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METHODOLOGY FOR THE DIGITISATION OF HERITAGE THROUGH INTERACTIVE TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE

Experience with the Residencia de Estudiantes de Madrid in the PLATA Project

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Cloud services

ABSTRACT

The New Urban Agenda, published by UN-Habitat, establishes that SDG 11 urges governments to protect the world's urban and natural cultural heritage, setting forth soft measures aimed at culture and education. Among these, it promotes the safeguarding of both tangible and intangible cultural heritage, including the use of new technologies, and emphasises the preservation of local heritage in the face of the current process of global acculturation. In a similar vein, the European Commission's Recommendation (EU) 2021/1970 states that heritage is a key element in building European identity and encourages Member States to continue their efforts to digitize and preserve Digital Cultural Heritage assets. The PLATA project, which is presented here, has worked on the creation of a methodology for the digitization of the editorial heritage of Madrid's Residencia de Estudiantes, incorporating interactive technologies, cloud services, and artificial intelligence into the process.

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1. Introduction

In the year 2050, the United Nations (UN) estimates that two thirds of the global population will be residing in cities (UN-Habitat, 2022). This phenomenon has been documented by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) as the Urban Age, underscoring the expectation that this ongoing process of urbanisation will generate novel opportunities for access to services and employment prospects for the emerging urban demographic. However, it is also anticipated that this transition will concomitantly engender heightened challenges pertaining to poverty, inequality, and social integration (UN-Habitat, 2020). In an effort to align urban development with the enhancement of opportunities and the mitigation of challenges, UNESCO has initiated a series of programmes, collectively termed Programmes and Networks of Cities (UNESCO, 2024c). These programmes encompass global networks for urban learning (UNESCO, 2024b), the conservation of urban heritage (UNESCO, 2024), and the Creative Cities programme (UNESCO, 2024a), among others.

UNESCO's study of creativity in cities as an asset for sustainable development was initiated at the 2005 Convention on the Protection and Promotion of the Diversity of Cultural Expressions (UNESCO, 2005a), which was approved during the 33rd session of the General Conference of the United Nations Educational, Scientific and Cultural Organisation, held in Paris from 3 to 21 October 2005 (UNESCO, 2005b). This framework has been subject to successive revisions by UNESCO, the most recent of which was published in 2022 in the public report entitled "Re|Shaping Policies for Creativity – Addressing culture as a global public good" (UNESCO, 2022). This 2022 review establishes the various elements that underpin the **P**royecto de digita**L**ización de **A**rchivos con **T**ecnología interactivA (PLATA. Project for the Digitisation of Archives with Interactive Technology). The present article will discuss this project, which has worked on the digitisation of the editorial heritage of the Residencia de Estudiantes for the design of interactive prototypes.

In the follow-up framework of the document "Re|Shaping Policies for Creativity – Addressing culture as a global public good" (UNESCO, 2022), various guiding principles are established that are operationalised in four objectives, which in turn are related to several Sustainable Development Goals and targets (SDGs) of the 2030 Agenda (UN, 2015). The following SDGs have been identified by UNESCO in relation to cultural policies:

Support for sustainable systems of governance of culture:

- SDG 4. Quality education
- SDG 8. Decent work and economic growth.
- SDG 16. Peace, justice and strong institutions.
- SDG 17. Partnerships to achieve the goals.

Achievement of a balanced exchanges of cultural goods and services and increase the mobility of artists and cultural professionals.

- SDG 8. Decent work and economic growth.
- SDG 10. Reducing inequalities.
- SDG 17. Partnerships to achieve the goals.

The integration of culture into sustainable development frameworks.

- SDG 8. Decent work and economic growth.
- SDG 17. Partnerships to achieve the goals.

The promotion of human rights and fundamental freedoms.

- SDG 5. Gender equality.
- SDG 16. Peace, justice and strong institutions.

Within these objectives, there is a set of core indicators that have been taken as the basis of the PLATA project. Specifically, within the first objective of "Supporting sustainable systems of governance in culture", the PLATA project relies on indicators:

- Policies and measures that support the development of dynamic cultural and creative sectors.
- Policies and measures that support creativity, business and digital markets.
- Policies and measures that facilitate access to diverse cultural expressions in the digital environment.

Of these three indicators, the third one is particularly relevant, as the recommendation to invest in local content and improve its discovery on digital platforms is a recommendation that stands out among the opportunities and challenges for cultural and creative industries in UNESCO's digital environment. In these recommendations, UNESCO highlights that the distribution and production of cultural products

is funded by large global corporations, which implies that they directly influence the promotion of cultural expressions that can marginalise regional and local expressions (UNESCO, 2022) . The digitisation of the editorial heritage of the Residencia de Estudiantes that is presented in this article is a methodological proposal that allows us to combat this risk of monopoly.

