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FOREWORD

Dear readers,

Welcome to the Proceedings of the 28th International Conference on Printing, Design and Graphic Communication BLAŽ BAROMIĆ 2025 (PDC BLAŽ BAROMIĆ 2025), organized by the University of Zagreb Faculty of Graphic Arts, taking place on May 8 and 9, 2025. The Conference highlights the latest scientific and professional achievements in graphic engineering, design, and visual communications, with a special emphasis on interdisciplinary research and the application of contemporary technologies.

This conference gathered together experts, researchers, and practitioners from graphic technology, packaging, multimedia, and visual communication to exchange the latest scientific findings and professional experiences.

Contributions from authors across multiple countries demonstrate the Conference's international scope and foster the development of future collaborations and partnerships. In an era of rapid technological change and increasingly complex media landscapes, an interdisciplinary approach is essential for understanding and shaping the future of visual culture and industry. Participants explore innovative technologies, research projects, and initiatives that are shaping our daily lives—from digital media and virtual reality to artificial intelligence, sustainable materials, circular design, and education.

The Conference also supports young researchers through activities in the Doctoral school, encourages the exchange of ideas, and enables the formation of collaborations that strengthen the global professional community. In addition, the program includes an International Student Exhibition and the Graphic Product Contest, celebrating emerging talent and creativity.

May these Proceedings serve as a lasting record of the presented research, as well as a source of inspiration for further exploration, innovation, and responsible action in the fields of design and communication. We proudly emphasise the importance of collective effort, knowledge sharing, and creativity in shaping a sustainable and innovative future.

We extend our sincere thanks to all authors, reviewers, and participants whose contributions have made this Conference possible.

Editor

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INVITED LECTURE

INOVATIONS YOU CAN FEEL: THE IMPACT OF MULTISENSORY PRINTING DESIGN

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ABSTRACT

In the broad field of communication, the role of multisensory printing technologies is becoming a central element in the design of interactions that transcend traditional visual boundaries. The paper shows how extensive knowledge of graphic prepress and printing techniques can revolutionise the way we interact with printed materials.

Through the detailed exploration of different printing techniques and the innovative integration of sensory elements such as scent and sound, this approach expands the communicative possibilities of print media. These technologies are carefully utilised to create printed materials that not only appeal to multiple senses but also ensure accessibility and enhanced interaction for a wide audience, including people with sensory impairments.

The focus is on the rigorous prepress processes that are essential to the accurate and effective reproduction of graphic content, preparing materials to convey information in new and meaningful ways. This preparation includes sophisticated design and layout adjustments, precise colour management and the careful selection of materials and inks to create tactile, auditory and olfactory elements that complement the visual aspects.

By presenting successful applications and technological advances, we emphasise the transformative impact of integrating multisensory elements into printing. These innovations not only cater to the needs of different users but also enrich the sensory experience for all by redefining the boundaries of printed communication and setting new standards for inclusion and engagement.

Keywords: printing, design, printing form, optical methods.

1. INTRODUCTION

In today's rapidly changing graphic communication landscape, advances in print technology are not only refining traditional techniques but also changing the way we interact with media in a multisensory world. This paper explores how cutting-edge print processes are incorporating tactile, auditory and even olfactory dimensions, extending the communicative power of print beyond the visual. This development reflects a broader shift in communication practise where dynamic, multimodal experiences such as image-audio combinations and interactive touch elements are becoming the norm.

Modern communication is characterised by its depth and diversity. It goes far beyond simple, text-based exchange and includes multisensory interactions with images, sounds and physical engagement. These diverse forms of expression are designed to appeal to a global audience with a variety of sensory needs and preferences. Recognising this diversity, the European Union [1–3] has introduced strict regulations to ensure that everyone – regardless of their sensory abilities – has access to comparable experiences. These regulations require communication materials to include features tailored to the needs of vulnerable groups such as the blind, visually impaired, dyslexic or colour-blind.

Through advanced graphic prepress techniques and the latest technological innovations, our approach to multisensory printing not only fulfils the new communication standards

but also contributes to their design. Features such as fragrances, sounds and enhanced tactile textures are now seamlessly woven into everyday print materials. These sensory elements are designed to provide an experience that goes beyond the visual, engaging multiple senses and opening new levels of interaction and expression in print media.

1.1. Multisensory design principles

Designing multisensory experiences goes far beyond combining image and sound – it requires a holistic approach that integrates a wide range of materials, methods and technologies. These strategies are carefully crafted to achieve specific goals, such as increasing user engagement in educational settings through interactive learning environments, creating emotional connections in marketing campaigns by evoking nostalgia or excitement through sensory elements, improving accessibility for people with sensory impairments by designing experiences tailored to different needs, or perhaps even promoting relaxation and well-being in therapeutic contexts through soothing soundscapes and visual stimuli. They are based on a deep understanding of how people perceive, process and respond emotionally to sensory input.

Multisensory experiences also go beyond the basic, physical senses – seeing with the eyes, tasting with the tongue, hearing with the ears, touching with the skin and smelling with the nose. Contemporary phenomenological research suggests that "seeing" is not limited to visual input but also includes contextual awareness and deeper cognitive processes such as intuition and mental imagery (Figure 1). This broader understanding applies to all senses, with the thoughtful integration of visual, auditory and interactive elements playing a key role in designing immersive and meaningful user experiences. [4, 5]

Figure 1: Multisensory design principles

The surface level – where users interact directly with a product – marks the pinnacle of experience design. It reflects the outcome of the previous phases, including strategic planning, structural organisation and the basic framework. For the experience to be effective, this layer must integrate seamlessly with the underlying components and ensure that the message is clearly communicated, and the user is fully engaged. [6–8]

2. ADVANCEMENTS IN GRAPHIC PREPRESS AND PRINTING TECHNOLOGY

2.1. Novelties in graphic prepress

Graphic prepress has evolved rapidly in recent years. The evolution was driven by the integration of digital automation, colour science, artificial intelligence (AI) and the growing demands for accessibility and personalisation. These innovations have redefined prepress – not just as a technical step in production, but as a strategic, creative and highly adaptable process.

One of the most important advances in recent years has been the integration of AI and machine learning into prepress workflows. AI-driven tools can now automatically detect image errors, correct colour imbalances, adjust resolution, optimise layouts for different formats and even detect accessibility issues such as low colour contrast. These intelligent systems significantly reduce human error and production time, allowing large print runs to be customised and personalised with greater efficiency.

Cloud platforms such as Adobe Creative Cloud, Enfocus Switch, callas pdfToolbox and Kodak PRINERGY On Demand enable the seamless integration of prepress tasks – such as file preflighting, proofing, imposition and design versioning – across teams in different locations. This not only improves collaboration, but also ensures consistent and accurate file preparation, especially for hybrid projects that include both print and digital formats.

The growth of data-driven print marketing has led to major advances in variable data printing (VDP) and content versioning tools. Today's prepress systems can automatically generate thousands of personalised outputs – from multilingual documents to custom names, images and dynamic layouts – while ensuring consistent colour fidelity and print quality across all versions.

