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San Millán de la Cogolla, its monasteries and its historical context compared using AI

Summary

History teaching often presents the past in compartmentalized units, which makes it difficult for students to perceive the simultaneity between local, national, European and global processes. San Millán de la Cogolla, with its monasteries of Suso and Yuso[1] and a continuous history dating back to the sixth century, offers an exceptional setting for addressing this problem through comparative history and heritage education. This paper aims to design and justify a pedagogical framework that integrates the synchronous contextualization of Emilian history with the educational use of artificial intelligence (AI) in secondary and baccalaureate history teaching. Methodologically, the study adopts a qualitative documentary design in three phases: a critical review of primary sources—the Vita Sancti Aemiliani, the monastic cartularies and the Glosas Emilianenses—and of specialized historiography; the construction of a comparative chronology that places eleven Emilian milestones alongside contemporary events in La Rioja, the peninsular kingdoms, Europe and other world regions; and the analysis of AI's didactic potential from the perspectives of historical thinking, heritage education and the TPACK framework. The main contributions are a comparative chronology table and three timelines that make historical simultaneity visible, together with a pedagogical framework that organizes five AI-supported lines of work: interactive timelines, source-grounded historical chatbots, linguistic analysis of the Glosas Emilianenses, visual reconstructions and the didactic metaverse, and adaptive assessment. The paper argues that these tools can strengthen historical thinking and heritage education when they are subordinated to primary sources, teacher mediation and a coherent instructional sequence, and it concludes that empirical pilot studies are required to evaluate their impact on student learning.

Keywords: San Millán de la Cogolla, monasteries of Suso and Yuso, comparative history, synchronous chronology, Artificial Intelligence

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Francisco José García Tartera
DESDE, Universidad Complutense de Madrid, Spain

Correspondence: Francisco José García Tartera, DESDE, Universidad Complutense de Madrid, Spain

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Introduction

The teaching of History in Secondary and Baccalaureate tends to present the events of the past in a compartmentalized way: a didactic unit for Visigothic Hispania, another for the High Middle Ages of the peninsula, another for the Byzantine Empire or for the Islamic world, without the students being able to clearly perceive what was happening simultaneously in both scenarios. This work is based on the conviction that one of the most valuable – and most neglected – learnings in History is precisely simultaneity: understanding that while San Millán lived as a hermit in the caves of the Sierra de la Demanda, the Western Roman Empire was crumbling, Clovis was unifying the Franks and, centuries later, while the monks of Yuso were consecrating their new church, the Normans were disembarking in England and Rome and Constantinople were breaking their ecclesiastical communion.

San Millán de la Cogolla, in the province of La Rioja, has exceptional conditions to develop this approach: it is a place of continuous memory from the sixth century to the present day, it has exceptionally rich documentation – from the Vita Sancti Aemiliani of San Braulio to the cartularies and the Glosas Emilianenses – and it offers an ideal setting for heritage education and for the development of historical thinking through work with primary sources and the local environment.[2–4]

This document is a pedagogical design proposal that offers a historical and hagiographic review focused on San Millán de la Cogolla and the application of Artificial Intelligence to the teaching of History in a conceptual framework. For this reason, in addition to synthesizing the historical account of the saint and the monasteries of Suso and Yuso, it dedicates its core argument to a synchronous and comparative reading of the history of Emilian with the history of the province, the peninsular kingdoms, Europe and other regions of the world, and concludes with a proposal for the use of AI as a didactic resource to present these comparative chronologies in a visual, interactive and meaningful way for students.

Objectives

The general objective of this work is to analyze the history of San Millán de la Cogolla and the monasteries of Suso and Yuso from a comparative and synchronous history perspective, and to explore its didactic potential using Artificial Intelligence tools. The following specific objectives are derived from this general objective:

I. To synthesize, from primary sources and specialized bibliography, the biography of San Millán and the historical and architectural evolution of the monasteries of Suso and Yuso.

II. To identify, for each relevant milestone in the history of Emilia, the most significant contemporary events in La Rioja, in the peninsular kingdoms, in Europe and in other regions of the world.

III. Develop visual representations (comparative tables and timelines) that allow teachers and students to compare briefly the simultaneity of these historical processes.

IV. To review the international state of the art on educational innovation, heritage education and artificial intelligence in the teaching of History.

