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Industrial Heritage as a Learning Environment: An Exploratory Case Study in Graphic Technologies and Design Education

ABSTRACT

This study explores how industrial graphic heritage can contribute to the contemporary teaching of graphic technologies and design through Project-Based Learning (PBL) and university-industry collaboration. It analyses, as an exploratory case study, the project «Celebrating 140 Years of Tipografia Lousanense», developed by the Polytechnic University of Tomar (Portugal) in collaboration with Gráfica Lousanense. Using PBL as a pedagogical framework, this initiative involved undergraduate students in Design and Graphic Arts Technology in observing production processes, engaging with company specialists and creating communication materials to meet the company's specific needs. The results suggest that industrial graphic heritage can function simultaneously as a cultural resource and a learning context, bringing together technical knowledge, design practice and professional engagement. The project also produced audiovisual content, graphic objects and exhibition materials that help to publicly communicate the history of this printing company. Although centred on a single case, the study highlights the potential of heritage-related educational projects to develop professional skills and support their public appreciation.

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KEY WORDS
Industrial heritage, graphic technologies education, graphic design education, Project-Based Learning

1. Introduction

1.1. Industrial graphic heritage as an educational opportunity

Industrial graphic heritage occupies a unique position at the intersection of technological innovation, material culture and graphic communication. Some former printing companies preserve machinery, artefacts and documentary collections, but they also embody technical knowledge, production processes and professional cultures that document the evolution of graphic technologies over time. Although their historical and cultural importance is widely recognised, industrial heritage contexts can also provide learning opportunities through direct contact with materials, technologies, production processes and professional practices. In the teaching of graphic technologies and design, these contexts can complement studio and laboratory-based learning, giving students access to authentic industrial environments and different forms of technical and professional knowledge.

This perspective creates an opportunity to bring together industrial heritage, project-based learning and collaboration between universities and industry within a shared educational context. Rather than viewing heritage merely as something to be preserved, this study explores its potential as an authentic learning environment, in which historical research, design practice, technical knowledge and professional interaction can come together.

Throughout this project, students on the bachelor's degree programme in Design and Graphic Arts Technology developed graphic communication materials, audiovisual content and exhibition materials, drawing on their engagement with the archives and industrial observation. The exhibition, organised as part of the project's public dissemination, served both as an educational outcome and as a strategy for interpreting and communicating industrial graphic heritage to wider audiences.

1.2. Research question and objective

The study seeks to answer the following question: How can industrial heritage contribute to the contemporary teaching of graphic technologies and design through project-based learning and university-industry collaboration? The aim is to explore how a heritage enhancement project can provide a meaningful learning environment for students of graphic technologies and design, integrating historical research and design practice in collaboration with an industrial partner.

1.3. Case and contribution

The research adopts an exploratory case study methodology, centred on the project «Celebrating 140 Years of Tipografia Lousanense». Project-Based Learning (PBL) provides the pedagogical framework for the educational experience, enabling students to tackle real-world design challenges within an authentic industrial context. The case study analyses how the collaboration between the Polytechnic University of Tomar (UPTomar) and Gráfica Lousanense fostered learning through historical research, observation of production processes, interaction with company experts, and the development of communication materials that met the institution's specific needs. The analysis of this case study suggests that industrial heritage can function simultaneously as a cultural resource and an educational environment.

2. Industrial graphic heritage, graphic technologies and design education

Industrial graphic heritage represents a field where the history of technology, material culture, design and education converge. Over more than five centuries, the evolution of printing technologies has profoundly transformed the production and circulation of knowledge, influencing communication, education, the economy and the construction of cultural identities. At the same time, the successive introduction of new technologies – from manual typesetting to digital printing – has not eliminated earlier processes but has built up a tangible and intangible legacy that documents the technical and social evolution of graphic production.

In this context, the industrial heritage associated with graphic technologies goes beyond the preservation of historic machinery or buildings. It also encompasses the production processes, specialist knowledge, professional practices and forms of work organisation that enabled the development of the printing industry. Its preservation therefore takes on a technological, cultural and educational dimension, offering unique contexts for understanding the relationship between design, production and innovation.

This framework seeks to establish this relationship through four complementary perspectives: the conceptualisation of industrial heritage as both technological and cultural heritage; the historical evolution of printing as a practice that links production and design; the complementarity between graphic technologies, education and design education; and, finally, the value of authentic industrial environments as spaces for experiential learning and PBL.

2.1. Industrial heritage as technological and cultural heritage

Industrial heritage is currently understood as a collection of tangible and intangible assets that bear witness to the history of productive activities and the technological evolution of industrial societies. According to the *Dublin Principles*, developed jointly by ICOMOS & TICCIH (2011), industrial heritage comprises sites, buildings, structures, machinery, infrastructure, documents, landscapes and knowledge associated with industrial activities, possessing historical, technological, scientific, social and cultural value. This definition significantly broadens the traditional notion of heritage, shifting the focus from purely architectural preservation to an integrated understanding of production systems and the communities that gave rise to them.

The material dimension of the industrial printing heritage includes factories, workshops, equipment, tools, printing plates, movable type, graphic archives, proofs and objects produced during industrial activity. These elements document different stages of technological development, providing an insight into production methods, technical capabilities and the changes brought about by successive innovations.

