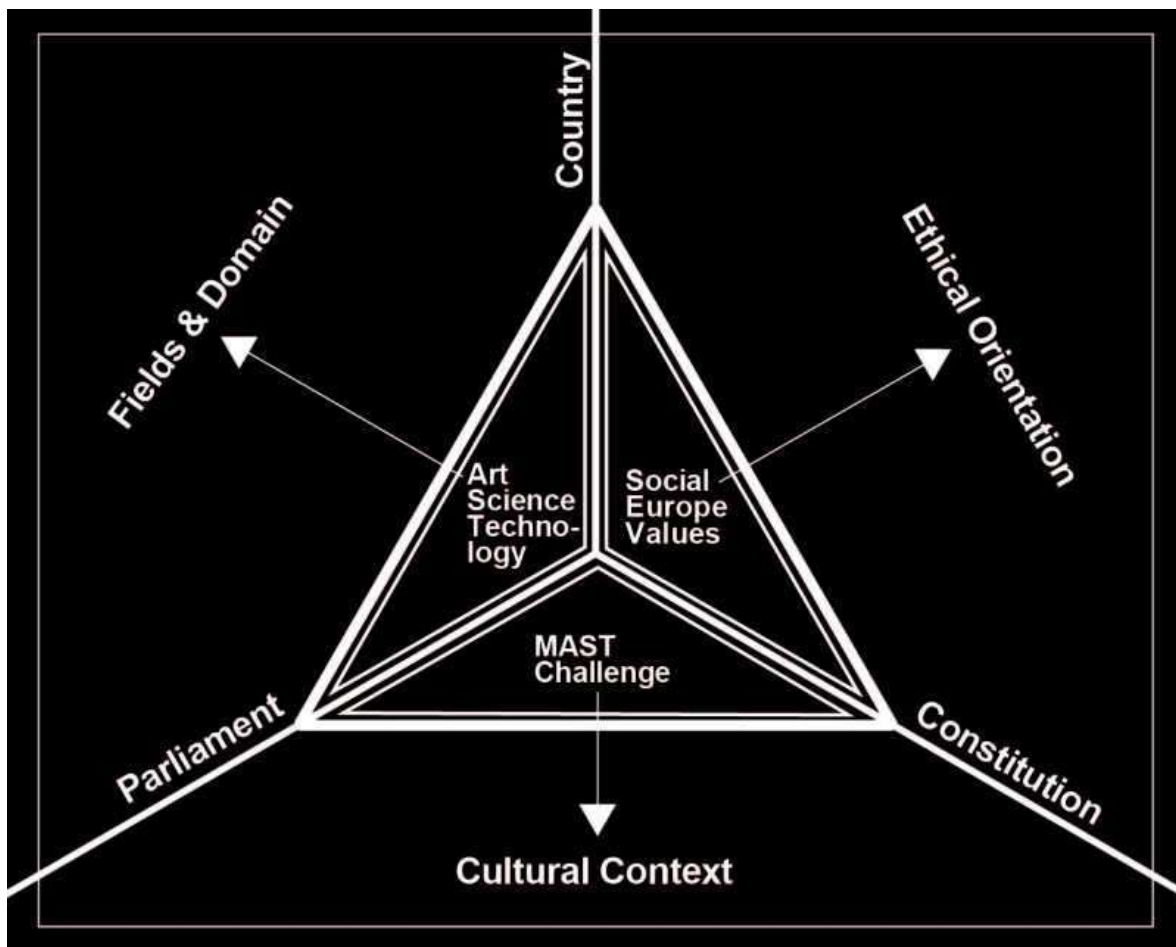


Figure 1: The Forces of MAST

Art, Science and Technology are the fields that the MAST module ultimately prepares students to navigate and cross-fertilize. An example could be a computer science course that teaches network theory emphasizing solidarity values, or an architecture class that deals with the built environment as a frame of social action. Another example would be a primarily artistic course that leads the students through all the key stages of developing an innovative service or product, by essentially including solid ethical and sustainability criteria.

Set at the beginning of the course, a 'MAST Challenge' provides a clear but still open conceptual framing, or context, for the student and faculty to be confronted with, bringing the learning process into close contact with the actual real-world issues. It manifests in courses, workshops, or even work placements, assignments and projects, and perhaps a concluding (master) thesis. At the heart of the MAST curriculum lies an all-encompassing concept of Project Work that integrates an extensive investigation of the topic, experimental setups and divergent explorative protocols which bring about responsible production (of artworks, scientific studies, or technological innovations; including their hybrids), all the way to its public dissemination as manifold interaction with the audiences or partners in the process.