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V. To formulate a reasoned proposal on the use of Artificial Intelligence as a tool for teaching the comparative history of San Millán and its monasteries.

Methodology

The work has been developed following a qualitative documentary research methodology, typical of the human sciences and the didactics of History, structured in the following phases:

Bibliographic review

A review of primary sources (The Vita Sancti Aemiliani of San Braulio de Zaragoza, the Cartulary of San Millán de la Cogolla and the cartularies known as Becerro Galicano) and of secondary, academic and institutional sources has been carried out: philological studies on the Glosas Emilianenses,[5–8] monographs of Hispanic medieval history[9–11] and, notably, the international scholarship on history education, heritage education and artificial intelligence in teaching.[2,12–14]

Construction of the comparative chronology

For each selected Emilian landmark, a systematic search of contemporary events has been carried out in four concentric circles of analysis: (a) La Rioja and the corresponding peninsular kingdom in each period (historical Cantabria, Visigothic kingdom, kingdom of Pamplona-Nájera, Crown of Castile, contemporary Spain); (b) Europe; and (c) other regions of the world (classical and medieval Islam, China, India, the American continent and Africa), reserving a fourth column for the Emilian landmark itself. The result is summarized in the comparative table in section 7 and in the timelines in Figure 1–3.

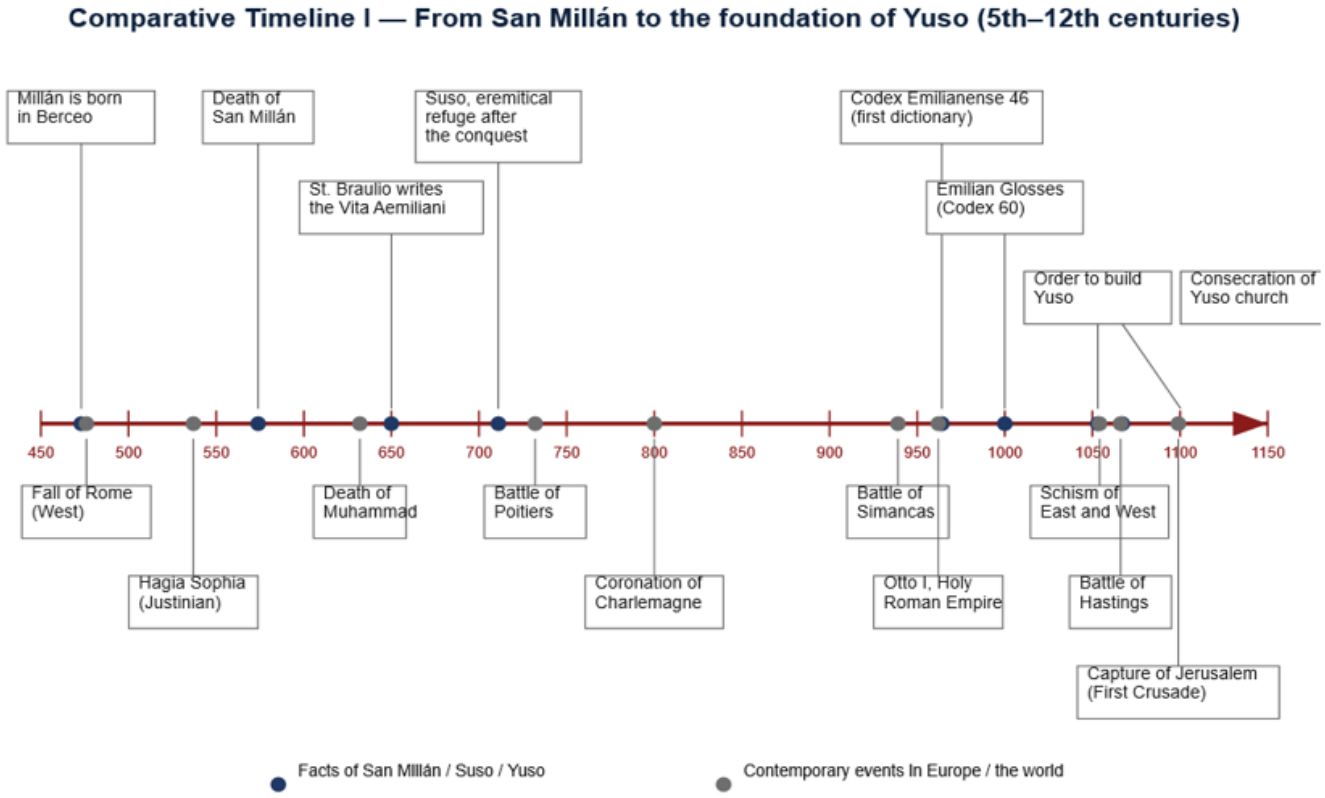


Figure 1 Comparative timeline I: from San Millán to the foundation of Yuso (V-XII centuries).

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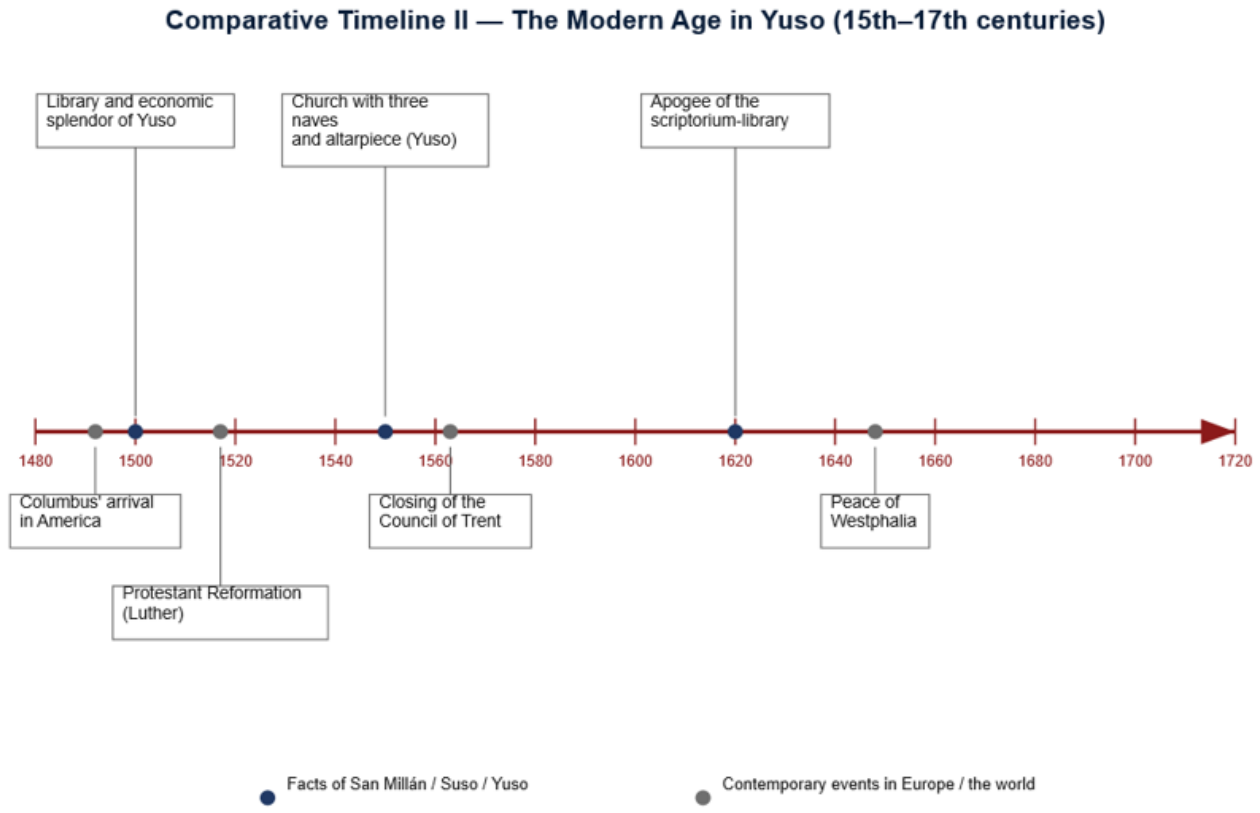


Figure 2 Comparative Timeline II: the Modern Age in Yuso (15th-17th centuries).