However, the preservation of these objects loses some of its significance if it is separated from the intangible dimension of heritage. The technical knowledge accumulated by printers, typographers, typesetters, engravers and machine operators constitutes a living heritage, passed on through practice, on-the-job training and experience accumulated over generations. Knowing how to prepare a printing form, fine-tune a letterpress, adjust an offset press or interpret the characteristics

of paper represents a set of skills that can hardly be preserved through written documentation alone.

In the case of the graphic arts, this perspective takes on particular significance. The evolution of printing has been characterised by successive technological changes (manual typesetting, mechanical typesetting, phototypesetting, offset printing and digital printing), which coexisted for extended periods and gave rise to different forms of technical knowledge. Each technology introduced new possibilities for visual communication, new materials and new skills, contributing to the development of contemporary graphic culture.

Industrial graphic heritage thus represents a technological archive of the history of printed communication. Preserving workshops, machinery and processes means preserving evidence of the evolution of information reproduction technologies and the cultural practices associated with editorial, commercial and institutional production. In addition to its historical value, this heritage has significant educational potential, enabling us to understand the evolution of technologies through direct experience of the production processes.

This approach aligns heritage preservation with a philosophy of active enhancement. Rather than preserving equipment merely as static, inert museum objects, it seeks to maintain an understanding of the technological processes involved, thereby facilitating demonstrations, research, training and cultural mediation. In this way, it is possible to transform industrial heritage into technological memory and a resource for new educational practices.

2.2. Printing and graphic design as interconnected practices

The history of printing is the history of the evolution of visual communication systems and the production of knowledge. Since Gutenberg perfected the use of movable-type printing in the 15th century, printing has become one of the main drivers of the dissemination of information, literacy and the cultural transformations that accompanied European modernity.

Briggs and Burke (2002) demonstrate that each innovation in printing technology has profoundly altered the ways in which information is produced, distributed and consumed. The letterpress enabled the large-scale reproduction of texts and images; the mechanisation of printing significantly increased productivity during the Industrial Revolution; lithography and, later, offset printing expanded the possibilities of multicolour printing; while digital printing has enabled personalisation, short-run production and new business models such as print-on-demand.

This technological evolution never took place in isolation. Changes in production processes directly influenced visual language, page layout, typography, illustration and, subsequently, graphic design as an autonomous discipline. Technology shaped formal possibilities, but at the same time it also opened new creative opportunities.

Before the profession of graphic design became established, the printer often played a role in visual design. Jury (2012) demonstrates that, between the 18th and 19th centuries, many printers selected typefaces, defined typographical hierarchies, organised layouts, designed ornamentation and made aesthetic decisions that would today be attributed to a graphic designer. The printer was simultaneously a craftsman, a technician and the creator of the graphic composition.

This historical relationship shows that design and production have always been deeply intertwined. The contemporary separation between design and manufacture stems primarily from the industrialisation of production processes and the professional specialisation that took place during the 20th century. Even so, design decisions remain dependent on the characteristics of materials, printing processes, finishing techniques and the available technological limitations or capabilities.

The history of graphic design is a process of constant interaction between technological innovation and visual culture (Meggs & Purvis, 2009). Each technological transformation has given rise to new graphic languages, new editorial formats and new possibilities for communication. The development of photography, colour printing, photocomposition and desktop publishing has simultaneously altered both working methods and the visual outcomes produced.

This perspective provides an important conceptual foundation for graphic design education, arguing that knowledge of graphic technologies is not a secondary subject but a fundamental component of the ability to design for graphic production.

2.3. Graphic technologies and graphic design education

Graphic technologies education and graphic design education share common objectives relating to the production of visual artefacts but differ in their epistemological focuses and the skills they prioritise. Whilst the former centres on the realisation of these solutions through mastery of materials, processes and graphic production technologies, the latter focuses predominantly on design, visual communication and the resolution of design problems.

Lawson (2005) defines design as an activity involving the resolution of complex problems based on the development of iterative solutions. The design process involves research, the interpretation of contexts, the generation of alternatives, experimentation and continuous evaluation. Designers develop skills to meet communication needs through the synthesis of function, meaning and form. Cross (2011) adds that «designerly ways of knowing» constitute a specific form of knowledge, distinct from scientific or humanistic approaches. Designers produce knowledge through experimentation, modelling and the construction of solutions, combining creativity with technical reasoning. However, the development of graphic solutions also depends on an understanding of production processes. Education in graphic technologies provides this specialist knowledge, enabling an understanding of material properties, ink behaviour, printing systems, colour management, file preparation, finishing, process sustainability and quality control.

The concept of the «reflective practitioner», introduced by Schön (1983), holds that professional knowledge emerges from reflection during action. The project evolves through the interaction between thinking and doing and is continually adjusted considering the results of experimentation. In *Educating the Reflective Practitioner* (1987), Schön applies this perspective to teaching, arguing that professional learning must take place in environments where students face real problems and reflect critically on their decisions.

In this context, education in graphic technologies broadens design education by introducing a dimension of technological literacy. Students learn not only to design a graphic object, but also to anticipate production constraints, optimise processes, select appropriate technologies and make informed decisions regarding production.

Design and graphic production learning benefits significantly from the interaction between academic contexts and authentic industrial environments. Whilst classrooms, laboratories and workshops enable students to develop fundamental skills, much professional knowledge is only truly consolidated when students participate in real-world production situations, where materials, equipment, time constraints, restrictions and decision-making coexist within the same context. This perspective is reflected in PBL approaches.