ART THINKING TO INNOVATE BEYOND DESIGN AND ENGINEERING

Scientist Rich Gold (Gold, 2007) described four key endeavours which contribute to making our world: Science, Engineering, Design, and Art, putting these fields on a matrix chart with three named axes, distinguishing among criteria of 'who receives the work?'; is it 'universal or specific?'; and whether it serves 'to move minds or molecules?'. The MAST project rationale acknowledges that Art, Science, and Technology (AST) have always interacted and co-influenced each other, most notably through historical individuals like Leonardo da Vinci; or in institutions like the 'Bauhaus' or the 'MIT Media Lab', and then through festivals like 'Ars Electronica' or 'Transmediale', reaching broad cultural relevance. The current historical period, however, will probably not be remembered as one with a strong interaction between these fields – which is a condition that MAST seeks to address by stimulating an active AST-hybrid citizenship and producing innovation catalysts to lead this mul-

tifaceted transformation.

Unlike STEM or the art-encompassing STEAM concepts (Science, Technology, Engineering, Arts and Mathematics), MAST specifically leaves out engineering. It also defocuses from the currently dominant paradigm of design (thinking) and postulates it – within the innovation cycle conceived – in terms of a stage that only comes after art thinking, i.e. when the artistic practices and the broad aspects of the humanities have already been considered. It does so not to diminish the importance of technology and design, but rather to embrace the fact that moving minds is ultimately more important to the AST nexus, and that the artistic methodologies have so far remained largely unexplored. Art thinking provides a series of dilemmas, intuitive observations, questions, paradoxes, etc. that are demanding more conceptual answers which do not necessarily offer a final result, and which do not necessarily lead to a solved challenge. This differentiates art thinking from design thinking that strives for problem-solving and thus (always) offers a possible scenario or product development.

The key curricular novum in the MAST module is a consistent introduction of art thinking as a core stage in the innovation or catalysis process. The key objective for the student is to become able to apply art-thinking methods and tools, combining them with design thinking to develop (or essentially improve) critical and unconventional breakthrough processes, services and products (MAST, 2020a). One key tenet of the current practices is that engineers and designers belong to service fields and thus are not accountable to the truth (or ethics or values a priori) but rather to clients and their needs. To avoid a mercantilistic understanding of art-making, the present position supports a description of the artistic production only concerning other practices, which means not looking at the artwork as such but instead discussing the artistic way of making or doing things, i.e. as production of meaning.

MAST builds upon the idea that technology serves a higher, socially-engaged calling, and that – by taking basic research (science), and having artists apply it, rather than engineers – a very different set of material outcomes and options are available. Within the respective endeavours of art and science, there are significant differences in how work is conducted, how value is measured, in funding, in education, and in

communication. Nonetheless, Gold (2007) reveals that artists and scientists gravitate toward each other among the four endeavours as their goal is some form of universal truth, and their work situation is one of ultimate independence. Art and science are intertwining not only methodologies and tools but also life- and work-styles. In many ways, this puts artists on a parallel track with engineering and applied science. Indeed, many art and design practitioners are working closely with people from these fields – for which the MAST Module is intended to prepare them.

THE MAST MODULE GRADUATE

The MAST Challenge Lab is the core course of the MAST module designed to introduce students to various methods applicable across the AST domain. Students may enter the Challenge Lab from one of many undergraduate disciplines, fields, and specializations, but finish the MAST module with a strong sense of methodological diversity, as well as concrete experience implementing some of these methods and tools. This is a full-semester course lasting for around three months consisting of regular group sessions, starting with an articulated challenge related to a concrete topic and ending with a solution in terms of a response to the challenge, gradually covering the course's learning outcomes as described here.

The Challenge Lab covers the following competencies that, however, do not explicitly mention social values, as they are topically integrated into the Challenge itself. Upon successful completion, the student will (MAST, 2020a):

- (AST Research) be able to perform background analysis and field research for problem finding and solving (esp. in terms of social innovation);
- (Art Thinking) be able to apply art-thinking methods and tools, combining them with design thinking, in order to develop critical and unconventional breakthrough processes, services and products;
- (Innovation Catalysis) be able to instigate, facilitate, coordinate, lead radical and meaningful, predominantly social innovation through specific combinations of AST stakeholders and methods;
- (AST Innovation) be able to bring ideas via

modelling of innovative solutions, based on design-thinking, to actual applicable services/products that respond to real-world (social) issues with sensible impact and sustainable legacy;

- (Ethics) be able to critically reflect the ethical and broader social aspects of interdisciplinary study and work preferably under consideration of policies and strategies;
- (Project and teamwork) be able and motivated to participate and contribute to successful and well-managed team projects.