1.1. The New Urban Agenda

Concurrent with the implementation of the Creative Cities programme, the United Nations has initiated the UN-Habitat programme, with the objective of overseeing the management of urbanisation and the projected increase in urban populations anticipated in the forthcoming decades. UN-Habitat, a Nairobi-based agency, is entrusted with the responsibility of developing the United Nations Human Settlements Programme, with a mandate to promote sustainable urbanisation on a global scale. The New Urban Agenda (NUA) has been formulated by UN-Habitat as a strategic framework to achieve the Sustainable Development Goals (SDGs). Specifically, UN-Habitat considers the NUA to be an accelerator of SDG11: Make cities and human settlements inclusive, safe, resilient and sustainable. Within this objective, access to culture and education are considered fundamental means to achieve this goal (UN-Habitat, 2020; UN-Habitat, 2022). The NUA is articulated in three main lines:

a) The core dimensions, which define the goals for achieving sustainable urban development within the SDGs:

a. Social sustainability
b. Economic sustainability
c. Environmental sustainability
d. Spatial sustainability

b) Means of implementation, which set out concrete methods to bring cities closer to the stated objectives:

a. Intervention mechanisms
b. Tough measures for infrastructure and services
c. Soft measures for culture, education, health and urban security
d. Measures in the field of technology and innovation

c) Mechanisms for the follow-up and review of the New Urban Agenda:
The heritage digitisation methodology described in this article is a proposal for action to advance the soft measures of Culture and Education corresponding to the means of implementation of UN-Habitat's New Urban Agenda.

1.2. Soft Measures: Culture and Education.

The New Urban Agenda (NUA) is predicated on Sustainable Development Goal (SDG) 11, which calls upon governments to 'protect and safeguard the world's cultural and natural heritage' (UN, 2024). Within the SDG, in point SDG 11.4, it is emphasised that such protection cannot be merely intentional but must be accompanied by public and private investment for the preservation, protection and conservation of all cultural assets and natural heritage SDG 11.4. Consequently, the NUA incorporates culture as a priority in urban plans and strategies (UN, 2017).The NUA employs the UNESCO definition of heritage, which characterises cultural heritage as the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present, and bestowed for the benefit of future generations (UNESCO, 1972). Furthermore, the NUA is informed by a culture-based approach to urban development, as outlined by UNESCO, which is based on three propositions:

- o People-centred cities are culture-centred spaces
- o Place-based urban planning incorporates local history and culture
- o Integrated policies use culture as a tool for sustainability and resilience (UN, 2017).

1.3. Digitisation of Cultural Heritage in the European Union

Concomitant with the measures for the culture of the NAU, the necessity to digitise the cultural heritage of our society has been included in Recommendation (EU) 2021/1970 of the European Commission (European Commission, 2021). This recommendation establishes that cultural heritage is a fundamental element in the construction of a European identity based on shared values and in the economic development of the region. The same Recommendation encourages Member States to continue their efforts to digitise and preserve Digital Cultural Heritage assets in the highest level of detail. For this reason, they must establish clear objectives for digitisation and conservation, as well as compliance figures for Cultural Heritage at risk and the most visited Cultural Heritage sites. It is emphasised that today there is a low level of digitisation of specific categories of CP. The European Commission acknowledges the challenge of digitisation and is working to ensure that it reaches all areas with sufficient quality, including small or local entities with lower budgets. For instance, the second cluster of the Horizon 2020 Programme underscores these concerns and fosters initiatives within this framework, leveraging multidisciplinary expertise from the European Social Sciences and Humanities to comprehend the ramifications of these advancements on societal transformation, economic shifts, cultural evolution, and political developments (European Commission, 2020).

In consideration of the extant EU-funded interests and projects (Sorli, 2022), a salient challenge in conceptualising Digital Cultural Heritage is the substantial heterogeneity of tangible and intangible elements constituting our culture. It is implausible that a single system could adequately address the prolonged, high-quality digitisation of any object or element designated as Cultural Heritage, due to the markedly divergent nature of these (Pandey & Kumar, 2020). Consequently, there is an absence of a unified data capture or metadata storage-access system that can cater to all requirements (Masenya, 2021).However, with the objective of preserving and disseminating the original cultural heritage object with maximum fidelity, it is feasible to digitise both tangible and intangible elements, such as sound information (acoustics, interpretation techniques, etc.). It is imperative to acknowledge the intricacies inherent in this concept, which encompasses multiple layers of knowledge. The integration of Digital Twins with a higher level of complexity, potentially encompassing real-time information, is a crucial aspect to consider (Ruppert & Abonyi, 2020). Technological advances and declining costs are facilitating access to tools and methods for the digitisation of cultural heritage, thereby rendering this activity accessible even to small institutions or entities (Herban et al., 2022).