3. Project-based learning and university-industry collaboration

3.1. Project-Based Learning in design and technology education

Project-Based Learning (PBL) is an active learning approach in which students construct knowledge through inquiry and engagement with real-world problems. Its conceptual roots lie in Dewey's notion of learning by doing and in Kilpatrick's project method, and one of its central principles is the deliberate alignment between academic learning and professional contexts (Franco, 2023). Thomas (2000) identifies five defining criteria: the centrality of the project in the curriculum, a driving question, constructive investigation, student autonomy and realism. Unlike Problem-Based Learning, which centres on the analysis of a problem, PBL culminates in a concrete artefact or outcome.

This requirement is particularly relevant to design and graphic technologies education, where the artefact is both the outcome and the medium of learning. Materialising a proposal – a printed piece, a publication, a video – obliges students to reconcile conceptual intentions with the constraints of materials, printing processes and media. Biggs and Tang (2011) describe this as the development of functioning knowledge: the capacity to put declarative knowledge, such as typography, colour or pre-press, to work in real decisions. Schön's (1983, 1987) reflective practitioner provides the complementary frame: in open-ended design situations, knowledge develops through reflection-in-action, as solutions are tested and adjusted, and reflection-on-action, as process and outcome are critically reviewed.

3.2. University-industry collaboration as an educational context

Ankrah & Al-Tabbaa (2015) define university-industry collaboration as interaction between higher education and industry aimed at exchanging knowledge and technology. Among its forms, their review identifies student involvement in industrial projects, the use of industrial facilities and the participation of professionals in educational activities. Among its benefits, it identifies students' and lecturers' exposure to practical problems and current technologies. The authors also distinguish between collaboration understood as a planned transfer of knowledge and collaboration in which knowledge emerges from sustained interaction between participants.

For programmes such as Design and Graphic Arts Technology, this second perspective is particularly relevant. Learning depends on materials, production processes and contexts of use that are difficult to reproduce fully in the classroom or laboratory. When a project originates in

a real industrial challenge, the partner is not merely the recipient of student work: it helps create the conditions for learning by setting the brief, giving access to facilities and processes, and bringing professional knowledge into the project. Students then work with actual objectives, requirements and constraints, while the project remains framed by pedagogical goals. The project «Celebrating 140 Years: A Creative Partnership between Industry and Higher Education» is an instance of this approach.

4. Methodology

4.1. Research design

This study adopts an exploratory, qualitative case study design to examine how industrial graphic heritage can inform the teaching of graphic technologies and design through PBL and university-industry collaboration. The case study approach allows for the analysis of a contemporary phenomenon within its real-world context, considering the relationships between activities, participants and contextual conditions (Yin, 2017)

The unit of analysis is the educational and collaborative project «Celebrating 140 Years: A Creative Partnership between Industry and Higher Education», developed between UPTomar and Gráfica Lousanense. The case is understood as a process that includes the development of the project within the curriculum, engagement with the company and its heritage, the development and selection of proposals, the discussion of production possibilities, and the public presentation of the results through an exhibition.

The exploratory design allows us to examine the educational opportunities and the relationships between heritage, design, graphic technologies and professional practice offered by this experience, without seeking to establish causal effects or directly measure learning outcomes. PBL provides the pedagogical framework for the experience, whilst the case study constitutes the research design through which the project is analysed.

4.2. Case selection and context

This case study was deliberately selected because it provides a context in which industrial graphic heritage, project-based learning, the teaching of design and graphic technologies, and university-industry collaboration come together in the development of a project with a specific communicative purpose.

The collaboration between UPTomar and Gráfica Lousanense provided students with access to historical documents, equipment, production processes and professional expertise. The selection of this case is therefore based on the relevance of these characteristics to the research question rather than on statistical representativeness (Yin, 2017).

The case was analysed between February 2025 and May 2026, covering the development of the curriculum project in the second semester of the 2024/25 academic year, the subsequent activities involving the selection and preparation of the projects, and their public presentation at the exhibition held in 2026. The historical context, the terms of the collaboration and the different stages of the project are described in Section 5.

4.3. Educational and collaborative setting

The project involved second-year students in the bachelor's degree in Design and Graphic Arts Technology at the Tomar School of Technology, part of UPTomar. It was organised as a transdisciplinary project incorporating three course modules, each supervised by one of the authors of this article:

- the design component was developed as part of the course of Artwork (second author);
- the selection of printing techniques and the graphic production were carried out as part of the Offset component in the course of Printing – Offset II and Pad Printing (first author);
- the narrative structure, editing and post-production of the audiovisual content were carried out as part of the course of Multimedia Design (third author).

The challenge originated with the printing company and was formalised by the lecturers in a written brief. Access was granted to the company's premises, historical resources and staff, and a representative from the company helped to curate the works presented in the exhibition.

The dual role of authors and project coordinators provides in-depth contextual knowledge but may also influence the selection and interpretation of evidence, through prior expectations and familiarity with the project and the students. Retrospective memory was used solely to locate and organise documented materials, and not as independent evidence of activities, decisions or learning.

To minimise this risk, the analysis focuses on materials produced or documented during the project and explicitly distinguishes between documentary evidence, the researchers' interpretations and inferences regarding learning opportunities.