Modern prepress workflows use spectral colour measurement and advanced gamut profiling – such as 7-colour extended gamut systems – to achieve greater colour accuracy and consistency across different substrates and printing technologies. Tools such as GMG OpenColor and EFI Fiery provide precise control over spot colour reproduction and ensure reliable colour consistency, especially in packaging applications.

As inclusive design continues to grow in importance, prepress systems are increasingly equipped with tools that evaluate and improve the accessibility of content. These tools can assess the legibility of fonts, ensure appropriate contrast ratios, check font selection for readers with dyslexia and optimise file structures for compatibility with screen readers or tactile formats.

Today, a modern graphic prepress software offers support for 3D modelling and visualisation, especially for printed packaging, labels and tactile graphics. These features allow designers to preview textures, depths, embossing and finishing effects – such as varnish, foil or raised ink – before production begins. Such tools are particularly valuable for multisensory printing, which supports applications such as tactile maps, Braille publications and interactive packaging.

Prepress also plays a leading role in promoting sustainable design. Modern tools help to optimise ink consumption, minimise waste through intelligent nesting and imposition algorithms and enable soft proofing to reduce reliance on physical materials. File preparation today typically includes the creation of eco-profiles tailored to the different printing systems, supporting efforts to reduce the carbon footprint throughout the print production lifecycle.

These advances in graphic prepress not only streamline production and improve output quality, but also redefine the possibilities of print as a multisensory, inclusive and environmentally conscious medium. As print technologies continue to evolve, prepress remains an important bridge between creative vision and precise technical execution, shaping the future of print communication.

2.2. Novelties in graphic printing technology

Recent advances in graphic technology have significantly expanded the capabilities of modern printing systems. Today's technologies are no longer limited to putting ink on paper, but enable the creation of multisensory, interactive, sustainable and highly personalised outputs – that meet changing design, communication and accessibility requirements. State-of-the-art digital printing systems deliver high-resolution output, reliable colour consistency and fast turnaround times. With features such as VDP, the ability to print with white ink and compatibility with a wide range of substrates, they are perfect for short run, personalised and on-demand production across all graphic arts industries – from publishing to packaging.

UV and LED UV curing have transformed both sheetfed and web printing by enabling instant ink curing, lower energy consumption and better compatibility with different materials. These technologies can also be used to achieve high gloss, raised and textured effects – ideal for tactile designs, luxury packaging and multisensory printing applications.

3D printing goes beyond traditional print formats and enables the production of tactile and structural elements used in education, museums and accessible design. Emerging 4D printing technologies – where printed materials change shape or properties in response to environmental factors such as heat, humidity or light – are opening new doors for dynamic, interactive communication tools and sensory experiences.

Innovations in ink formulation have paved the way for functional inks, including thermochromic, photochromic, conductive and microencapsulated fragrance inks. These advanced materials are increasingly being used for packaging, branding and tactile printing to introduce interactive and informative elements. Coatings based on microcapsules, for example, release fragrances when touched and add a rich, sensory dimension to the print. Today, modern technologies enable the precise digital application of foils, varnishes and embossing effects – so you no longer need conventional cutting dies. These embellishments can be customised in each run and offer significant benefits for brand identity, accessibility (e.g. raised tactile elements) and visually appealing design.

Hybrid printing systems combine digital and conventional technologies – such as offset and flexo printing - in a single production line and enable print service providers to utilise the strengths of both processes. This integration makes it possible to switch between static and dynamic content in real time, maintain efficient production over long periods of time and process a variety of materials with greater flexibility.

Sustainability focussed innovations in graphic technology promote the use of biodegradable or recyclable substrates, low VOC inks and energy-efficient production methods. Techniques such as waterless offset printing, bio-based UV inks and environmentally friendly paper alternatives – such as stone or grass paper are becoming increasingly popular to meet environmental standards without compromising print quality.

Machine vision (image processing) systems and AI-driven quality control systems are increasingly being integrated into modern presses to detect defects, ensure colour accuracy and fine-tune print parameters in real time. These technologies increase reliability, minimise waste and support zero-defect environments – crucial for high-precision areas such as packaging and security printing.

Today's advances in graphic technology are transforming print into a medium that is not only visually sophisticated, but also interactive, inclusive and environmentally conscious. As the boundaries between physical and digital media continue to blur, graphic technology is redefining the way we experience printed communication – engaging the senses of sight, touch, hearing and even smell in entirely new ways.

In today's digitised and automated world, graphic technology has evolved into a cutting-edge, interdisciplinary field driven by advanced software, AI driven systems and

precision engineering. The industry is no longer considered "dirty work"," but combines creativity with innovation, sustainability and smart manufacturing. This shift emphasises the need to promote technological literacy and spark the interest of current and future students. It is important to inspire curiosity and appreciation for this dynamic field – not only to ensure its continued relevance, but also to empower the next generation of professionals to shape the future of visual communication with smart tools and forward-thinking processes.

3. FROM THEORY TO PRACTICE

Building on the technological and conceptual developments explored in this paper, we have moved from theory to practise through a series of application projects. These initiatives were not only educational, but also research-led design experiments. They utilised advanced graphic prepress techniques and cutting-edge print technologies to create meaningful, multisensory experiences tailored to specific user groups.

One of the first project was a tactile picture book for children entitled Kiki the Mouse Fell into the Pantry, which is suitable for blind and visually impaired readers as well as sighted readers. To bring this inclusive vision to life, flexo and screen printing techniques were purposefully combined, resulting in vibrant, touch-responsive illustrations and text. In addition to braille and large print formats, specially developed screen printing inks were used – that contained expanding microcapsules with different fragrances to appeal to children's sense of smell and enhance the content. This innovative blend of techniques resulted in a rich, multisensory reading experience that allowed children to connect with the story not only visually or through the text, but also through touch and scent – making the book even more engaging, intense and memorable.

The second project, entitled The Tactile Wall Story – The Magical Journey of Girl Ada and Dog Beni, was a large-scale, multisensory installation for the staircase of the Centre IRIS – Centre for Education, Rehabilitation, Inclusion and Counselling for the Blind and Partially Sighted in Ljubljana. The installation was designed to transform a typically overlooked transitional space into a vibrant, interactive learning environment.

By combining printed visual backgrounds, tactile elements, soundscapes and educational games, the project provided a unified narrative experience. A sophisticated prepress workflow allowed for the inclusion of braille, large Latin letters and tactile graphics created from high-resolution vector illustrations and overlaid file formats. Production used both UV inkjet and screen printing techniques on a variety of materials including wood, textiles and thermoformed surfaces. Additional sensory layers – such as fragranced microcapsules and inbuilt audio components – added depth and richness to the experience. This immersive installation is an example of how graphic technologies can be used to create inclusive educational environments. Here, children are not just passive observers, but active participants in a multisensory journey that makes learning both accessible and engaging.