2. SILVER Project

The PLATA project constitutes an innovative response to the requirements arising in the context of the digitisation of heritage, combining the efforts and knowledge of several key organisations. It is the result of close collaboration between the Residencia de Estudiantes, the research group Innovation and Technology from and for Education, Culture and Society (ECSiT) of the UDIT University of Design, Innovation and Technology, and the company Gammera Nest, which specialises in the creation of interactive experiences using advanced technologies. This multidisciplinary alliance has enabled the development of a pioneering methodological approach to the digitisation of heritage that goes beyond traditional methods, seeking to transform the way in which users interact with digitised assets.

The PLATA project has focused on the digitisation of several books from the Residencia de Estudiantes publishing house, addressing a significant challenge in this field. Specifically, the project has sought to expand beyond the concept of the digital twin, which is the creation of a precise replica of a physical object in digital format. While this is an essential tool for conservation, it does have certain limitations in terms of interaction and accessing additional information. In light of these limitations, the PLATA project aims to enhance the functionality of these digital twins by developing an augmented format that not only replicates the content but also facilitates interactive exploration of cultural heritage in a more comprehensive and accessible manner.

The outcome of this endeavour is an augmented digital book that serves as an expanded instrument for the utilisation of heritage. This development represents a significant advancement in the field, as it ensures that digitised books are not merely available in a passive digital format but also offer users the possibility of interacting with additional content, accessing related files, and browsing information in a dynamic and personalised manner. The success of this format is predicated on the integration of

technologies such as augmented reality (AR), artificial intelligence (AI), and cloud service platforms, which facilitate exploration of heritage from multiple angles and enrich users' understanding of the materials.

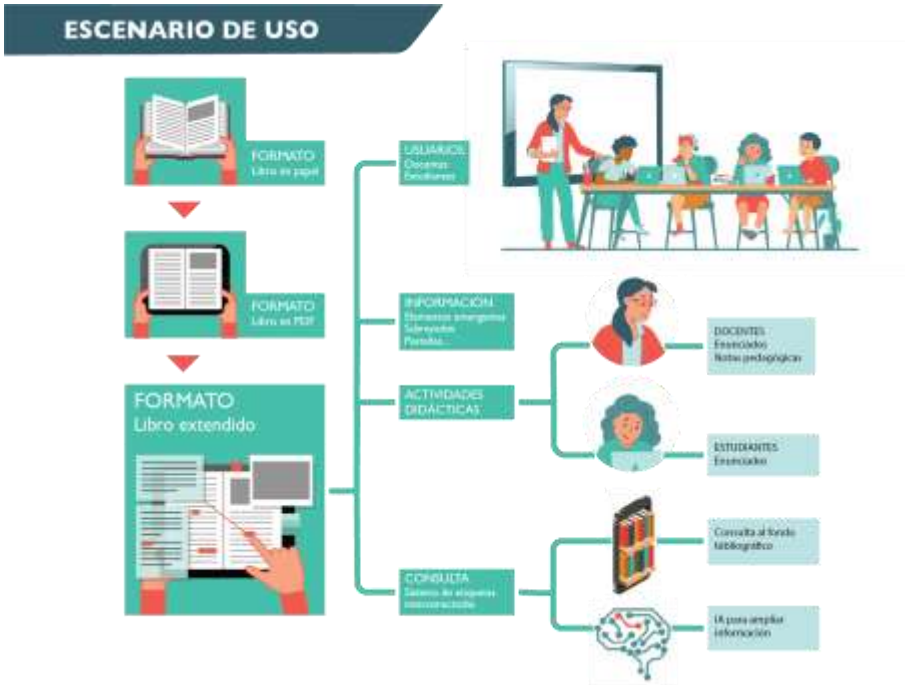
Moreover, this methodological approach is not confined to bibliographic collections alone but proposes a comprehensive solution for the digitisation of various types of heritage. Examples of future applications include material heritage, such as architecture and paintings, opening up new avenues for the preservation of and access to cultural assets in an interactive digital environment. By expanding the scope of digitisation, researchers, students and the general public are empowered to explore and study heritage from an immersive perspective, enhancing the educational and cultural value of the project.

This study describes both the digitisation methodology followed and the prototype design process that has enabled this level of sophistication to be achieved. The detailed workflow presented offers a clear guide for future digitisation projects, establishing a replicable model that can be used by other institutions or work teams interested in modernising the management and interactive management of digitised cultural heritage. Furthermore, the PLATA methodological proposal is not only intended to be applied to specific contexts but is positioned as a model adaptable to different heritage and technological environments, becoming a reference for the digitisation of heritage at an international level.