4.4. Sources of evidence

The study draws on multiple sources of evidence to examine the context, development and outcomes of the project (Yin, 2017). These sources include:

- The document setting out the planned learning programme (the objectives, the distribution of tasks across the course modules and the planned timetable) is therefore interpreted as a statement of intent to be compared with the documented activities and outcomes.
- The photographic and video records of the on-site visit, which constitute selective evidence of the industrial context and the activities carried out during the visit. These include images of the spaces, equipment and processes observed by the students, as well as records of information and testimonies gathered from the company representative. These materials are not considered a complete record of the participants' experiences but are used to document the students' engagement with the industrial context and the resources made available by the company.

4.5. Analytical approach

The analysis of the students' work is limited to the pieces selected for public display at the exhibition and documented in the accompanying catalogue. This collection constitutes a defined corpus of the project's outcomes and does not represent the entirety of the students' work.

The choice of this corpus allows for the analysis of artefacts which, within the scope of the project itself, underwent the selection process and were deemed suitable for public presentation. The artefacts are not used as a means of assessing the students nor as direct evidence of the acquisition of skills. They are analysed as material evidence of the design decisions, technical choices and approaches to interpreting heritage developed within the context of the project.

For the graphic designs, the analysis considers the selection and transformation of elements relating to the history and identity of Gráfica Lousanense, the visual and typographical decisions, the relationship between concept, form and content, and the proposed printing and finishing techniques. It also considers the relationship between the graphic solutions and the production possibilities discussed as part of the collaboration with the company.

In the case of audiovisual content, the analysis considers the selection and organisation of the materials collected during the project, the aspects of the company's history and activities that were prioritised, and the choices made regarding narrative structure and editing. Where different students drew on materials from a common source, the differences in the ways in which these materials were selected, organised and interpreted are considered.

The analysis combines a contextual reconstruction of the case with a qualitative analysis of the various materials documenting its development and outcomes (Yin, 2017). The materials were organised by project stage and by type of source. The analysis sought to link planned activities, documented activities, development decisions and the outcomes produced, distinguishing between directly observable evidence and the researchers' interpretations.

Based on the research question and the theoretical framework, six analytical dimensions were defined, which were subsequently refined during the case analysis. These dimensions were operationalised in an analytical matrix that links each dimension to the aspects to be observed and to the main sources of evidence used (Table 1). The matrix was applied to the corpus of artefacts selected for the exhibition and linked to the other documentary sources in the case.

Table 1
Analytical matrix

Dimension	Focus of the analysis	Evidence
Industrial heritage	Presence and use of elements from the company's history, equipment or materials	Historical documentation, on-site visit, artefacts
Design and graphic technologies	The relationship between visual decisions and technical solutions	Proposals, models, specifications, artefacts
University-industry collaboration	Interaction with the company and contributions from its staff	Project records, on-site visit, meetings
Professional practice	Addressing a real-world challenge and taking production requirements into account	Statements, proposals, artefacts
Interpretation of heritage	How a company's history and identity are reflected in contemporary communication	Artefacts, videos, exhibition
Documented learning opportunities	Documented situations in which students were required to draw on their knowledge, make decisions, integrate different subject areas or respond to production conditions.	Set of sources

The analysis of the selected artefacts is integrated within these dimensions and does not constitute a standalone analysis of the objects as design pieces. The works are considered in relation to the context in which they were produced and to the other sources of evidence. Thus, a particular graphic solution can be analysed simultaneously as a design decision, a response to a technical possibility, an interpretation of an element of heritage, and the result of an interaction with the industrial context.

The analysis of the artefacts is carried out in Section 6 using selected examples from the corpus. The study considers works that highlight different relationships between the analytical dimensions, namely the use of elements from the company's history or identity, the relationship between visual concept and production possibilities, the exploration of printing and finishing techniques, and the different ways in which historical and documentary materials are interpreted in audiovisual content.

The analysis seeks first to identify the observable elements in the artefacts and then to relate them to other sources within the case study. This approach enables the results produced by the students to be interpreted within the context of the activities, decisions and interactions that characterised the project.

Schön's concepts (1983, 1987) are used as an interpretative framework for analysing documented relationships between practical situations, design decisions and review processes. Thomas (2000) provides guidance on interpreting the development of responses to an authentic challenge, whilst Ankrah & Al-Tabbaa (2015) contribute to the analysis of collaboration and knowledge relationships between universities and industry.

These dimensions constitute an analytical framework developed for this study and are not a validated assessment tool. The analysis distinguishes between observable outcomes, documented processes and inferred learning opportunities.

Comparing different sources makes it possible to contrast planned activities, documented activities and the results produced. Where different sources do not support a particular interpretation, this limitation is made explicit rather than being resolved through inference.

The scope of the evidence limits the conclusions that can be drawn. The final artefacts, on their own, do not prove that skills have been acquired, and the selective documentation of the project does not provide a complete account of learning or collaboration. The conclusions therefore relate to the educational practices and opportunities documented in this case, rather than to measured individual learning outcomes.