The third project focussed on the redesign of the Museum of Post and Telecommunications – the first fully inclusive museum renovation in Slovenia designed specifically for blind and visually impaired visitors. The initiative, which focussed on accessibility, showed how cultural institutions can effectively integrate the principles of equal opportunities. A practical guide for museum professionals, designers and technicians was developed, including detailed documentation on tactile graphic design, material selection, substrate preparation and specialised printing techniques. Using screen printing, UV curable inks and relief printing, selected exhibits were transformed into tactile models, raised maps and Braille displays. This project emphasised the important role of graphic technology in promoting the cultural participation and social inclusion that the museum strives for.

The fourth project extended this approach by adapting various works of art, animals (such

as the fauna of Postojna Cave) and everyday objects. These adaptations were created both as tactile 2D graphics and as 3D printed models developed jointly by students and researchers. Each model was carefully adapted in shape, size and level of abstraction to meet the perceptual needs of blind and visually impaired people. The aim was to translate the invisible into tangible, accessible forms so that users can explore the cultural and natural heritage through direct tactile interaction. The production process combined modern techniques such as 3D printing, digital sculpting, thermoforming and screen printing, demonstrating the diverse possibilities of modern graphic and material technologies.

Taken together, these projects show how graphic technology, when considered from an inclusive perspective, can go beyond the needs of underrepresented groups. They also enhance the expressive and communicative potential of print products for everyone. They are impressive examples of interdisciplinary collaboration and demonstrate the importance of integrating accessibility, sensory design and technological innovation for the future of design education and practise.

4. CONCLUSION

Graphic communication today has evolved into a sophisticated, multisensory and interdisciplinary field that seamlessly combines creativity and cutting-edge technology. With the advent of intelligent prepress systems, advanced materials and innovative printing techniques, modern print media appeals not only to the eyes, but also to the sense of touch, sound and even smell.

In our increasingly digital and automated world, graphic technology is being enhanced by AI, precision engineering and smart manufacturing. Far from being the "dirty job" of the past, it has evolved into a clean, modern and forward-thinking profession that is essential to delivering rich, meaningful and engaging communications.

For this dynamic field to continue to grow, it is crucial to promote technological literacy and inspire both current and future generations of students. By addressing diverse needs and promoting accessibility, we are paving the way for more inclusive, engaging and impactful communication experiences.

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INVITED LECTURE

ÉCRAN-PAPIER-ÉDITER : WEB-TO-PRINT TECHNOLOGIES

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ABSTRACT

Digital technologies have been transforming professions in the graphic design chain since they emerged: production of documents for printing, support for book design, typographic design, illustration... all these professions have been affected by the development of new tools, generally inspired by older manual techniques. Through these new digital tools, a new way of thinking has also been introduced: computing and programming are not simply the means of mimicry, but rather a new way of designing and organizing editorial and graphic workflows. Today, as a relative technical maturity is reached in graphic engineering and the industry it has made possible, a latent development that has been going on for several decades is coming to completion: the profound cross-over of editorial objects between screen and paper. Web-to-print, understood as a set of web-based technologies that enable the content of a web page to be printed on paper, is at the heart of this evolution. We would like to take a look at the challenges and effects of web-to-print through the work carried out as European cooperation project EPE (Ecran-Papier-Editer), which brings together art and design schools and engineering schools to consider the impact of web-to-print in the future professions of the graphical chain, but also to produce tools chains for graphic designers. Between screen and paper, what new opportunities and techniques are opening up at a time when the web browser has become a virtual machine?

Keywords: web-to-print, graphic design research, computed layout, open source, computer programming.

1. ABOUT GRAPHIC DESIGN ACCEPTIONS

Ecran-Papier-Editer[1] is a European cooperation project initiated by the École Supérieure d'Art et Design in Valence[2], France. Its origins lie in the recent evolution of web-to-print technologies, a term we use to describe the possibility of producing printed editorial objects from a web browser. We see web-to-print in the context of graphic design practices and the impact this technology could have on the profession of graphic designer in the near future. It seems important, in the framework of this scientific and technical conference, to first situate the type of graphic design that is considered in the Graphic Design department of Esad•Valence.

1.1. Design in art schools

Like design in general, graphic design has its origins in the industrial revolution and the assembly-line reproduction techniques it introduced, making it possible to manufacture objects in large numbers at low cost. Modernity and its impact on the environment and daily life, particularly in urban environments, have led to a significant increase in the need for visual organization of information: newspapers, magazines, advertisements, public announcements, posters for commercial or political propaganda, books and urban signage are just some of the graphic productions that involve a more global design dimension than that of the objects themselves. Consideration of the environment of visual artifacts has become an issue, in addition to their aesthetic characteristics.
This implies a certain understanding of the sociopolitical mechanisms at work in society

at the time a given graphic object is conceived, in addition to the constraints defined by the commissioner. For graphic design, therefore, it's not simply a matter of giving shape to information so that it transmits a message. It's also a matter of knowing how to organize the equivalent of a sub-text, a second possible interpretation layer. This distancing, done in articulation with the assignment, enables graphic objects to carry a certain critical dimension, to produce a discourse. In this respect, graphic design does have a certain aesthetic quality in what it produces, in a similar way to the work of artists (who produce "artworks").

This approach to graphic design as part of the practice of art, and as a means of questioning the world, is quite common among art and design schools in France and, to a certain extent, more widely in Europe. However, this critical dimension also means not forgetting the strong relationship that design has always had with technology and, by extension, with industry. It is here that the EPE project intends to position itself: the technical fact is part of design practice, and we maintain that it participates in the construction of the critical discourse that design can deliver. If we insist on this way of looking at graphic design practices, it's because one of its consequences is that we keep a certain distance from other practices, such as those of graphic design more directly attached to a certain effectiveness of the communication objects it shapes (advertising, adherence to ideas, marketing, industrial design). The aim of this article is to offer some insights, drawn from the EPE project, into the role that graphic design can assume in challenging professions in the graphic design chain, at the intersection of the arts, engineering and technology.

1.2. Graphic design and digital technics

Graphic design works in many fields and on many scales. Typeface design defines the fundamental elements of text formatting, making it possible to register discourse. These texts, which are organized within inscription spaces, are accompanied, or sometimes replaced, by images. Just as texts can be of very different natures (poetic, scientific, novelistic, descriptive, administrative, etc.), images have different origins and purposes (illustration, photography, technical diagrams, etc.). Organizing this information into coherent units is one of the missions of graphic design, and the resulting objects are designed in relation to the nature of the "content" assembled together: a long text might be presented in the form of a book, shorter and more ephemeral factual information in a poster or flyer, a regularly changing set of information in a digital medium such as a website, and so on in a wide variety of formats and techniques that we won't list here.

The "media" thereby produced are intended both to respond to an assignment and to be distributed to their target audience. This means that there are other professions involved in graphic design, both in the production of content and in the manufacturing of the objects: writer, photographer, scientist, journalist, artist, papermaker, printer, web developer, interaction designer, publisher... or perhaps we should say that graphic design is at the crossroads of all these professions. For graphic designers, it's a crucial task to know how to relate to these professions, to understand their practices, and to design their projects according to their inherent constraints. An obvious example concerns the choice of paper, ink and printing technique for a printed product: everything that makes up the physical object must be taken into account in the graphic design of the object, each technique having its own limitations.