2.1. Project Methodology

In accordance with the principles of human-centred design and user experience design (Norman, 2023), the design of the prototype commenced with a usage scenario (fig. 1), which provides a preliminary approach to understanding the key elements that influence the user experience. This tool is valuable for designers, but also for academics, as it offers a comprehensive view of the relevant factors in the study and design of the user experience. According to Cross (2004), the strategy of expert designers is based on an adequate definition of the problem space, focusing on the collection of information and on establishing design priorities.

Figure 1. User experience scenario.



Source: Own elaboration, 2025.

In the context of the PLATA project, archives and libraries are engaged in a comprehensive digitisation process of their collections, enabling publications to be accessed in PDF or ePub format (a term denoting electronic publication), thereby constraining the experience to a digital facsimile of the physical book. However, the PLATA project aims to transcend the concept of the digital twin, which is

defined as “the creation of a virtual replica, in the image and likeness of a tangible product, process or system” (Varas et al., 2020, p. 302). The PLATA project aims to move beyond this traditional concept by exploring the potential of the extended book, which offers more advanced interactivity functionalities. According to Beyoda (1997), the extended book can be defined as the recipient's ability to manage a non-linear message, depending on what the sender allows, in the context of an asynchronous communication medium. In essence, this means that the user can autonomously explore the content previously designed by the issuer and interact with the content dynamically. By selecting keywords, users can access additional publications and related documentation from archives or institutions (in the case study, the archive of the Residencia de Estudiantes), including photographs, videos, and further documents. The system incorporates artificial intelligence trained on the archive's own sources, enabling more advanced and efficient searches, providing secure information and its physical location or geolocation.

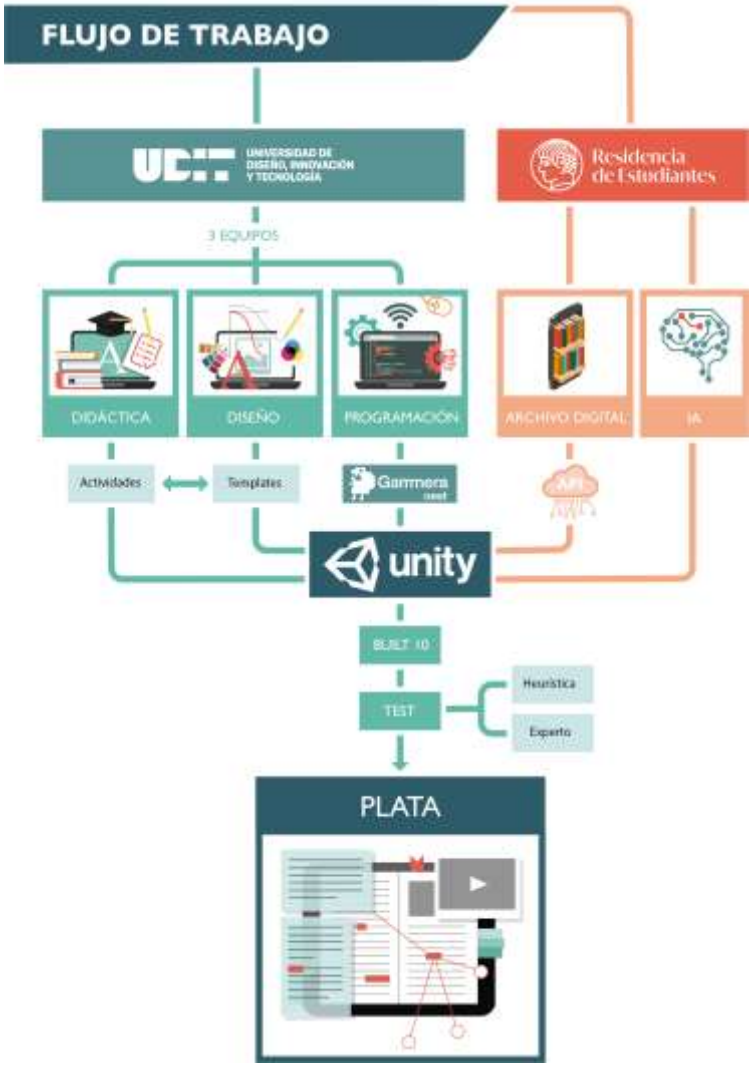
The primary objective of this interactive product is to transform the way in which students access and use knowledge, offering a didactic tool that not only encourages reading, but also active research and the interconnection between contents. In this context, the extended books would be used dynamically by students at different educational levels (secondary education, university and even researchers). Teachers would have access to educational activities designed around the contents of the extended book, while students could explore it to solve the tasks set. This approach facilitates the connection of students with other pertinent elements, thereby enriching their subject comprehension.