5. The case: celebrating 140 years of Tipografia Lousanense

5.1. Tipografia Lousanense: historical and industrial context

Tipografia Lousanense was founded in 1885 in the town of Lousã, in the district of Coimbra, Portugal, by Aníbal Fernandes Tomás Pipa, who opened the print shop with the release of the newspaper «Jornal da Louzan». As was common in 19th-century Portuguese printing works, the company combined the production of a local newspaper with more general commercial and editorial printing, a dual function that placed the business at the intersection of industrial production and regional public life. Briggs and Burke (2002) describe this convergence between printing technology and the press precisely as constitutive of the emerging modern media landscape in nineteenth-century Europe. The print shop changed owners twice during its first decade and a half of existence: it was acquired in 1893 by Bernardino Lopes Padilha, and was subsequently sold, in 1898, to Júlio Ribeiro dos Santos, a former employee of the firm (Sanches et al., 2026). This transaction marked the beginning of an unbroken family lineage in the management of the company, which has continued through five generations to the present day; this continuity is, in itself, a central defining feature of the company and one of the elements that the programme of events marking its 140th anniversary sought to highlight to the public.

Over the following decades, the company's premises changed location several times, in line with the growth of its business. Each move was accompanied by an expansion of production capacity and a gradual modernisation of equipment and processes, culminating in the operation the company runs today. In the publishing sector, Tipografia Lousanense has built a reputation in the field of book printing, having printed works by authors such as Nobel Prize-winning author José Saramago; this places the company within the broader context of the history of publishing and printing in Portugal, rather than merely within the sphere of local commercial printing.

The company's technological development reflects the broader evolution of printing from manual typesetting to offset and, more recently, digital and hybrid workflows (Briggs & Burke, 2002). This trajectory is further marked by quality and sustainability certifications, the introduction of digital printing, and the implementation of an integrated management system, illustrating the company's transition from artisanal production to contemporary industrial and digital practices.

Alongside its documentary records, the company preserves historic printing equipment, machinery and printed materials accumulated over 140 years of

continuous operation. At the time of the exhibition, these resources were being inventoried as a first step towards their conservation, restoration and possible future museum use. This approach aligns with international principles for industrial heritage conservation, which emphasise documenting and safeguarding both the tangible and intangible traces of historical production, including machinery, materials and technical knowledge (ICOMOS & TICCIH, 2011).

The case of Lousanense is distinctive precisely because it is not a disused industrial site or a site turned into a museum, but a company that remains in continuous commercial operation, and simultaneously a body of industrial heritage. It is this combination of active industrial practice and an emerging awareness of heritage – formalised through the family's own initiative to mark the 140th anniversary – that provided the empirical basis and institutional impetus for the collaborative project analysed in this study, which is discussed in the following sections.

5.2. The university-industry collaboration and the educational project

The collaboration between UPTomar and Gráfica Lousanense took place as part of the celebrations marking the company's 140th anniversary, to be commemorated in 2025. Formalised as a partnership between higher education and the printing industry, the initiative involved the company, lecturers and students. The collaboration was structured around a specific challenge set for the students: to develop graphic designs and multimedia content capable of celebrating the history, identity and activities of Gráfica Lousanense.

The initiative brought together three academic areas of the bachelor's degree (Graphic Design, Graphic Technologies and Multimedia Design), combining conceptual development, graphic production and audiovisual content. The initial brief called for the development of a set of commemorative graphic items, namely posters, postcards and leaflets, complemented by audiovisual content. Students were also required to consider the technical characteristics of the proposed items and explore possibilities for special printing and finishing techniques.

The project began through direct contact between the students and the company. An initial presentation in February 2025, led by a representative from Gráfica Lousanense, provided an insight into the company's history and its professional context (Figure 1a). This activity was followed by an on-site visit to the premises in March 2025, during which the students collected visual records and information, spoke directly with professionals and observed production processes, equipment and working practices (Figure 1b).



(a)



(b)

» **Figure 1:** *Initial contact with the industrial partner: (a) presentation of Gráfica Lousanense at UP Tomar in February 2025; (b) on-site visit to the company's facilities in March 2025. Note: Photographs by the authors*

The development of the proposals required the integration of knowledge from the various curricular areas involved. In the field of Graphic Design, the students developed visual proposals for the commemorative items, incorporating elements relating to the history and evolution of Gráfica Lousanense. In the field of Graphic Technologies, the proposals were analysed in terms of printing processes and possible complementary techniques, including special inks, varnishes, embossing, debossing and die cutting. In Multimedia Design, audiovisual content was developed to complement the printed items and extend the experience through digital media.

Interaction with the industry partner continued beyond the initial briefing and fieldwork. In November 2025, a further meeting was held with the manager of Gráfica Lousanense, at which the students' selected proposals were presented and the possibilities for their production were discussed (Figure 2a). This stage introduced a new dimension to the interaction between the academic proposals and the demands of professional production. The discussion focused particularly on the technical feasibility of the selected solutions and on defining the most appropriate printing and finishing strategies (Figure 2b).

This phase was significant because the projects were no longer regarded solely as academic proposals. Their development now involved considering how visual and conceptual decisions could be realised as physical graphic



(a)



(b)

» **Figure 2:** *Discussion of the selected student proposals with the industrial partner: (a) presentation and discussion of the selected graphic artefacts; (b) detail of the production discussion. Note: Photographs by the authors*



(a)



(b)

» **Figure 3:** *Public presentation of the project: (a) exhibition opening; (b) exhibition view. Note. Photographs by Joana Cordeiro. Reproduced with permission*

objects through specific production processes. The relationship between design and production thus became an integral part of the educational experience, enabling students to weigh up visual and communicational decisions against technical constraints and possibilities.