The case of digital media is of particular interest to us here, as the design of on-screen objects, most often interactive, has become one of the skills expected of graphic designers by their clients. Recent history has shown us that computer technology and its tools have already greatly disrupted the more traditional practices of graphic design: typography, page layout, image creation and editing have been based entirely on the use of computer software dedicated to media production for several decades. What interests us here

is not the use of software to replace and enhance earlier analog, mechanical or manual techniques. It's the possibility offered by digital technologies to conceive new modes of production that we place at the heart of our research: the creation of tools for design and by design. In our view, the challenge of graphic design working with digital technologies is not to reproduce already familiar media production contexts (text, images, animations, videos) using dedicated editing tools (InDesign, Photoshop, AfterEffect or Première in the Adobe suite), but rather to invent new media enabled by the flexibility allowed by digital technology.

2. WEB-TO-PRINT?

2.1. Designing programs

In computer science, the creation of software tools requires the writing of programs. The computational potential of digital machines can only be exploited on one condition: that you write down in advance what you want these machines to do. This is an engineering skill, because computer programming is a branch of mathematics with a strong technical dimension. But as computer science evolves rapidly, programming languages have become closer to natural languages, while remaining firmly rooted in their mathematics-logic origins: the syntax of the languages must be scrupulously respected for the program to be executed, and ingenuity is required to design a program that will produce the expected results (and not something else). Today, web technologies are a little more technically accessible because they are based on interpreted languages (as opposed to compiled languages), and because of their ubiquity on screens of all sizes (computers, smartphones, smartTVs), they have also become one of the major fields of experimentation for graphic design. This has led to the emergence of several design categories: Web Design, User Interface and User Experience Design (UI/UX), and interaction design. A form of convergence between design and engineering is at work here.

2.2. The web universal machine

The Web browser is a software program designed to interpret documents made available by another software program, the server. These documents are described in specific languages and are stored on disk spaces made accessible using data transfer protocols. Using an address representing the location of the documents (URL), the browser downloads a main document described in HTML, which it interprets fragment by fragment to produce a graphic representation. HTML is a tag-based language that defines the organization of the elements making up the document (header, body, titles, sections, divisions, etc.). It can also be used to call up other files using complementary languages, such as CSS, which defines the graphic style of page elements (colors, fonts, spatial organization, animated transition effects, etc.), and JavaScript, a scripting programming language that defines the behavior of the page itself and its elements (elements, styles, external resources). This software stack was originally designed to display information within an operating system window, i.e. on a screen. However, many of the notions used in HTML specifications originate from the world of print, starting with the very notion of document. One might then see a kind of contradiction if web documents can't be printed, or at least not properly.
In practice, it has always been possible to print a web page, but what is then produced is merely an automatic and often clumsy migration to paper of the document in the same format as it appears in the browser window. In other words, there is no adaptation of content to the destination printing format. However, this concept of adaptation to the target medium does exist on the web, the most obvious use case being the transition from one screen size to another, for example between a computer screen and that of a smartphone.

So-called responsive design has been implemented in the CSS language through media queries[3]. Initially designed primarily for layout variations between screens of different dimensions, media queries enable the application of certain style rules only if the chosen media meets certain specified characteristics (e.g.: if the screen is less than 320 pixels wide, then a particular group of elements will be arranged vertically rather than horizontally). The ability to define rules for a particular type of print media was then introduced, to separate styles intended for screens from those intended for print, with its associated rule, @page, which defines the behavior of elements on the current page when printed.
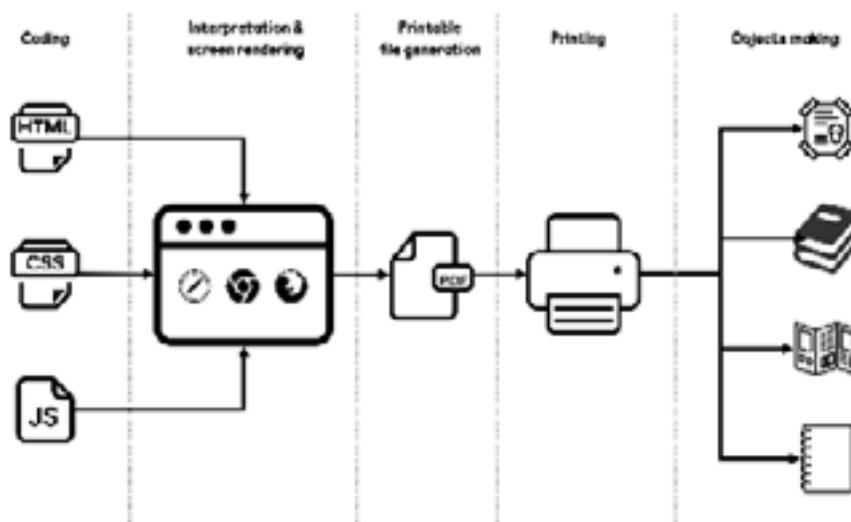
Figure 1: Web-to-print scheme: from web browser to printed object
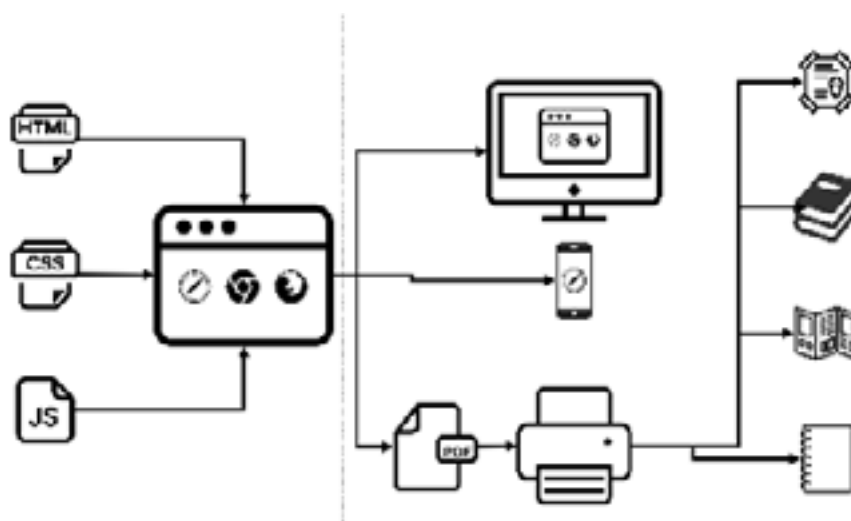
Figure 2: Web-to-print scheme: from web browser to multiple output format, printed objects and digital displays

This apparently straightforward possibility is of major interest to graphic design, as it presupposes that it is possible to use the entire range of web technologies to design printed works directly from the browser. This opens the door to a vast amount of experimentation that has the potential to profoundly transform the methodologies currently used in the graphics chain.