A salient benefit of this approach is that reading and knowledge acquisition do not follow a linear pattern, but evolve as a network of knowledge (Sanz, 2013). Through the extended book, students can link information from diverse sources, creating their own conceptual map. This enables them to follow a predefined path, but also to design personalised learning routes, adapted to their interests and needs. The ability to explore knowledge in a non-sequential way encourages critical thinking and autonomous learning, giving each student a unique experience.

Furthermore, this approach offers a double advantage: students not only have access to expanded and contextualised content, but also learn, in parallel, to use artificial intelligence tools correctly to carry out academic searches. This fosters the development of critical skills in the utilisation of AI, which will become increasingly pertinent in both educational and professional domains.

Following the delineation and ratification of the usage scenario by the Residencia de Estudiantes and UDIT, the workflow was conceptualised (Fig. 2) to achieve the stipulated objective. At UDIT, three collaborative teams were established to address three distinct lines of work that would converge in the final product: a teaching team, a design team, and a programming team.

Figure 2. Workflow.



Source: Own elaboration, 2025.

a) The teaching team developed a standard activity (Fig. 3) with the objective of integrating the use of the digitalised book in the classroom, with a focus on reinforcing and expanding the knowledge acquired through the contents of the book. This activity is adaptable to different learning environments, allowing for flexible implementation in varied educational contexts. The activity's design encompasses three fundamental components:
   - A comprehensive description of the activity, delineating the precise steps that students must follow to ensure successful completion.
   - A pedagogical note that provides guidance to teachers on the implementation of the activity in the classroom, incorporating practical examples and didactic recommendations.
   - An analysis of the curricular competencies addressed in the activity, facilitating its incorporation into official academic programmes and other educational documents.

In terms of usage scenarios, three types of access to the content were defined, designed to adapt to the needs of different types of users:

- Teacher User: Has full access to the three contents of the activity, allowing them to prepare and supervise its implementation in the classroom.
- Student User: This profile is designed to allow access to the activity statement, with the intention that the student can concentrate on their task without distractions.
- Reader User: In this profile, the activities are omitted so that the user can focus exclusively on reading and research, facilitating autonomous use of the book.

Figure 3. Pop-up sheet with proposed Teaching Activity for the teaching profile, note that it includes the pedagogical note, in addition to the statement.

Source: Own elaboration, 2025.

As illustrated in Figure 3, the activity description outlines the objective of the activity, which is to assist teachers in its execution. The designated pages for this activity are specified, and the pedagogical objectives are elucidated. In this particular instance, the objectives are to consolidate bibliographic knowledge and to acquaint students with select works by the author Juan Ramón Jiménez. In order to achieve this objective, it is proposed to work on Sternberg's three types of intelligence (analytical, creative and practical) (Sternberg, 1997) to create a literary, geographical and temporal route of the author's formation.

The statement, which can be seen in the centre of Figure 3, is a description of the activity written as it should be delivered to the students. It is written in a simple style and is markedly didactic and indicative. In this example, students are invited to work in groups to read the indicated text and extract the main ideas. Once this is done, tasks are described that allow them to exploit the capabilities of the extended book achieved with the PLATA methodology and described in this article. For example, students are asked to consult the Student Residence archive (from the book itself) to obtain the information necessary to construct the literary, temporal and geographical line of the author Juan Ramón Jiménez. Additionally, although not explicitly stated, students are encouraged to utilise the artificial intelligence (AI) integrated into the book, which has been programmed to provide answers based exclusively on primary sources from the Residencia de Estudiantes archive. This ensures that students access reliable and verified information and also includes a reference to the sources consulted. Concurrently, students are instructed in the proper utilisation of AI tools, receiving education on their functionality and the advantages of their application in academic settings, thereby minimising the likelihood of misinformation.

The pedagogical note accompanying this activity is intended to ensure its incorporation into the official school curriculum. As illustrated in figure 3, this activity is recommended for 4th year ESO students, with a detailed description of the skills developed and their alignment with current educational regulations. The key learning outcomes associated with the students' exit profile are also specified, allowing teachers to incorporate these activities into their existing programmes without the necessity of creating additional exercises outside the curricular context. The pedagogical note also includes recommendations on the prerequisite knowledge and the use of supplementary resources to enhance the efficacy of the activity.