The project subsequently extended beyond the classroom and the industrial setting, taking on a public dimension through an exhibition.

5.3. Public exhibition and dissemination

The exhibition, held at the Casa dos Cubos – Centre for Photography Studies in Tomar, between 25 February and 17 May 2026, brought together the students' selected projects, including posters, postcards and leaflets, as well as audiovisual works and materials relating to the history of graphic production and Gráfica Lousanense (Figure 3).

The exhibition served both as a platform for the public presentation of the results of the educational project and as an opportunity to share aspects of the company's industrial graphic heritage with a wider audience. The work produced by the students (informed by their engagement with the company, its production processes and the historical materials made available to them) was presented alongside with elements documenting the company's history and graphic heritage.

In this way, the project established a link between the contemporary work produced by the students and the company's historical legacy. The graphic proposals were based on information relating to the history, identity and technological evolution of Tipografia Lousanense, while the historical materials presented in the exhibition helped to contextualise this work. The interplay between the graphic and audiovisual works developed by the students and the company's historical materials thus established a dialogue between past and present, bringing industrial graphic heritage closer to contemporary practices in design and graphic production.

The project therefore unfolded through a series of interlinked experiences: engagement with the industrial partner, an exploration of the company's history and professional context, observation and documentation in the workplace, the development of design proposals and graphic technologies, and a discussion of production possibilities and public presentation through an

exhibition. These stages were not isolated activities, but successive phases of integration between academic learning, professional practice, and the interpretation and communication of the company's graphic heritage.

In this regard, the case provides a concrete context in which design, graphic technologies and multimedia production were brought together around an authentic industrial object and a real commemorative challenge. The university-industry collaboration served not merely as a context external to teaching activities, but as an integral part of the learning process itself.

6. Analysis and discussion

6.1. Industrial graphic heritage as an authentic learning environment

This case demonstrates that industrial graphic heritage can serve not only as a subject of historical research, but also as an authentic learning environment. The educational experience went beyond the conventional context of the classroom and the laboratory through direct contact, within the company, with its equipment, production processes, historical materials and technical knowledge.

The students' first contact with the company provided them with an insight into aspects of graphic production that are difficult to replicate in full within an academic context. The visit to the premises enabled them to observe production spaces and equipment, gather visual records and information, and engage directly with professionals. These experiences were subsequently drawn upon in the development of the graphic and audiovisual proposals. The industrial context thus served not merely as a source of visual references, but as part of the conditions within which the project was conceived and developed.

The industrial environment also provided access to forms of knowledge embedded in practice. The company's history, its equipment, production processes and professional experience constituted a body of knowledge that complemented the academic knowledge acquired at university. This aspect is consistent with the concept of industrial heritage adopted in this study, which encompasses not only material remains, but also processes, technical knowledge and professional practices.

This case thus allows us to distinguish between learning about industrial heritage and learning through industrial heritage. In the former case, the company and its history would primarily be subjects of study. In the latter, which characterises this project, the heritage context also shapes the design process and provides material, historical and professional information that informs the project's development.

This aspect is particularly significant because Gráfica Lousanense maintains an active industrial environment; it is not a heritage site removed from its context. The students encountered a company that continues to operate while preserving and beginning to organise historical equipment and materials. The coexistence of current production and accumulated industrial heritage created a context in which continuity and technological transformation could be observed side by side.

6.2. Learning design through an authentic project

The project also illustrates how a real-life brief can structure the learning process as a sequence of interconnected design activities. Rather than treating research, conceptualisation, development, production and communication as separate exercises, the project organised these activities around a common objective: to celebrate and communicate the company's 140-year history.

The process documented in this case involved contacting the company, gaining an understanding of its history and professional context, conducting on-site observation and documentation, developing graphic and audiovisual proposals, considering production options, selecting and preparing the final outputs, and subsequently presenting them in a public exhibition.

This sequence is consistent with the characteristics of PBL discussed by Thomas (2000), namely the centrality of the project, the presence of an authentic problem or purpose, research, and the production of concrete results. The relevance of PBL in this case lies not only in the fact that the students produced artefacts, but in the way in which these resulted from an open-ended challenge that required research, interpretation and decision-making.

The physical outcomes are particularly significant in this context. The posters, postcards, leaflets and videos were not merely exercises produced for assessment. They were developed as part of a commemorative project and subsequently selected for public display. The exhibition thus extended the project beyond the production of the individual artefacts and added a communicative dimension to the process.

The evidence does not allow us to establish individual learning gains. It does, however, allow us to document situations in which students were asked to investigate, make design decisions, consider technical possibilities, communicate proposals and respond to a real-world project context. These situations constitute documented learning opportunities, which correspond to the level of interpretation supported by the study's exploratory design.

6.3. Learning graphic technologies through industrial practice

The project did not treat graphic technologies as a subsequent stage, separate from the design. The brief asked students to consider printing and finishing options, whilst the development of the proposals involved discussing techniques such as special inks, varnishes, embossing, debossing and die cutting. A subsequent meeting with the company focused specifically on the technical feasibility of the selected proposals and on the most appropriate printing and finishing strategies.