3. EPE PROJECT MAIN FOCUSES

3.1. Specifications versus implementation

One of the cruel realities of software development is the speed at which software technologies appear and disappear, and the difference in pace between the definition of specifications for certain functionalities and their actual implementation. Specifications make it possible to define with great precision the principles of a technique and the results it should produce. In the case of the @page rule and its derivatives, the specifications have been in draft form since 2013 under the title "CSS Paged Media"[4]. At the time we were writing the EPE project for submission to Europe Creative, in 2023, the first specifications were already 10 years old, and yet almost none of them had been implemented in the major web browsers on the market (Chrome and all Chromium derivatives, Safari and Firefox). Despite a degree of evolution in the specifications, the absence of actual implementation in browsers meant that any experimentation under real conditions was postponed to a hypothetical future, making the great potential opened up by Paged Media a dream as distant as it was uncertain.
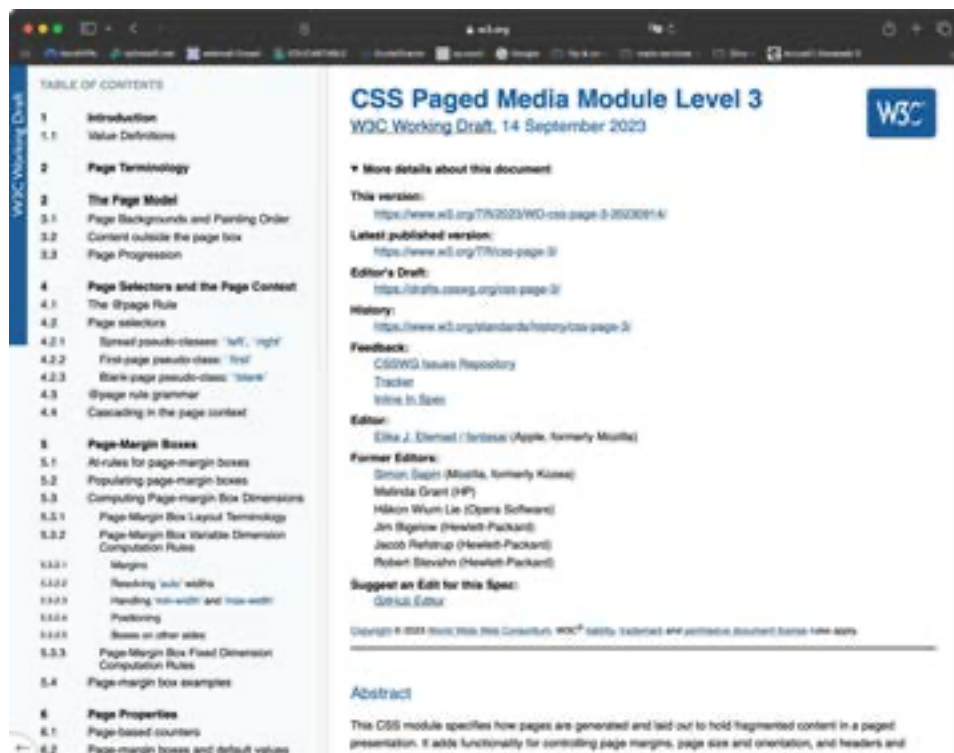
Figure 3: CSS Paged Media Module Level 3 [https://www.w3.org/TR/css-page-3]

A group of enthusiasts (the Coko Foundation[5]) then decided to implement a polyfill of the Paged Media specification, i.e. a software library that enables "replication of an API using JavaScript when the browser doesn't have it natively". Named Paged.js[6], and released under an open-source license, this library paved the way for numerous experiments, from which we were able to build the EPE project. As a small-scale cooperation project under the scientific responsibility of Esad-Valence for a period of 2 years (2023-2025), Ecran-Papier-Editer brings together institutions of higher education, Faculty of Graphic Arts of Zagreb (the very location of this conference), Izmir University of Economics Visual Communication Department (Turkey), Sfax University – Institut Supérieur des Arts

et Métiers, center 4C (Tunisia), INP-Pagora International school of paper, print media and biomaterials (Grenoble), as well as a national theater, the Hexagone theater. The project has three main pillars: education, technology and research.

3.2. Education

We are convinced that the profession of graphic designer is constantly evolving, and that web-to-print is going to disrupt publishing practices. It is therefore essential to ensure a certain transmission of the knowledge that future professionals will need to be actively involved in designing the new editorial chains that web-to-print makes possible. EPE offers workshops bringing together professors and students from the consortium's member schools and universities. Three phases have been designed. Propagation, to introduce web-to-print technologies and collectively explore their potential; Prototyping, to implement these technologies in the design of new tool chains and new editorial principles; Production, which proposes that Théâtre Hexagone set up a specific editorial chain to promote the artist residencies organized by its team, in other words, an experimental production on a scale of 1 in a real context.

3.3. Technology

Web-to-print tools are still fragile. Paged.js is one of the major technical elements we've used to design editorial chains requiring automatic pagination. Distributed under a free and open-source license, Paged.js, like all software tools based on a similar development model, needs support to be maintained and evolve. EPE therefore contributes to its development. But we're also looking at the entire editorial object production chain. We are particularly interested in the current limits of web-to-print chains for industrial printing: if professionals are still unable to move away from hegemonic tools such as InDesign, it's because printing standards are not currently respected by web-to-print, such as conversion between RGB and CMYK of PDFs produced by browsers, but also the ability to easily and precisely manage the separation of color layers in direct tones or the screening to be used. We propose concrete software solutions to resolve these difficulties.

3.4. Recherche

The fundamentally interdisciplinary nature of EPE's work naturally drives us to structure the project according to research methods. In this case, the development of certain tools requires close collaboration between expertise in graphic design, computer science and printing systems engineering. But more general issues also came to the surface, concerning the content management methods used to produce hybrid publications, and their possible forms on screen and on paper.

4. SOME EXEMPLES

To illustrate a part of our approach in the EPE project, we would like to present a few projects realized during the series of workshops that were organized. The first was produced at the Faculty of Graphic Arts in Zagreb during the second workshop, in March 2024. A group of 5 students from Esad-Valence travelled to Zagreb for this occasion, each forming a duo with one of the 5 FGA students. The aim of this workshop, part of the Propagation phase, was to create a booklet using Paged.js, based on text and image content prepared before the workshop, and for some of the groups to develop an original screen proposal based on the same content. One of the groups, formed by Maïssane Escur (Esad-V) and Ema Lovrić (FGA), worked on content dealing with the history of packaging in Croatia. The texts and images, collected from various online sources and compiled into a docx

document, were first reformatted in Markdown (md), a popular lightweight language that can be seen as a highly simplified form of HTML. Using markdown-it[7], an open-source JavaScript library, md files are converted on the fly into valid HTML elements, generating two distinct objects.

The first is a 38-page A5 booklet, entirely layouted using CSS and Paged.js. The meticulous work carried out revealed certain difficulties linked to the management of document sections and the management of certain object positioning properties (chapter heading pages, page breaks, etc.), as well as the many advantages of such a technique: when technical knowledge is sufficient, a booklet showing good graphic quality can be produced with these technologies, avoiding the need to use software such as InDesign.