Consequently, the pedagogical team has not only conceptualised functional learning activities but also ensured their compatibility with the curricular framework. This guarantees that digitalised and extended books can serve as comprehensive and accessible educational instruments at diverse levels of education.

b) The design team's efforts were concentrated on the creation of new layout templates, a necessity for adapting the books to the interactive environment of the PLATA project. Despite the books on which work had already been done having been published and having a previous layout for printing and in PDF format, this procedure was essential to guarantee an adequate adaptation to the digitisation process. This phase facilitated not only the transfer of the content, which was subsequently managed by the programming team, but also the establishment of a coherent visual identity for the collection.

   The decision to redesign the books was not only due to technical issues, but also a conceptual approach that sought to consolidate a homogeneous image for all the volumes of the project. This visual identity not only facilitates user navigation but also reinforces the perception of the extended book as an advanced and modern educational tool.

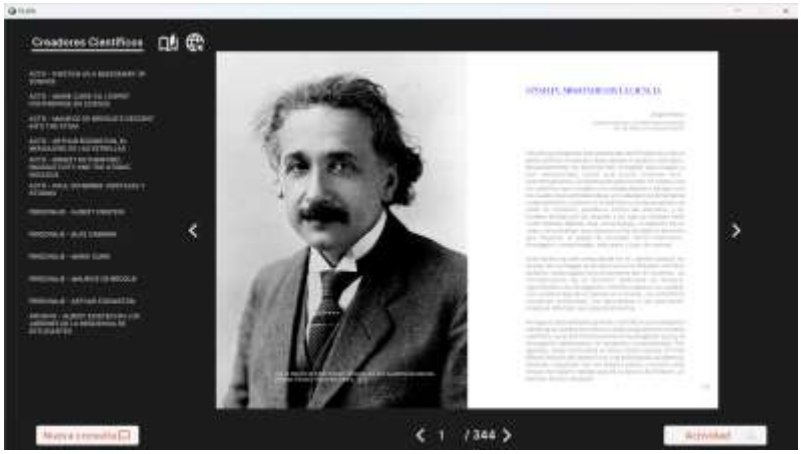
   The integration of interactive and multimedia elements, such as videos, audios, and additional documents, necessitated an initial conversion of the books to the ePub format. The ePub format, which facilitates flexible access to the text and is adaptable to different devices, is a widely utilised method for the digitisation of books due to its capacity to optimise reading on screens of various sizes. However, the ePub format does possess certain idiosyncrasies, namely the fact that it does not retain the original layout or pagination of printed or PDF books. Instead, it automatically adapts to the user's preferences in terms of visual parameters such as font size and typeface (Ribes et al., 2009). This aspect proved to be a challenge, as it necessitated a complete reorganisation of the contents to guarantee a coherent and functional presentation in the digital environment.

   In response to the identified situation, the design team developed a series of seven bespoke templates. These templates were intended to facilitate the organisation of content and enhance interaction with users. The templates encompassed a range of functionalities, from the home screen, which enabled users to register and access the book index, to specialised templates for viewing characters, events, documents and educational activities. Each of these templates was meticulously designed to balance aesthetics and functionality, ensuring that users could navigate content in an intuitive and enriching manner. The templates developed included the following:

   - Home screen / registration
   - Book index
   - Book display for interactive reading, including access to menus for consulting chapter and file indexes
   - Character file
   - Video and/or audio event file
   - Document file
   - Visualisation of educational activity

An example of the character file and the audio file with a use case is shown below (figure 4). When browsing through any of the books, references to relevant characters who have passed through the Residencia de Estudiantes throughout its history can be found. On this occasion, a photo of Einstein is included in the book Scientific Creators.

Figure 4. Book reading interface.



Source: Prepared by the authors based on Residencia de Estudiantes (n.d.)

Should further information be required regarding the historical figure, it is possible to access additional materials by clicking on the photos or texts that are linked to the file. For example, the character file can be obtained as follows:

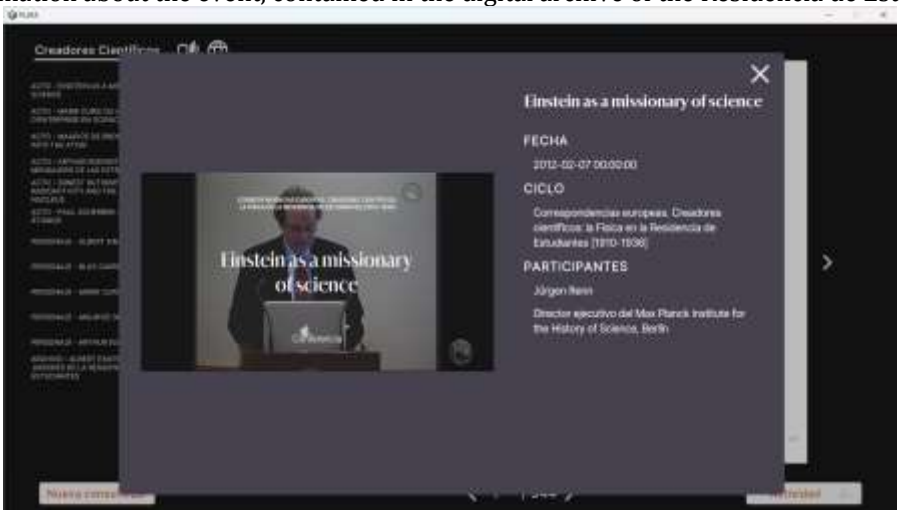
Figure 5. Auto-generated pop-up file including image and text information about Einstein from the Residencia de Estudiantes digital archive.

Source: Prepared by the authors based on Residencia de Estudiantes (n.d.).

It is imperative to elucidate that this character file is not contained within the book itself; rather, upon clicking on the photograph of the book associated with the file, the book conducts an online search in the Residencia de Estudiantes archive using an API (Application Programming Interface). The book then generates this file on the designed layout, incorporating images and texts that it extracts from the archive in real time. Consequently, the same book can obtain additional information as the Residencia file undergoes digitisation or other files are linked via APIs.

Furthermore, it is possible to make calls to videos and audios of events from the Residencia archive through the texts and photographs:

Figure 6. Auto-generated pop-up file that includes the video of the event "*Einstein as a missionary of science*" and the text information about the event, contained in the digital archive of the Residencia de Estudiantes.



Source: Prepared by the authors based on Residencia de Estudiantes (n.d.).

The pop-up window is generated in real time, with information extracted via API from the digital archive of the Residencia de Estudiantes. This allows the incorporation of additional material, including videos, audio, and various multimedia files suitable for digitisation.

c) The programming team was responsible for creating the project's executable file, a task that included the implementation of the didactic activities and the interface design. For this purpose, the Unity programming engine, developed by Unity Technologies, was selected, a platform widely recognised for its versatility in the development of interactive experiences. Unity has become a staple in the realm of video game creation, 3D application development, augmented reality (AR), and virtual reality (VR) projects, thanks to its ability to compile and execute content across a diverse range of platforms. This facilitates the integration of high-quality graphics and sophisticated interactive features, a key advantage of Unity. Its flexibility and ease of use further solidify its position as a prime choice for the project under consideration. (Unity Technologies, 2023).

   In order to facilitate the technical implementation of the executable file, collaboration was undertaken with Gammera Nest, a company specialising in the use of Unity in educational and cultural contexts. Gammera Nest played a crucial role in the compilation of the previously designed didactic activities, as well as in the integration of the proposals for augmented reality from the Residencia de Estudiantes.

   The project design incorporated two key proposals to enhance the user experience: cloud services and artificial intelligence (AI). The objective of these additions was to improve the interactivity and accessibility of the content.

   - Cloud services: Residencia de Estudiantes implemented a remote access system from the digitised books to its digital databases, located on its server. This access enables users to consult a wide range of files of historical and documentary value, which enrich the reading and study experience. The available files include:
     - Photographs contained in the books, including archival information about them: date, place of creation, place of conservation, etc.
     - Videos of acts and events held at the Residencia de Estudiantes, the content of which is directly related to the topics covered in the digitised books.
     - Different types of files of bibliographic and historiographic value: documents, handwritten letters, etc.
   - Artificial intelligence (AI): Another of the most outstanding advances of the project is the integration of an AI within the digitised book itself. This artificial intelligence is specifically designed to answer users' questions based on the primary sources available in the Residencia de Estudiantes archives. Unlike general AI, this AI focuses on providing answers

extracted exclusively from verified archive sources, minimising the risk of misinformation and ensuring a more reliable and coherent learning experience.

3. Results: SILVER Methodology

The prototype under discussion extends beyond the digital twin nature of heritage and fulfils new functions. This type of prototype is proposed not only for working with published heritage, as is the case of the PLATA project described in this article, but also as a proposal for a prototyping standard in the case of other forms of heritage: physical (sculpture, painting, etc.), architectural or intangible (music, performing arts, etc.).

The methodology defined in this study is proposed for the digitisation of all types of heritage and fulfils the objectives of the European Commission Recommendation (European Commission, 2011) and can help promote the soft measures related to education and culture of the NUA (UN, 2017). This methodology is hereby referred to as PLATA, the same as the project that led to its definition.

Figure 7. Silver Methodology.

Source: Own elaboration, 2025.