The students that participate in a MAST Module implementation should develop the following module-specific competencies (MAST, 2020a):

- be able to contribute in a meaningful way to the fields of AST internationally (start-ups, exhibitions, projects, services, products, civil initiatives, etc.);
- understand the social impact of innovations in a broad sense (and from an ethical standpoint);
- be able to work as hybrid profiles in multidisciplinary environments among Art, Science, and Technology.

In terms of the specific learning outcomes, students that pass through the MAST Module implementation will acquire the following transferable skills (MAST, 2020a):

- be able to adopt insights in different artworks and translate them into meaningful observations that can be translated to possible results;
- be able to critically reflect the ethical and broader social aspects of interdisciplinary study and work (preferably under consideration of policies and strategies);
- conceive, develop, complete, and evaluate well-managed team projects.

The above points thus subsume the innovation catalyst competency profile.

CHALLENGE LAB SYLLABUS

While assuming that a truly comprehensive innovation catalyst profile could be developed

entirely along with a full M(F)A or MSc program, MAST found that in many cases a department or a school, and especially an international partnership consortium may not be able to create an entire master program flexible enough to accommodate this level and kind of novelty. Thus, the curricular development focused on an expandable and flexible module format with different components. Optimally, these should be covered fully along one semester (at least, but may be iterated at different complexity levels) in the following order:

1. Challenge	Identify the topic by determining a set of relevant questions that lead to a deep understanding of the issue at stake.
2. Team	Create a varied expert group (artists, designers, entrepreneurs, scientists, inventors, philosophers, researchers, etc., both individuals, groups and institutions) to establish an innovation team.
3. Values	Create a scaffolding or framework of policies, strategies, laws, conventions, and values to arrive at a clear legal and primarily ethical framework for the process and its results (defining common ground, possibly creating a manual of conduct and envisioning the innovation's social sustainability).
4. Mapping	Map the existing cases, good and bad practices, their theory, and implementation. Understand these cases within their specific ecosystem(s) as cultural, historical, political, and economic contexts.
5. Beneficiaries	Thoroughly understand the challenge originators and find out how to negotiate the values involved (with decision-makers and users), making them understand the existing practices mapped. Decide the time frame of the process of innovation.
6. Art Thinking	By referring to already known artistic ideations, the perspectives on the topic are challenged through the features of art thinking. This may encompass artistic work and experience (such as in a group or individual project) to reflect on the empathetic, reflexive, imaginative (and thus ethical, societal, and political) characteristics of art. Artworks and artistic ideas are explored to mind-shift and inspire, creating different and new questions.
7. Design Thinking	Understand and utilize the possibilities that potential scenarios, demos, prototypes, models, etc. bring about multiple possible solutions.
8. Modelling	Designed solutions (as proposals) are chosen or prioritized. Create more detailed scenarios, demos, pre-testing, etc. In the design paradigm, this is usually called prototyping (of both non-functional and functional kinds). At the end, one solution is chosen.

9. Applicability	Testing of the full solution (prototype) in the real context. It might show the need for iteration on any of the previous stages. In the end, the solution is applied, implemented for real and in the real.
10. Impact	Final evaluation of change or transformation, leading to lessons learned, and several kinds of legacy (experience, skills/knowledge, network, data sets, etc.) and sustainability (longevity) solutions.

THE MAST MODULE PILOTING 2018–2020

During the first piloting year, the MAST Challenge orbited around the ‘Future of Work’. A broad even if partial understanding of this topical field, along with the first creative concepts, were brought by both students and mentors to the Nova Gorica, Slovenia ‘FUTURE.HUMAN@WORK’ event already from the preceding workshop on ‘Progressive Product Prototyping’ in Funchal, Portugal (November 2018). Then they were further iterated at the Graz, Austria ‘Algorithmic Space Studies’ and the Ljubljana, Slovenia ‘Work Without Humans’ events. Eventually, they were evaluated, jointly reflected and prepared for the next academic year (second pilot) at the Rijeka, Croatia ‘Interfacing Academy’ event in July 2019.