Figure 4: Booklet PDF screenshot made by Maïssane Escur (Esad•V) and Ema Lovrić (FGA) during the second EPE workshop (2024) in the Faculty of Graphic Arts of Zagreb, about packaging design in Croatia

The second is a website organizing the four chapters in a grid of four zones, each displaying a chapter title and summary. By clicking on one of the zones, the opposite half of the window changes to show the corresponding text, but in a different layout to that of the printed booklet, navigable by scrolling. Clicking on any part of this text populates a table of contents displayed in the remaining area: the user selects the paragraphs to be added to the table of contents in the background. Clicking on the "preview for print" button displays a preview of a booklet composed of all the elements selected by the user during consultation, respecting the graphic choices of the 38-page booklet produced separately. The aim here was to prototype an interactive booklet composition system, to be printed out by the user and composed of the elements chosen voluntarily, in order to avoid printing a complete document in which only a few parts would be of interest. So, to a certain extent, it's an eco-responsible approach: if reading is more pleasant on printed media, it's possible to limit the amount of paper we use when only a few parts of a potentially very large set of online contents seem relevant to us.
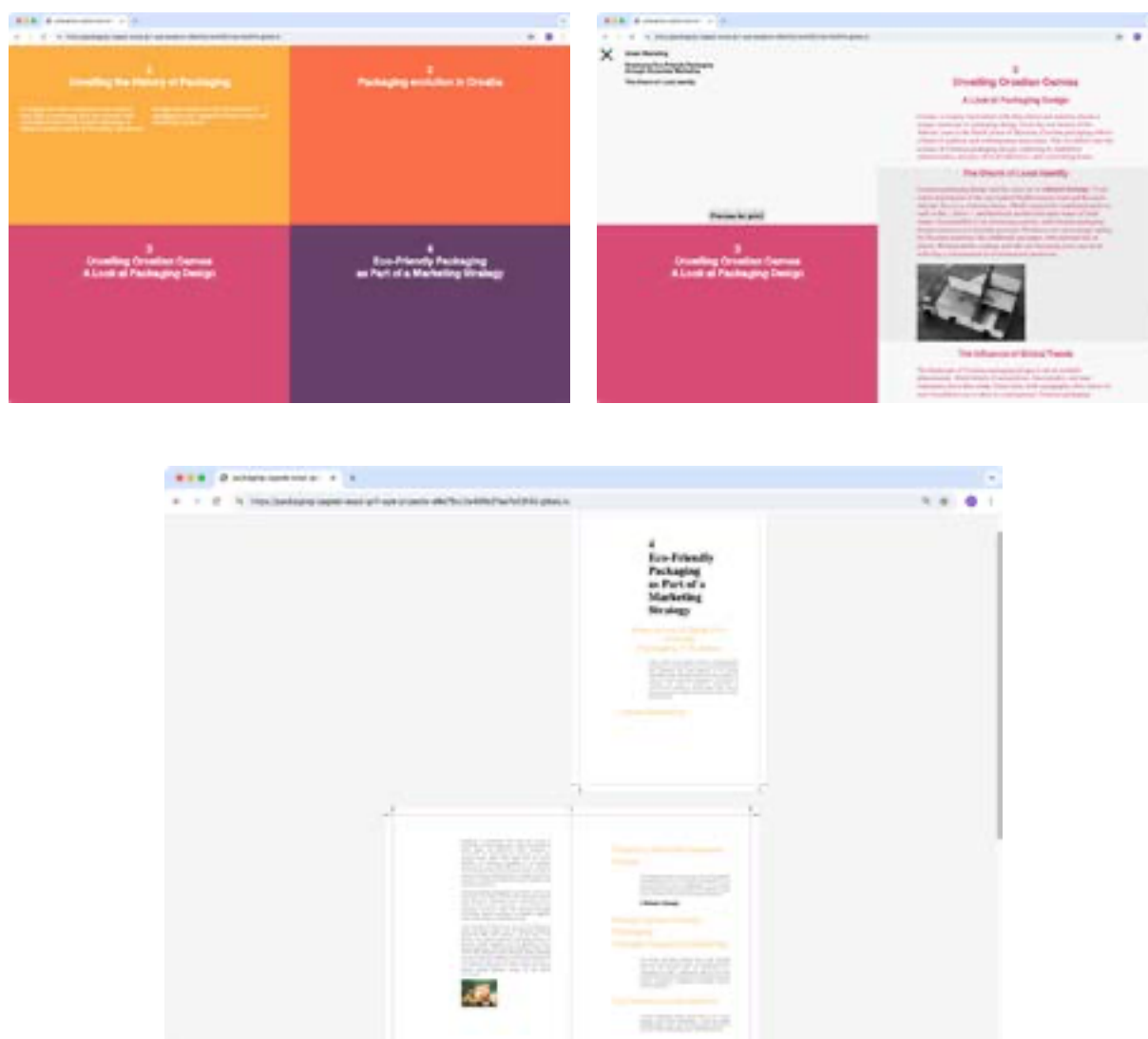
Figure 5: Screenshots of the website version made for the project of Maïssane Escur (Esad•V) and Ema Lovrić (FGA). The last screenshot shows the result after the user selection of the paragraph to be printed. [https://packaging-zagreb-esad-gv1-epe-projects-d9e75cc3e40fb37aa7e02f43.gitlab.io/. 2024.]