The PLATA methodology (Fig. 4) has been developed to address the various functions of digital heritage, combining conservation, consultation and research in a single interactive standard. This proposal is structured around three key functions that define the use and value of digitised heritage, maximising the capabilities of new technologies applied to culture:

a) The first function, conservation, focuses on preserving heritage in a digital format that is durable and true to the original. Through the process of digitisation and the creation of advanced prototypes, a digital twin is produced, which comprises all the intricacies and properties of the original object with the utmost precision. This replica fulfils two functions: firstly, as a backup of the physical object, and secondly, as a compliance with digital preservation standards, thus ensuring the endurance and availability of the relevant information to future generations.
Furthermore, the implementation of extended reality technologies allows for conservation that goes beyond simple digitisation, as multimedia elements and metadata are integrated to enrich the digital twin. Despite the advanced interactive functions described below, the proposed digital prototype is still valid as a fundamental heritage preservation tool.

b) The second function is searching for information, which broadens the possibilities of using digitised objects by integrating them into interactive experiences. In contradistinction to a rudimentary scan or modelling of a physical object – be that a book, a building or a recording –

the proposed standard in PLATA converts these objects into interactive digital environments. The utilisation of technologies from the realm of video games, as well as extended reality (AR/VR), allows the user to explore the object dynamically.

The user can opt for either free exploration, akin to open-world (sandbox) games, or directed exploration, wherein gamification mechanics or interactive narratives are employed to guide the journey. Moreover, prototypes can offer both options, enabling the user to select the type of interaction that best aligns with their interests or needs. This flexibility transforms the consultation into an enriched experience, reproducing the object and concomitantly enabling new angles and perspectives to be discovered.

c) The third function is research. As an extension of the previous consultation function, research enables the prototype to expand the information contained in the original heritage object using the possibilities of new technologies. In the prototyping standard of the PLATA project, three modes of operation in this research function have been defined:
   i. Using cloud services. The incorporation of metadata into any digital object enables online searches in digital archives to be linked from any digital heritage prototype. This facilitates the consultation of related heritage objects, both physical (e.g. geolocating the location of an object observed in the digital prototype) and digital databases (e.g. accessing and listening to the music contained in a score observed in a book).
   ii. Using artificial intelligence tools embedded in digital heritage prototypes, users can pose questions to access information not contained within the object itself. For example, if a relevant historical figure is mentioned, the user can ask the AI for the biography of this person or their most important works. To incorporate this mode of operation in the exploration of digitised heritage prototypes, it is imperative that future research and development endeavours are undertaken to ensure the accuracy and reliability of the responses generated by the AI, utilising primary sources as a foundation.
   iii. Through educational activities. The digitisation process presents a significant opportunity to seamlessly integrate heritage into the classroom environment. The ability to access out-of-print books, original works of art, and stage performances directly from the classroom itself opens up a series of highly compelling opportunities for educators. To this end, the prototypes can incorporate proposals for activities that follow the pattern previously described in the case of the PLATA project, with pedagogical notes to facilitate their implementation. These notes should include help in the analysis of the curricula to allow their inclusion in the programmes and documents of the centre.

4. Discussion

The SILVER methodology, proposed for the digitisation of cultural heritage, complies with the requirements established by the European Commission Recommendation 2011/711/EU on the digitisation and online accessibility of cultural material and digital preservation. Specifically, it follows the guidelines in terms of the creation of accessible, high-quality digital content, the interoperability of systems and the long-term preservation of digital data. Furthermore, the SILVER methodology facilitates the implementation of standardised procedures that guarantee the adequate preservation of cultural heritage through sustainable and accessible digital formats, as demanded by the EU Recommendation. This is regardless of the size of the institution.

The PLATA methodology, as outlined in this article, facilitates the alignment of our practices with the guiding principles established by UNESCO, which establish a nexus between culture and the Sustainable Development Goals and targets of the 2030 Agenda. Specifically, the indicator that pertains to policies and measures that facilitate access to diverse cultural expressions in the digital environment. In these Guiding Principles and Indicators, UNESCO highlights the risk of acculturation due to the distribution and production of cultural products dependent on the resources of large global corporations, which directly influence the promotion of cultural expressions that may marginalise regional and local expressions. The PLATA digitisation methodology has been employed to digitise the editorial heritage of the Residencia de Estudiantes, thereby exceeding the concept of a digital twin by incorporating interactive technologies, cloud-based file consultation and artificial intelligence. The

future application of this methodology to the digitisation of all types of local heritage —including, but not limited to, editorial, architectural and immaterial heritage— is a methodological proposal that can combat the risk of monopoly and acculturation, as denounced by UNESCO.

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