The second piloting year faced the ‘Solidarity’ challenge by firstly ‘Mapping the Art-Science-Technology’ field globally in a workshop combined with a ‘MAST Symposium’ that featured two dozen lecture contributions from across the AST domain. Both events took place in Nova Gorica within the ‘Pixxelpoint 2019’ international festival of contemporary art under the topic of ‘Checked Reality. The Work at the Interface Continues’ in November 2019, thus linked with the first-year piloting topic. Thereafter the MAST curriculum was discussed extensively at the ‘Occupying the Middle. On Transdisciplinary Research’ forum in Brussels (January 2020), while a workshop on ‘Solidarity’ in Funchal brought about a completely student-edited ‘Ze Povinho, a magazine on Solidarity’ in February 2020. This was followed by the Graz-based blended workshop ‘Stories of the Neighborhood’ in June 2020 as well as the exhibition ‘in|filtration’ (July/August 2020) at the ‘esc media art lab’, all to converge into the final ‘Hybrid Interfacing Academy’ event in September 2020 (Ljubljana, Slovenia). With its hybrid format, MAST managed to respond to the suddenly transformed possibilities of aca-

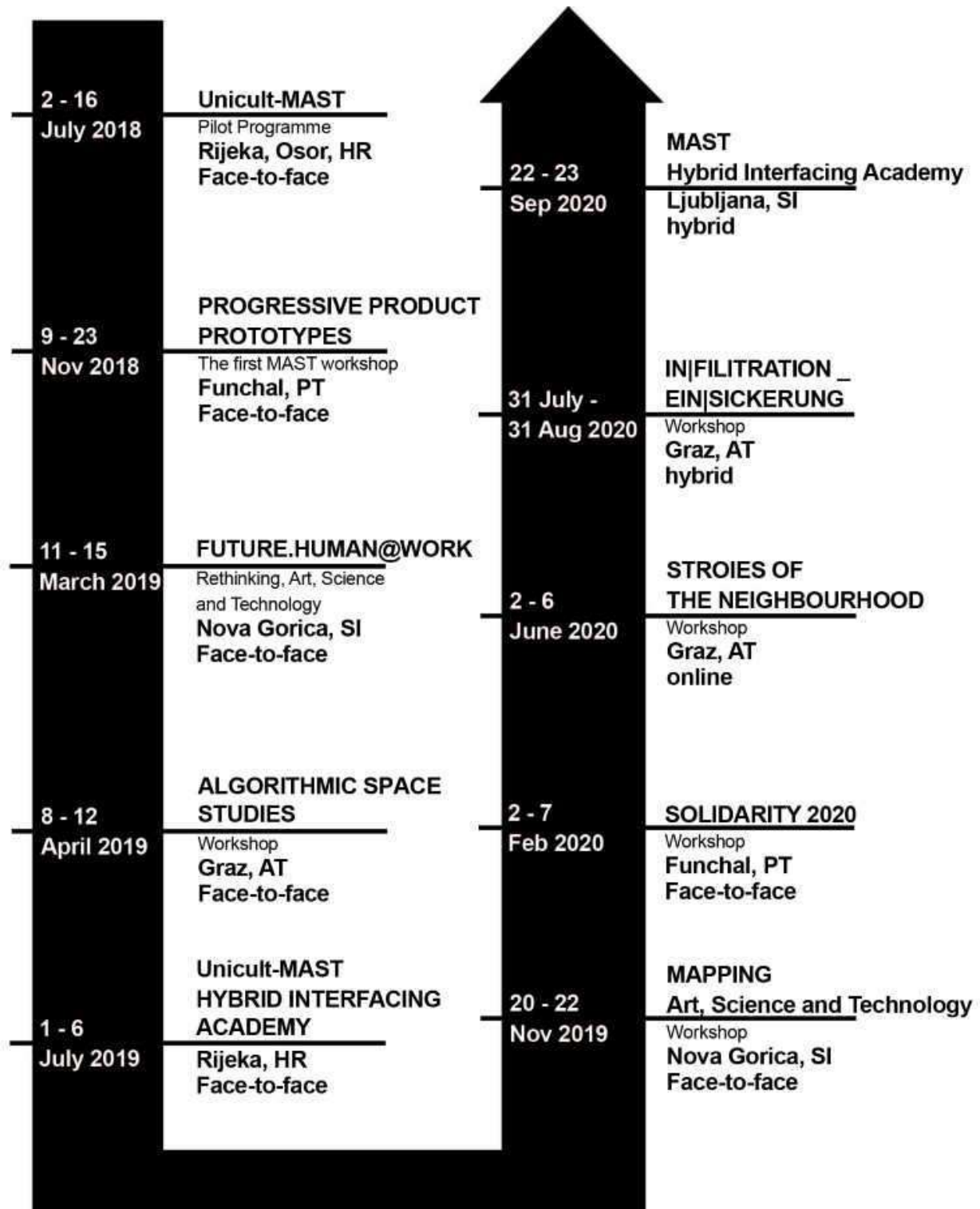
demical mobility and presence teaching due to the COVID-19 pandemic in the year 2020, covering (mostly online) both collective self-reflection and mainstreaming of the developed tools, methods, and messages. All these events are documented on the project website www.mastmodule.eu (MAST 2020: n.pag.).