The selected artefacts provide visible evidence of this relationship. The exhibition documentation identifies different combinations of offset printing and finishing techniques used on the posters, postcards and leaflets, including fluorescent ink, scratch-off ink, UV varnish, hot and cold foil stamping, die-cutting and matt lamination. These variations show that the technical aspect was not uniform throughout the project, but rather formed part of the specific development of the different proposals.

The case thus illustrates the role of industrial practice in contextualising technological knowledge. The students were asked to consider how a visual proposal might be transformed into a physical object and how different production processes might contribute to the intended result. This relationship is consistent with the argument developed earlier in the paper, according to which design decisions and technological decisions constitute interlinked dimensions of graphic production.

6.4. Connecting design and graphic technology education

The project was structured around three areas of the bachelor's degree: Graphic Design, Graphic Technologies and Multimedia Design. The graphic proposals were developed in line with the company's identity and history; the technological aspect focused on the possibilities for printing and finishing; and the audiovisual component extended the project into another form of communication.

This approach made it possible to establish links between conceptual decisions, visual communication, technological choices and material outcomes. A poster, for example, was not considered solely in terms of composition or visual identity. The proposed printing process and finishing were also incorporated into the design brief. Similarly, a leaflet involved the organisation of information and editorial structure, while also considering the format, printing and finishing.

This case thus illustrates a form of integration in which design and technology remain distinct fields of knowledge yet operate within a shared design context. This relationship is consistent with the historical perspective outlined in Section 2, according to which design and graphic production are deeply intertwined and the possibilities for visual communication depend, at different times, on the technologies available.

The importance of this integration becomes particularly evident in the transition from design to production. The meeting held with the company directly incorporated the production context into the development process. The proposals had to be discussed in terms of what could be technically achieved, and the printing and finishing techniques were adjusted accordingly.

This project thus created an opportunity for students to experience graphic design not merely as the creation of visual solutions, but as the design of objects that will need to be brought to life. This aspect reinforces the view of graphic technologies as an integral part of design competence, rather than as a separate technical discipline.

6.5. University-industry collaboration as a learning condition

The collaboration with Gráfica Lousanense took place at various stages of the project and was not limited to the initial briefing. Firstly, the company set the challenge and provided information about its history and professional background. Secondly, the students visited the premises, where they were introduced to the equipment, processes and staff. Thirdly, the company took part in the discussion of the selected proposals and their feasibility for production. Finally, the results were presented publicly at an exhibition focusing on collaboration.

This sequence is relevant to understanding the university–industry collaboration proposed by Ankrah and Al-Tabbaa (2015). Their review identifies student involvement in industrial projects, interaction with professionals and access to industrial environments as forms of interaction between universities and industry that can bridge the gap between academic and professional knowledge.

In this case, the company's contribution was not limited to the role of client or recipient. Its involvement helped to shape the conditions under which the project unfolded. The company's history formed the subject of the project; its premises and resources provided the context for the research; its staff contributed contextual and technical knowledge; and the company's production capabilities influenced subsequent design decisions.

This does not mean that the company has replaced the university's educational role. Rather, the collaboration has established a complementary relationship between academic supervision and the professional context. The educational framework has remained an integral part of the university curriculum, whilst the industrial partner

has introduced elements of authenticity that are difficult to replicate in full within a purely academic setting.

Thomas (2000) is equally relevant in this context, as the project combined a real-world problem with research, collaboration and the production of concrete results. The case illustrates how university-industry collaboration can reinforce these characteristics of PBL, providing a real-world context in which the project acquires purpose and constraints.

6.6. From learning about heritage to interpreting heritage through design

The project drew on the company's history, identity, technological development and material resources as sources of information. The students engaged with these materials through a company presentation, a site visit, historical documentation and the observation of equipment and processes. They subsequently transformed selected aspects of this information into contemporary graphic and audiovisual communication.

This transformation is evident in the diversity of approaches represented in the exhibition. Some entries emphasised the company's longevity and continuity since 1885; others highlighted technological developments, its identity, its values or its relationship with printing. The audiovisual content also offered different ways of organising and communicating information about the company. The exhibition placed these contemporary interpretations in dialogue with historical materials and documentation relating to the activities of Tipografia Lousanense.

The audiovisual content added a temporal and auditory dimension to the representation of the industrial context. By recording the machinery in operation, the processes and the sounds of the working press, the students sought to convey the dynamics of the work and the production processes. This representation made it possible to showcase aspects of industrial activity that a static image does not convey in the same way, such as rhythm and sequence.

This process is significant because the interpretation of heritage does not necessarily depend on the literal reproduction of historical materials. Design can serve as a means of selecting, organising and translating information into forms that are accessible to contemporary audiences. In this case, posters, postcards, leaflets and audiovisual content have become both educational outputs and objects of interpretation.