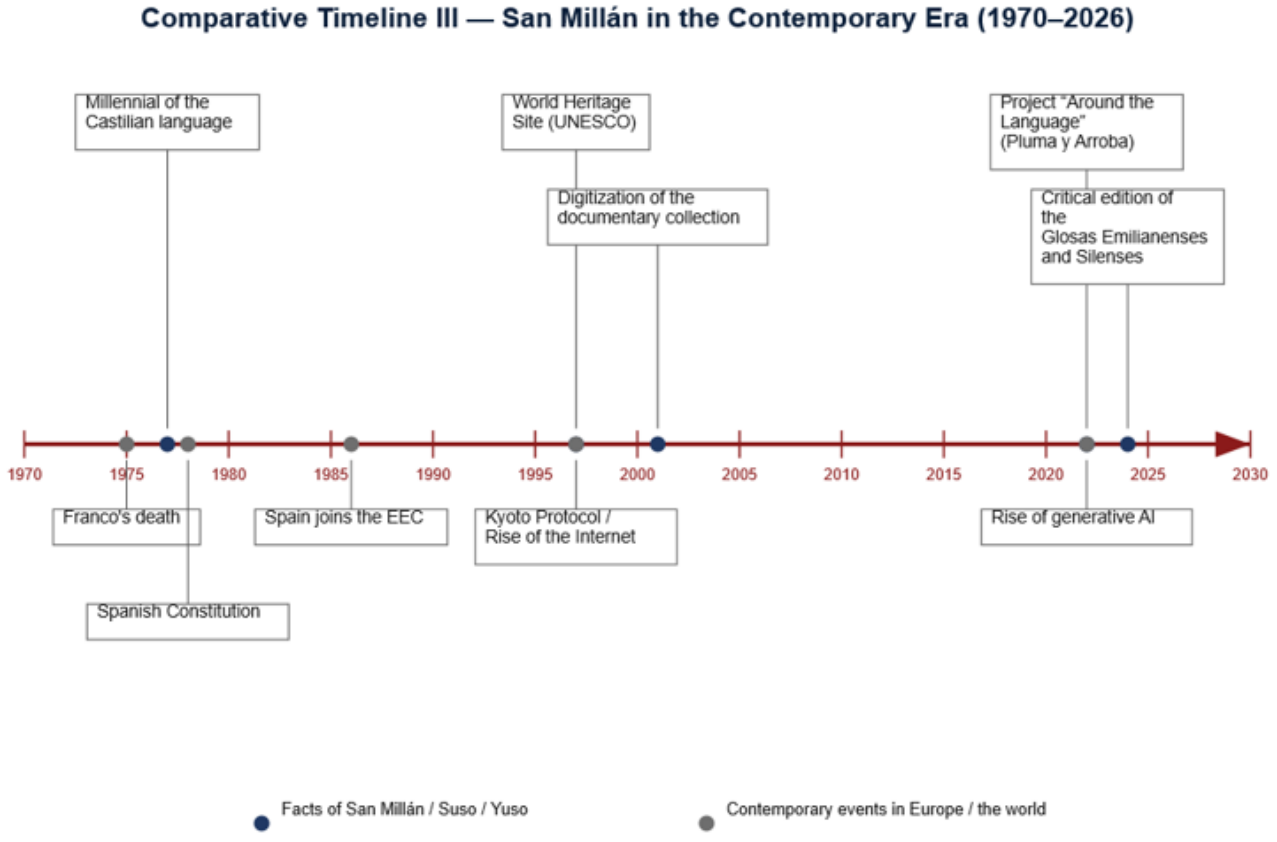


Figure 3 Comparative Timeline III: San Millán in the Contemporary Era (1970-2026).

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Analysis of the didactic potential of AI

Finally, the use that recent educational research has made of digital technologies (augmented reality, immersive environments and Artificial Intelligence) in heritage education has been analyzed, to formulate from there a proposal for specific application to the comparative chronology object of this work.

Theoretical framework and state of the art

The bibliography on San Millán de la Cogolla is extensive and can be grouped into three large blocks: (1) the classical hagiographic and philological studies, focused on the Vita Sancti Aemiliani and the Glosas Emilianenses; (2) the historical-artistic studies on the architecture and institutional evolution of the monasteries of Suso and Yuso; and (3) the most recent educational and informative production, aimed at transferring this heritage to the classroom.