A concluding activity of the project, the ‘Hybrid Interfacing Academy’ explored how the imagination of artists and their creativity tools can bring about true novelty within AST, tackling the most complex challenges of the future, both for society at large, and the industries in particular. The range of events included a concluding symposium and an overview of best practices and experiments presented live by MAST alumni and mentors. Two policy-making workshops were organized with strategically composed lists of participants (including national and EU legislators), one pivoting around crucial matters of education, the other in the realm of industry.

RESULTS AND EVALUATION

Ten Intensive Learning Events (ILEs) were organized by the consortium in different locations across Europe, eight were implemented face-to-face and two online due to the COVID-19 pandemic, as follows:

To analyze the content and critically reflect on the methodology implemented along the ten ILEs, text mining techniques (Gupta & Lehal, 2009) were used to conclude the evaluation phase of the MAST project, and fine-tune the eventual curriculum. To that end, ‘KH Coder’ (KH Coder Index Page, 2020) was employed, free software for quantitative content analysis or text mining utilized for computational linguistics. The co-occurrence of words (verbs and nouns) was computed from the full syllabi



ArtsEduca 31, Enero 2022 | 10.6035/artseduca.6323 | pp. 209-222

Figure 2: Intensive Learning Events of the MAST project

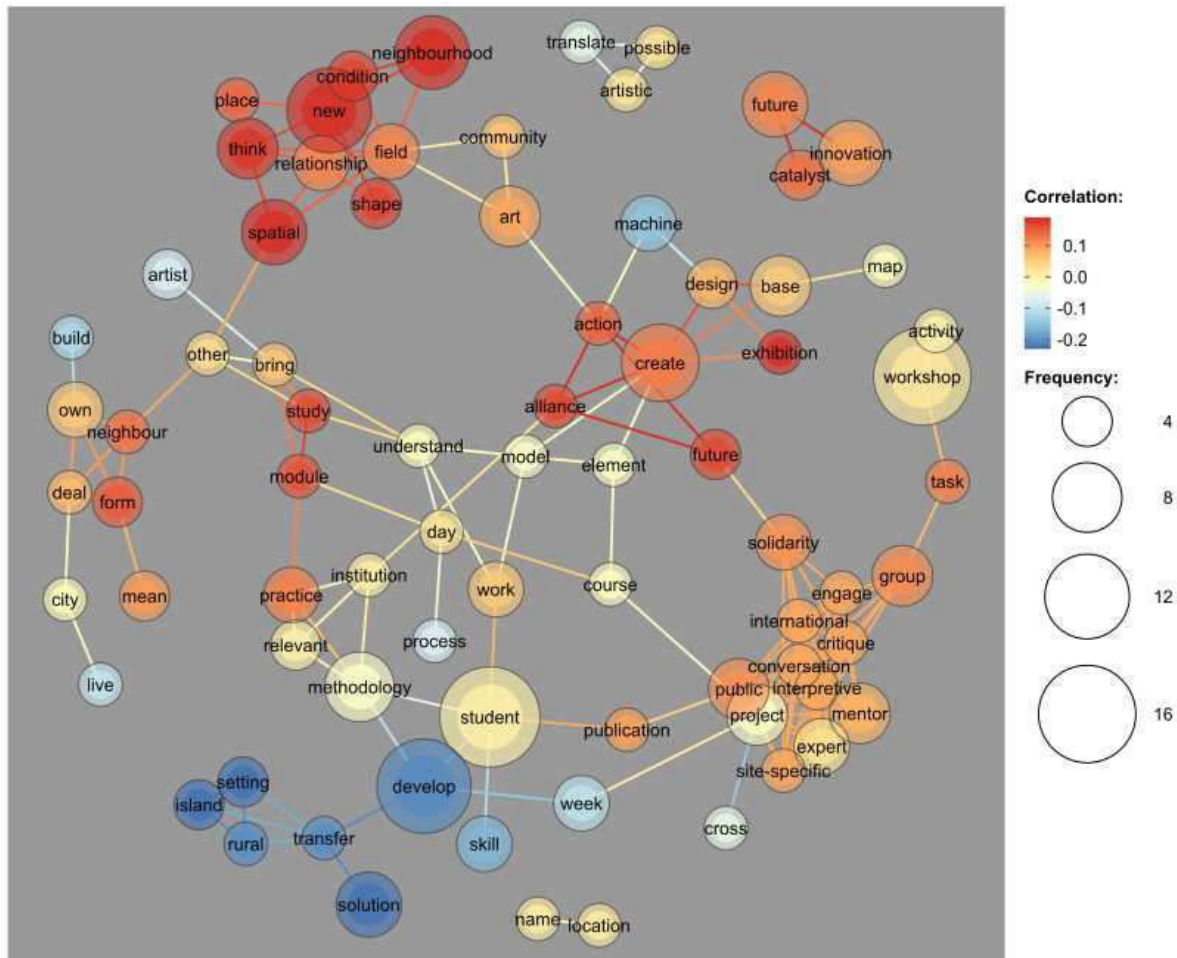


Figure 3: Co-occurrence network diagram from the MAST Intensive Learning Events syllabi

texts of all the ILEs, the analysis of which rendered a co-occurrence word network diagram (Higuchi, 2016). Such a diagram shows words with similar appearance patterns, connecting them by lines (edges) according to their frequency of appearance. Only co-occurrences with a correlation value higher than 0.2 were considered for this analysis:

The above co-occurrence network diagram shows that the main concepts of the ILEs, according to their frequency of appearance, were STUDENT, DEVELOP, WORKSHOP, and NEW, followed by CREATE and NEIGHBOURHOOD, then by SOLUTION, INNOVATION, FUTURE, SPATIAL and METHODOLOGY.

From the analysis, some clearly separated clusters can be identified, the triangle of FUTURE + INNOVATION + CATALYST and TRANSLATE + POSSIBLE + ARTISTIC being featured as the most relevant. These reflect some of the un-

derlying hypotheses of the MAST project, such as using artistic practices as a transformative enabler to innovation, as well as the focus on social innovation and its impact on the future of our societies (i.e. social change).