This process was followed up by a workshop at Izmir University of Economics in May 2024. For this third and final workshop in the Propagation phase, all five student duos were asked to produce printable website projects. Maïssane Escur and Dilara Sirkeci (Izmir) worked on a prototype presenting a scientific text dealing with semiotics in relation to drawing and design (Drawing, Design and Semiotics, Clive Ashwin,Design Issues, Autumn, 1984, Vol. 1, No. 2 Autumn, 1984, pp. 42-52, MIT Press). The web page presents text in paragraphs that are obviously independent of each other on the page, as they appear in an animation starting from the outer areas of the page, as the reader scrolls down. Here again, paragraphs can be selected, but this time it's not the paragraphs themselves that are stored in memory to form a printable publication, but content linked to these paragraphs: images from the original article or other proposals selected by the students, as well as fragments of another scientific text written in Turkish and offering an echo to the article written in English.
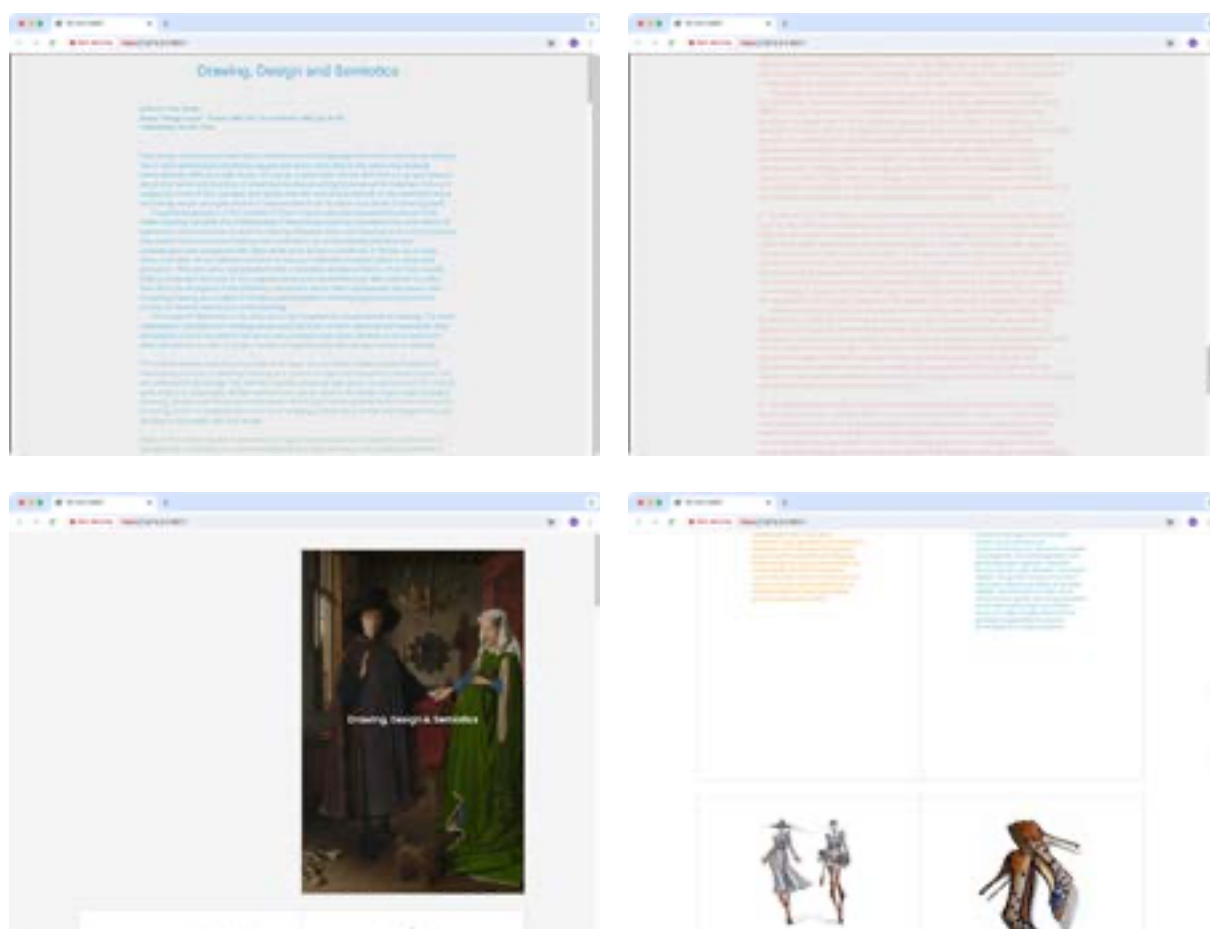
Figure 6: Screenshots of the website made by Maïssane Escur and Dilara Sirkeci for the EPE workshop in Izmir University of Economy, VDC. [https://dds-izmir-esad-gv1-epe-projects-15b21b32d9330ca9cbc7d04d5e9676a.gitlab.io/. 2024]

About 25 projects were completed over the course of the 5 workshops covering the Propagation and Prototyping phases of the EPE project (at the time of writing, the last workshop, covering the Production phase, is in active preparation). Entering into the details of these projects would reveal numerous directions for research, ranging from writing environments for authors to image screening systems before printing, as well as hypotheses for workflows and various methodologies between all the parties involved in the graphics chain. Such a study cannot be proposed within the limits of this article, so we prefer to formulate a number of observations and open the debate on the basis of our experience for the last part that concludes this text.

5. SOME STATEMENTS TO TAKE FROM EPE

By bringing together professionals and students from the fields of graphic design, visual communications, software engineering, papermaking and printing systems, the EPE project and the experiments it has enabled in the exploration of new tool chains for the publishing industry demonstrate the interdisciplinary nature of graphic chain professions. The diagram below provides a non-exhaustive overview of the special role played by graphic design in the web-to-print era.
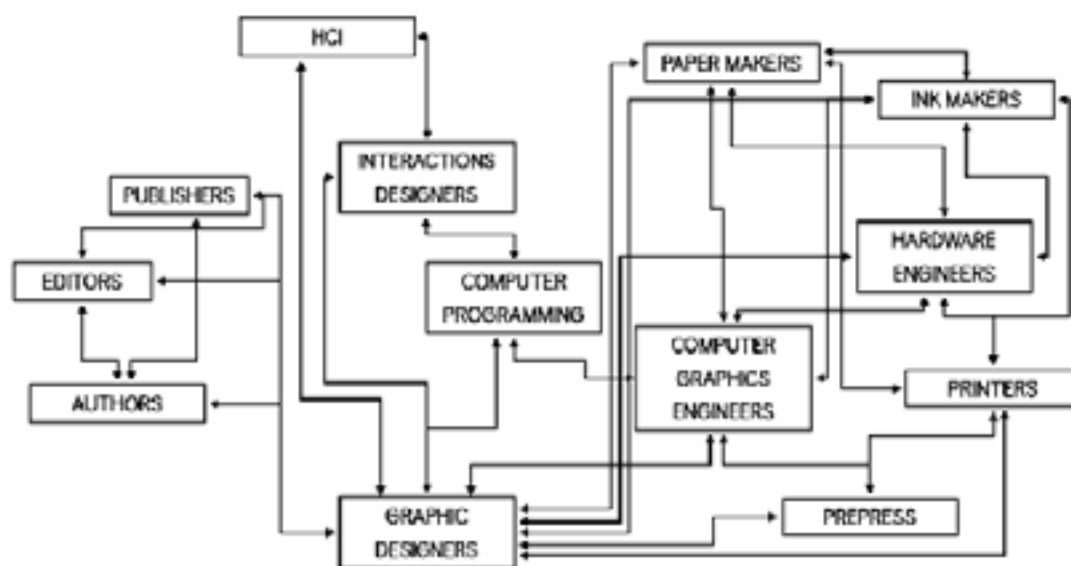
Figure 7: Relationship graph of professions in the graphics chain we deduce from the EPE projects

Based on this evidence, which we have been able to confirm in the fields of pedagogy, technology engineering and research, we would like to outline a few general positioning statements that the EPE project enables us to make.

5.1. New media art & design

As we briefly pointed out in the introduction, digital technologies make it possible to reproduce existing media. Most production software (DTP) clearly demonstrates this. The simple example of digital images confirms this: they are made up of a set of data discretized into fundamental units, colored dots, organized in a regular two-dimensional grid. This organization of digital data responds to a pre-existing model that originated in the history of images, from painting to photography, and which postulates the idea that an image is a two-dimensional object that we observe frontally. Digital videos, sounds and documents share this genesis, linked to the history and form of pre-digital media. However, a different attitude is possible: that of inventing new media thanks to the potential of the digital. This is what new media art does, proposing new media forms and, in the process, redefining the very functions of digital technologies. That's the attitude we claim to represent.