In the first block, the biography of San Millán written around the year 650 by San Braulio, bishop of Zaragoza, stands out, which constitutes the fundamental primary source on the life of the saint (Braulio de Zaragoza, trans. Minguella), and which would be glossed centuries later in Romance verse by Gonzalo de Berceo. There is a philological tradition of reference on the Codex Emilianense 60 and the Glosas Emilianenses, initiated by Menéndez Pidal[15] and continued decisively by Manuel C Díaz y Díaz[5,6] and Claudio García Turza[8,16] whose works have recently been updated with the critical-philological edition of the Glosas Emilianenses and Silenses and the facsimile edition of the Codex Emilianense 60, presented in 2024 by the San Millán de la Cogolla Foundation.[17]

In the second block, the studies on the architectural and institutional evolution of Suso and Yuso – Visigothic monastery, Mozarabic monastery, Benedictine monastery duple and, currently, convent of the Order of Augustinian Recollects – have been summarized by Olarte,[18] Peña,[19] Puertas[20] and Ubieto,[21] among others, and are also included in the institutional documentation of the San Millán de la Cogolla Foundation itself and in the UNESCO World Heritage declaration file.[1]

The third, more recent, block is the one that gives meaning to this congress: the international literature on educational innovation and history teaching, which since the beginning of the century has progressively incorporated STEAM methodologies, technological pedagogical content knowledge and, more recently, immersive environments and artificial intelligence.[12–14,22] Within this framework, heritage education has emphasized the value of local contexts, material sources and mediated experiences for the development of historical thinking.[2–4,24] This state of the art highlights a gap that this paper aims to fill: the absence of an explicit systematization of the history of San Millán and its monasteries in terms of comparative and synchronous history with Europe and the world, beyond punctual and scattered references in the monographic studies themselves.

San Millán: life, work and hagiographic sources

Millán —Emiliano, in his Latin form— was born in the year 473 in Berceo, in the neighborhood known as Madriz, in the bosom of a family of shepherds of Hispano-Roman origin (Virtual Library of La Rioja, n.d.; San Millán de la Cogolla Foundation, n.d.-a). Until he was twenty years old, he exercised the pastoral trade inherited from his father. According to St. Braulio in the Vita Sancti Aemiliani, a mystical dream showed him the way to the cliffs of Bilibio, near Haro, where St. Felices lived as a hermit, who instructed him for three years in the ascetic life. Millán then returned to the mountains of his native land and lived as a solitary anchorite for about forty years in the caves of the Sierra de la Demanda, devoted to penance, fasting and contemplation, following the model of the fathers of the desert. His reputation for holiness – linked to numerous miracles of healing and protection of the flocks – led Bishop Dídimo de Tarazona to ordain him a priest and to appoint him parish priest of Berceo, a position in which he distributed his goods among the poor. Retired again to the caves, he was joined by other disciples – Aselo, Gerontius, Cytonato, Sophronius, Oria and Potamia – with whom he formed, around the year 550, a first monastery in the place now occupied by the monastery of Suso (CVC, n.d.; San Millán de la Cogolla Foundation, n.d.-a).

Saint Millan died on November 12, 574, at the age of 101, and was buried on the floor of the oratory that he himself had built. He left nothing written. It was Saint Braulio, bishop of Zaragoza, who around the year 650 – based on the stories he had heard from his own brother Fronimiano, a monk in La Cogolla – wrote in accessible Latin the first biography of the saint, the Vita Sancti Aemiliani, structured in two large blocks: the ascetic life of the saint and the account of his miracles in life and postmortem.[26] This work would be glossed and expanded six centuries later by Gonzalo de Berceo —notary of the abbot of San Millán documented in the middle of the thirteenth century— in his poem in verse La vida de San Millán, the first great testimony of poetry in the Spanish language signed by a known author.

Tradition also places San Millán in the battle of Simancas (939), appearing mounted on a white horse in defense of the Christian troops of Count Fernán González against Abd al-Rahman III, an episode that – in parallel to the vow of Ramiro II of León to Santiago Apostol – is the basis for his proclamation as patron saint of Castile.[19,26] This legend, of great symbolic value, illustrates the central objective of this work: to understand an Emilian milestone requires understanding the political and military framework – the dispute between the Christian kingdoms of the north and the Caliphate of Córdoba – in which it is inserted.