The remainder of the diagram shows a highly interconnected network around the most frequent words. This diagram places STUDENT next to the DEVELOP cluster, which mediates with the translation of solutions to specific learning settings (ISLAND + RURAL + SETTING). The STUDENT cluster and the DEVELOP cluster are also connected through METHODOLOGY, highlighting the role of RELEVANCE, PRACTICE, and INSTITUTIONS in the methodological choice. The clusters STUDENT and DEVELOP are connected to WORKSHOP through a web of concepts describing the processes. These processes involve PROJECT, SITE-SPECIFIC, EXPERTS – MENTORS – PUBLIC, and actions such as CONVERSATION-CRITIQUE-ENGA-

GE-INTERPRETIVE that obviously confluence in GROUPs to perform TASKS in the WORKSHOP, which may confirm the relevance of the conducted workshop pilots for the attainment of the above-mentioned competencies. These processes are also connected to the CREATE cluster through values set in the MAST Challenge topics (SOLIDARITY and FUTURE). Moreover, the STUDENT cluster is connected to CREATE through the WORK (challenge topical) node and the UNDERSTAND-MODEL-ELEMENT realm.

The CREATE and the NEW clusters are mediated through the ART – COMMUNITY – FIELD triangle, indicating the critical mediating role of the arts in the creation of innovation. Connected between the METHODOLOGY and NEW clusters, one may find a variety of concepts related to situatedness (CITY – NEIGHBOUR – SPATIAL – RELATIONSHIP – SHAPE – PLACE) as well as actions (LIVE – DEAL – OWN – FORM – MEAN – BUILD – STUDY – BRING – THINK) which suggests the actual social or even spatial and not least corporeal impact of the encompassed educational process.

In terms of pedagogical approaches and observations as well as deducing from the above analysis, the pilot phases in different ILEs supported not only a deep exchange among students, but also among faculty and other (external) stakeholders across the Creative and Cultural Industries (CCI) sector, and among different countries. One of the systematic approaches spanning from the first prototyping workshop until the concluding Hybrid Interfacing Academy event was the training of a specific action/reaction balance and strategies to seek novel solutions. This consolidated a particular pedagogical approach that not only brought the participants into the reality of the decision-making process in a broader CCI context but also stimulated them to act in accordance with Art-thinking aspects considering the artistic production of meaning, passing through a range of experimental and speculative design-thinking approaches. In all of them, embracing the unexpected and responding with envisioning alternative solutions seem to have been primordial, which corresponds with the above-mentioned key elements of artistic thinking such as imagination, empathy and critical (self)reflection, enframed into a value-driven work- and lifestyle.