We should not forget that the word technology, in its etymology, refers to the science of technique. Technique can be seen as a set of gestures and manipulations of materials that make it possible to produce artifacts. Technique is therefore essential to the practice of art, since it enables us to give form to objects that will incorporate artistic intentions. The arts, of which design is also a part, as we explained in the introduction, aim to release what we call aesthetic artefacts, capable of producing a critical perception of the world. The aim of an aesthetic artefact is to reach out to the senses of its recipient, and thus touch their emotions and intellect. In other words, works of art are intended to stimulate reflection by formulating questions through objects. In this context, design can be understood as a set of tools for designing and producing aesthetic objects in a methodical way, in response to needs identified in projects or assignments. In a similar way, engineering enables the design and production of technical artifacts, such as tools or machines, which provide

solutions to identified problems. It's clear, then, that design lies at the intersection of the arts, engineering and technology.

5.2. Designing tools, tools for design

Our research thus always comes back to the same statement: the tools of design are correlated with the design of tools. It is through the activity of creation that we are brought to think about the tools of creation. Because contemporary creation, in the broadest sense, is increasingly based on digital technologies, it's by designing the tools of creation with technologies that we fully embrace our epoch. In other words, we support the idea that it is only through technique that we can (re)take power over technologies and create with them in a state of awareness of their potential. This mindset is at the origin of the EPE project and underpins its interdisciplinary approach. A similar mindset can be found in the STEAM (Science, Technology, Engineering, Art & Mathematics) educational method. This method is an evolution of a previous one, STEM (Science, Technology, Engineering & Mathematics), which promotes the linking of scientific disciplines very early on in the school curriculum (elementary school), emphasizing the importance of their interaction. The motivation behind this link-up is essentially the expectation that it will produce more open-minded and agile individuals, able to cope with the growing complexity of our contemporary societies, governed by digital technologies and largely organized around often opaque algorithmic systems. But there was another essential skill: critical thinking, which enables us to reconsider the reality we live in, and to imagine alternative forms, possibly breaking with what already exists. The arts were then introduced into these educational models to fill this gap. These educational models, that were modeled by research, are making their way into higher education, because it's an increasingly asserted necessity: our future cannot rely on individuals who reproduce a siloed system of thinking, separating knowledge from each other in non-porous (and therefore, non-curious) disciplines. Today, at a time when AI technologies are casting doubt on entire sectors of our society, this interdisciplinarity, which focuses on the development of critical thinking and its articulation with the exact sciences and engineering, needs to be joined by design to arrive at a STEAM+D model.
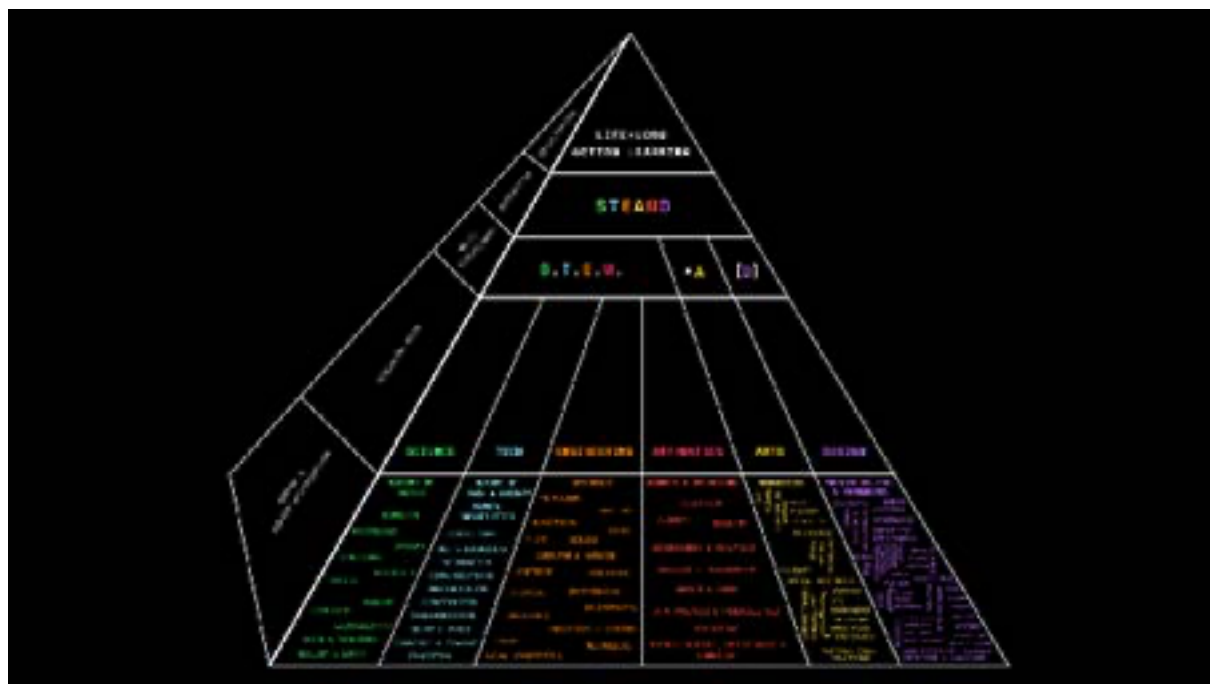
Figure 8: S.T.E.A.M.D. - A modern framework for education - Ai Design Corps™ [Available from: https://aidesigncorps.org/steamd]

The challenges currently being faced by our societies, and indeed by humankind as a whole, require an accurate yet critical perception of the world we have built up over the ages. Climate change is forcing us to make an energy transition, as our way of inhabiting the planet must evolve to guarantee future generations some hope of a future. The economic system, essentially capitalist and based on productivity, has been showing its limits for several decades now, and should be transformed too. The means of communication we have at our disposal have never been so fast or so complete, but they also generate behavioral drifts. The cocktail produced by smartphones and social networks is a form of poison whose only antidote seems to lie in a significant strengthening of the world's education systems. With the advent of AI, these problems will accelerate even further, bringing back old ones that are reminiscent of previous industrial revolutions: professions will disappear to make way for new ones, the daily lives of certain countries will be disrupted for better or worse, and the economy will change its balance.

All of this is based on the same basic technologies and our relationship to them: the digital. In the end, it all boils down to the same problem: what kind of policy do we need to produce and get people to act on? Perhaps the STEAM+D education model, still in its infancy, doesn't represent the solution to all our problems, but it does at least seem to enable an unprecedented alliance between the exact sciences, the natural sciences and the humanities and social sciences. Unprecedented in that it involves one of the fields that is most propitious to invention: creation in art and design.

Acknowledgement(s):

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[3] Media queries allow you to apply CSS styles depending on a device's media type (such as print vs. screen) or other features or characteristics such as screen resolution or orientation, aspect ratio, browser viewport width or height, user preferences such as preferring reduced motion, data usage, or transparency. For more precisions: https://developer.mozilla.org/en-US/docs/Web/CSS/CSS_media_queries/Using_media_queries. Accessed 20 May 2025.

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