The monasteries of San Millán de Suso and San Millán de Yuso

The monastery of Suso

The primitive monastery of San Millán de Suso ("from above", from the Latin sursum) has its origin in the Visigothic monastery carved into the rock where the saint lived and died. Its oldest nucleus – three small sanctuaries excavated in the stone – dates back to around the year 550, which makes it one of the oldest monastic complexes in Spain.[27,28] After the Muslim conquest of 711, the region was practically depopulated, inhabited only by hermits, while Millán's tomb became a focus of pilgrimage for Christian counts and kings who came to take care of it before their military campaigns. In the tenth century, Suso was inhabited by Mozarabic monks, from whose time date the horseshoe arch of its access door and the square chapels inside; the documents of consecration (959) and dedication (984) of the building are preserved.[20,21,28]

In its scriptorium, the Codex Emilianense 60 was elaborated during the ninth century, on which the famous Glosas Emilianenses would be added later, between the tenth and eleventh centuries, interlinear and marginal annotations in Latin, in a variety of Navarrese-Riojan Romance and in Basque, considered by a large part of Hispanic philology to be the oldest written testimony of a peninsular Romance language.[5,6,8,29] In 1977, a great institutional party was held in San Millán on the occasion of the millennium of the birth of the Spanish language, with the participation of authorities, linguists and academics.

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The monastery of Yuso

The royal monastery of San Millán de Yuso ("from below", from the Latin *deorsum*) is located in the valley, on the left bank of the Cárdenas River. Its foundation is linked to the legend of the miracle of the oxen: in 1053 King García Sánchez III of Nájera ("the one of Nájera") ordered the relics of San Millán to be transferred to the newly founded monastery of Santa María la Real de Nájera, but the oxen pulling the cart stopped without there being any way to make them move forward, a fact interpreted as a divine sign to build a new monastery in the valley in its place.[26,28] Although the exact date of the start of the works is not entirely certain, the church was consecrated in 1067, at which time the relics of the saint were definitively transferred to the main altar.[28]

This new establishment, of Benedictine affiliation, coexisted for a time with the primitive monastery of Suso, each with its own abbots, until around the year 1100 Suso disappeared as an independent institution and remained as a dependency of Yuso, who kept some monks for its care. Suso's desk thus had continuity in Yuso, from where numerous manuscripts come from that are preserved today, including the Codex Emilianense 60.[27,28]

With the passage of time, San Millán de Yuso became the most important monastery in the territory, both among the Benedictine houses and among those of other orders. By the sixteenth century it maintained its economic power despite the decline in the number of members of the community; the three-nave church dates from this period, with Corinthian columns and paintings by Juan Rizzi, and later the main altarpiece (Seventeenth century) and the Greco-Roman style choir. Its library, one of the most important in Spain due to the value and antiquity of its holdings – more than three hundred documents dated between the eleventh and fifteenth centuries, incunabula and codices from the twelfth and thirteenth centuries[19] – has been the subject of a digitization process that began in 2001 and has made it possible to digitize 169 books, with more than 87,000 images, and a periodical publication.[30]

The monumental complex of Suso y Yuso was declared a World Heritage Site by UNESCO on December 4, 1997,[1] a recognition that consolidated San Millán de la Cogolla as one of the enclaves of international reference for the study of the origin of the Spanish language, a role it currently plays, together with the International Center for Research on the Spanish Language (Cilengua), headquarters of the educational congress to which this communication is addressed.

Comparative historical contextualization: San Millán in his time and in the world

This section constitutes the core of the contribution of this work. In contrast to the usual linear story, a reading in concentric geographical "layers" is proposed: each relevant milestone in the history of San Millán and its monasteries is accompanied by the contemporaneous events – with a tolerance of a few years, typical of any comparative chronology – that took place in La Rioja and the corresponding peninsular kingdom, in Europe and in other regions of the world. Table 1 summarizes eleven chronological phases, from the birth of San Millán (473) to the most recent educational and philological projects (2024-2026); Figure 1 to 3 represent these same phases in the form of comparative timelines for direct use in the classroom.