A method to get in touch with or even boldly enter the unknown is the open experiment wi-

thout anticipating results or narrowing the frame of action. It supports unconventional ways of collaborative work, focusing on individual inputs in the working process and divergent interpretations of results. This means that the researcher – in this case the student – is a crucial stakeholder of the experiment influencing it by personal decisions, and eventually affecting it with constitutive innovative production, such as in an artwork, an (improved) technology solution, a public (communication) act, social action or service etc.

It may thus be claimed that the here presented approach can lead to innovative outcomes, especially if social-design-oriented pedagogy is combined with student-centred teaching that is based on a concrete challenge, meaningful to a real community. In a challenge-oriented investigation, a failure is always an option incorporated within the method, and to be learnt from. The experiment can be adjusted to accommodate the unforeseen and to respond to the opportunities arising during the process. It allows to constantly rethink, reorient, and improve on how the operator – in this case the MAST faculty – responds to the results emerging from the process encompassing a lived (community) experience and proactive experimentation, based on (primarily artistic) observation and conceptualization. Indeed, “together with the versatile and deeper learning results for the students, experiential learning is also rewarding for teachers” (Kärnä-Behm, 2019, p. 288).

From the above analysis, it may be concluded that the MAST social innovation (learning) methodology focuses, in a mutually transformative way, on the student, who engages in a complex dialogue with stakeholders and exercises a critical thinking process that leads toward creating innovative solutions based on social values. Therein the student is crucially inspired by the artistic way of thinking as presented above, including the ten ILEs embedded in two annual challenges on ‘Solidarity’ and ‘The Future of Work’. This inspiration relies on a methodology that primes a deep cross-disciplinary understanding of a complex innovation challenge and the spatial, corporeal as well as emphatic situatedness of its corresponding solutions.

The following statements obtained during program evaluation of three different stakeholders in the MAST project seem to approve these processes, especially the transformative value of the MAST approach for the students within the perception of the creative industries and other stakeholders around the project:

Starting by prototyping an idea in Funchal, creating a common space in Graz, on-going into setting up a real exhibition at the Pixelpoint international media art festival, listening and working with experts in Humans@Work, mapping AST CCLs in Nova Gorica, making real connections to cultural venues, all until developing documentation – MAST has been a truly empowering process, allowing me to develop and implement the learned lessons in real life. (MAST-Student, Personal Communication, 2020)

Admiration for those who are able to face substantial societal issues with creative thinking. Besides being often meaningful, I found creative thinking in MAST beautiful. I would describe it as a very aesthetic way of elaborating complex concepts. (Communications and tech collaborator, Evaluation Questionnaire, 2020)

MAST is a training program where early-stage researchers are exposed to a curriculum at the meeting place of art, science and technology, from a somewhat academic perspective and for the purpose of equipping the students to address the complex societal and environmental issues gripping Europe and the world. (Invited faculty, Reflection Questionnaire, 2020)

Besides evident interdisciplinary empowerment across all participant groups, it seems that the students who were not studying art (but rather architecture or communication technology) had been transformed mainly by the open possibilities of art-inspired creative thinking and the gained understanding of the intricate intertwining of ethics and aesthetics within an artistic (thinking) process.

Architecture students from Graz who took part in the Nova Gorica workshop at first used only well-known design-thinking-based tools and methodologies. In a personal evaluative communication with one of the mentors, they claimed to have been primarily focused on the product in both their studies and their professional approach to projects beforehand. They worked in an architecture studio in Graz and habitually applied research and design methods without reflecting or iterating the results in any way related to art thinking or artistic practice in general. After the workshop in Nova Gorica already they found themselves

much more focusing on or observing the pro-

cess that became a part of my both design-based as well as a more creative, art-based academic professional approach toward project and/or research work. (MAST student, Personal Communication)

A new pedagogy for catalyzing a social kind of innovation

The above methods and approaches indicate how the MAST project used new-media-based innovation strategies and creative tools to eventually leverage the Social Europe agenda throughout the AST triangle. They have been gathered and published in the openly accessible 'MAST Manual' (MAST, 2021) offering a selection of the project's results and legacy for broader usage. It remains to be validated in the coming years of the MAST module's full implementation, whether these approaches shall continue to bring students toward rethinking social values consistently, if not empowering them to boldly re-imagine and redesign the future world. And this challenge is of course arising particularly after the EU project funding has been finished, and the institutions need to depend on their stamina and further mechanisms to sustain such high frequency and quality of educational provision (workshop opportunities, different experts, mobility etc.)