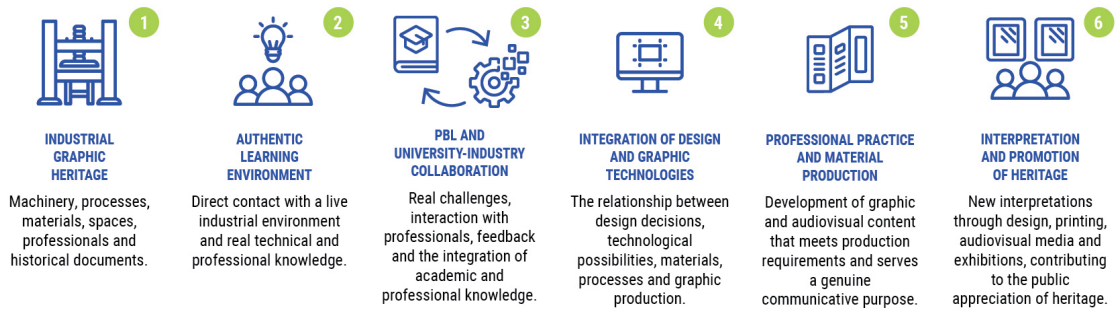
The relationship with industrial heritage is therefore reciprocal in nature. The students had the opportunity to learn through engagement with the company's history and material culture, whilst their work produced new ways of communicating that heritage to the public. The exhibition reinforced this reciprocity by placing the contemporary works in dialogue with historical materials and company documentation.

This interpretation is consistent with the concept of industrial heritage set out in the *Dublin Principles* (ICOMOS & TICCIH, 2011), which encompasses both tangible and intangible dimensions and recognises the importance of documentation, interpretation and engagement with the public. It also draws on the historical relationship between print production, technology and communication discussed by Jury (2012) and Meggs and Purvis (2009).

The case thus suggests that design education can contribute to heritage interpretation without turning students into heritage specialists. Its contribution lies in the application of design and communication skills to historical and industrial materials, producing new forms of interpretation capable of bridging the gap between heritage sites and contemporary audiences.

6.7. Integrative discussion

Taken together, the results reveal a sequence of relationships rather than a set of isolated educational activities. The industrial graphic heritage provided the authentic context; PBL provided the project framework; university-industry collaboration linked the educational process to professional practice; and the integration of design



» **Figure 4:** *Relationship between industrial graphic heritage, authentic context-based learning and the integration of design and graphic technologies*

and graphic technologies enabled students to move from historical information and conceptual proposals to tangible and communicative outcomes. This sequence should not be presented as a validated educational model or as a transferable framework. Rather, it represents the relationships observed in this specific case (Figure 4).

The evidence is more consistent regarding the conditions and opportunities created by the project: the students were exposed to a real-world industrial environment, interacted with professionals, worked with historical and technical information, produced concrete graphic and audiovisual outputs, considered production possibilities and took part in a public exhibition.

The case therefore suggests that industrial graphic heritage can occupy a productive position between cultural heritage and higher education in design and graphic technologies. Its educational value in this context stems not only from its historical importance, but also from its ability to bring together materiality, technology, professional knowledge, design decisions and communication within a real-world project.

7. Conclusions

7.1. Answer to the research question

This study sought to answer the question of how industrial heritage can contribute to the contemporary teaching of graphic technologies and design through PBL and university-industry collaboration. The case study «Celebrating 140 Years: A Creative Partnership between Industry and Higher Education» suggests that industrial graphic heritage can function both as a cultural resource and as an authentic educational context.

The contribution of the heritage context was not limited to providing access to historical content. The company's facilities, equipment, materials, production processes, historical information and professional expertise formed the framework within which the students developed their responses to an authentic project. PBL provided a structure for mobilising these resources in research, design development, technical decision-making and production activities, whilst collaboration with the industry partner brought these activities closer to a real-world professional context.

The study therefore suggests that industrial graphic heritage can support learning when it is approached not only as a subject to be studied, but also as a context through which students can investigate, design, produce and communicate.

7.2. Contributions

This project highlights the educational value of the interplay between design and graphic technologies in the context of a shared project. The development of posters, postcards and leaflets required conceptual and visual decisions to be aligned with formats, printing processes and finishing options. The audiovisual outcomes extended this integration to another form of communication.

The project also provided opportunities to gain experience of professional working conditions, including an external briefing, interaction with a company, production requirements and the public presentation of selected results. These experiences complement the learning that takes place in the classroom and laboratory by applying design and technical knowledge to a specific project.

The study does not establish individual learning gains. Rather, its contribution lies in documenting the conditions and opportunities through which students were able to draw upon and connect different forms of knowledge.

The project also demonstrates a reciprocal relationship between education and heritage interpretation. The students had the opportunity to learn through the company's history, its technological development, its material resources and its professional practices, whilst the graphic and audiovisual outputs created ways of communicating these elements to wider audiences.

The exhibition took on particular significance in this process by placing the students' contemporary work in dialogue with the company's historical materials. The combination of documentation, graphic design, audiovisual content and the exhibition itself contributed to the public's understanding of Gráfica Lousanense's industrial legacy.

7.3. Limitations and future research

Several limitations affect the scope of these findings. Firstly, the study focuses on a single case, involving a specific industrial partner, a specific higher education programme and a specific curricular context. The findings should therefore not be regarded as statistically generalisable. Secondly, the analysis is based on project documentation and selected outcomes, rather than on a longitudinal assessment of individual learning. Thirdly, there is no comparative case study that would allow the educational experience to be assessed by contrast.

These limitations point to several possibilities for future research. Comparative studies could analyse similar collaborations involving other forms of industrial heritage or different educational contexts. Future research could also incorporate interviews with students, reflective accounts or longitudinal assessments,

enabling a more direct investigation into the influence of engagement with industrial heritage on learning.

Overall, this case suggests that industrial graphic heritage can serve as a meeting point between design, production and interpretation. Its educational value lies precisely in the possibility of bringing these dimensions together within an authentic context.

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