By and large, the assessment shows that MAST eventually succeeded in developing "the graduate skills and competencies that foster design for social change and innovation" (Souleles et al., 2017, p. 1) throughout the learning events, gradually developing students' cross-disciplinary competence. Thus, it may be concluded that the above-discussed tools and methods can well reflect the contemporary realities of communication and collaboration found in the interdisciplinary triangle and should be made to shape them critically in turn. Moreover, they also bring about important topical implications that call for iteration iterated, such as the 2018/19 challenge to the students: 'How can work, collectives, or enterprises be designed to ensure a more inclusive, supportive, verdant, and open society?' Along the way of developing efficient solutions to meaningful challenges in the realm of technological and social innovation (possibly combined), the MAST community will continue to explore how to support the virtuous cycle of progressive European social values, and thus 'contribute to solutions for a better Solidarity' (from the 2019/20 MAST Challenge).

Aspiring to develop full potentials of the innovation catalyst role within a social and technological innovation process, the ideal MAST graduate should thus act as a coordinator and an integrator across the realms of AST. Remaining in positive control over own (and our common) digital tools and electronic platforms, the innovation catalyst masters technological knowledge and develops an informed attitude across scientific fields, while safely navigating among the methods and knowledge from across the arts.

REFERENCES

- Buschkühle, C.-P. (2019). Educating for Artistic Thinking through Visual Arts: Examples of Pedagogical Practice in Europe. In *The International Encyclopedia of Art and Design Education* (pp. 1–30). American Cancer Society. <https://doi.org/10.1002/9781118978061.ead012>
- Carr, D., Giddens, A., Duneier, M., & Appelbaum, R. P. (2018). *Introduction to Sociology* (Eleventh edition). W. W. Norton & Company.
- European Commission. (2018, September 21). *Relevant and high-quality higher education* [Text]. Education and Training. https://ec.europa.eu/education/policies/higher-education/relevant-and-high-quality-higher-education_en
- European Commission. (2020, November). *The European Pillar of Social Rights in 20 principles*. European Commission - European Commission. https://ec.europa.eu/commission/priorities/deeper-and-fairer-economic-and-monetary-union/european-pillar-social-rights/european-pillar-social-rights-20-principles_en
- Gold, R. (2007). *The Plenitude: Creativity, Innovation, and Making Stuff* (Illustrated edition). The MIT Press.
- Gupta, V., & Lehal, G. S. (2009). A survey of text mining techniques and applications. *Journal of Emerging Technologies in Web Intelligence*, 1(1), 60–76. <https://doi.org/10.4304/jetwi.1.1.60-76>
- Haralambos, M., & Holborn, M. (2008). *Sociology: Themes and perspectives*. HarperCollins.
- Higuchi, K. (2016). *KH Coder 3 reference manual*. Kyoto (Japan): Ritsumeikan University.
- Hochtritt, L., Ahlschwede, W., Halsey Dutton, B., Fiesel, L. M., Chevalier, L., Miller, T., & Farrar, C. (2018). Public Pedagogy and Social Justice in Arts Education. *International Journal of Art & Design Education*, 37(2), 287–299. <https://doi.org/10.1111/jade.12120>
- Jacobs, J. (2018). Intersections in Design Thinking and Art Thinking: Towards Interdisciplinary Innovation. *Creativity. Theories – Research - Applications*, 5(1), 4–25. <https://doi.org/10.1515/ctra-2018-0001>
- Kärnä-Behm, J. (2019). Experiencing a space: Applying experiential methods to support the learning of art and design. *International Journal of Education Through Art*, 15(3), 281–295.
- KH Coder Index Page*. (2020, December). <https://kncoder.net/en/>
- Martin, R. L. (2011, June 1). The Innovation Catalysts. *Harvard Business Review*, 89(6), 82–87.
- MAST. (2021). *MAST manual*. <https://mastmodule.eu/manual/>
- MAST. (2020a). *MAST – Master Module in Art, Science and Technology*. <https://mastmodule.eu/>
- Sloterdijk, P. (2017). *The Aesthetic Imperative: Writings on Art* (K. Margolis, Trans.; 1st edition). Polity.
- Souleles, N., Savva, S., & Ferreira, A. M. (2017). *The challenge of embedding design for social change and innovation in Higher Education curricula and the role of DISCERN (Design for Social Change and innovation through a European Network)*. 9th International Conference Senses and Sensibility 2017, Funchal, Madeira.

Funding details: This work was supported by the European Commission (CNECT, i3), under Grant Ares (2018)1239462 – Connect/2017/3346110.

The MAST project was co-financed by the Creative Europe program of the European Union.