Table 1 Comparative chronology of San Millán de la Cogolla and its monasteries with La Rioja, Spain, Europe and the world (own elaboration based on the sources cited in section 3.1)

Time / date	San Millán and the monasteries of Suso and Yuso	La Rioja and the kingdom (Navarre / Castile / Spain)	Europe	Other regions of the world
473–574 (sixth century)	Birth of Millán in Berceo (473); eremitical life with San Felices in Bilibio; ordination as a presbyter of Berceo by Bishop Didymus of Tarazona; retreat to the caves of La Cogolla; formation of a first monastery (c. 550) with Aselo, Gerontius, Cytonatus, Sophronius, Oria and Potamia; death on 12 November 574, at the age of 101.	Territory of ancient Cantabria, with resistance to Visigothic authority; the same year of his death (574) King Leovigild subdued the Cantabrians and Suebi and consolidated the Visigothic kingdom of Toledo.	476: Fall of the Western Roman Empire (Odoacer deposes Romulus Augustulus). 496-511: Clovis I converts the Franks to Catholicism. 493-526: Theodoric's Ostrogothic kingdom in Italy. 527-565: Justinian I, Corpus Iuris Civilis (529-534) and construction of Hagia Sophia (537). 529: Foundation of Monte Cassino by St. Benedict.	India: decline of the Gupta Empire. China: Northern and Southern dynasties, expansion of Buddhism. Japan: official introduction of Buddhism (552).
589–654 (7th century)	Around 650, Saint Braulio, bishop of Zaragoza, wrote the Vita Sancti Aemiliani based on the testimony of his brother Fronimiano, a monk in La Cogolla; the first written biography of the saint and the essential source of his cult.	Consolidation of Visigothic monastic life in Suso under the Spanish Rule; Braulio participates in the councils IV (633), V (636) and VI (638) of Toledo.	589: Recaredo's conversion to Catholicism (III Council of Toledo). 636: Saint Isidore of Seville, author of the Etymologiae, dies. 654: promulgation of the Liber Iudiciorum under Receswinth. 622: Hegira of Muhammad; 632: death of Muhammad; expansion of the Rashidun Caliphate (conquest of Jerusalem, 637; fall of the Sassanid Empire, 651).	China: Tang dynasty (founded in 618), cultural and commercial apogee. India: Harsha unifies the north of the subcontinent.

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Table 1 Continued.....

Time / date	San Millán and the monasteries of Suso and Yuso	La Rioja and the kingdom (Navarre / Castile / Spain)	Europe	Other regions of the world
711–800 (8th century)	After the Muslim conquest, the region was semi-depopulated; Suso subsists as a refuge for hermits and a focus of pilgrimage to the tomb of the saint, maintaining the Visigothic Rule.	722 – Battle of Covadonga, beginning of the Kingdom of Asturias (Pelayo), the beginning of the Reconquista in the north of the peninsula.	732 – Battle of Poitiers (Charles Martel stops the Muslim advance in France). 750 – The Abbasids overthrow the Umayyads and move the caliphate to Baghdad. 756 – Abd al-Rahman I founds the Emirate of Cordoba. 800 – Charlemagne is crowned emperor in Rome.	China: Chang'an, capital Tang, the most populous city in the world. 762: foundation of Baghdad. Mesoamerica: apogee of the Classic Maya civilization (Tikal, Copán).
884–984 (9th–10th century)	Consolidation of Suso as a monastic and cultural centre: documents of consecration (959) and dedication (984); in 964 the Codex Emilianense 46 was written, considered the first encyclopaedic dictionary of the Peninsula. The Codex Emilianense 60 was drawn up in the scriptorium during the ninth century.	Consolidation of the kingdom of Pamplona under Sancho Garcés I; border territory between the Christian kingdoms of the north and the Emirate/ Caliphate of Cordoba.	909-910: Foundation of the Abbey of Cluny, the driving force behind the Benedictine monastic reform. 911: Treaty of Saint-Clair-sur-Epte (Duchy of Normandy). 929: Abd al-Rahman III proclaims himself caliph of Cordoba. 939: Battle of Simancas (Ramiro II of León defeats Abd al-Rahman III); tradition places here the miraculous appearance of Saint Millan and his proclamation as patron saint of Castile. 962 – Otto I, crowned Holy Roman Emperor.	909: Foundation of the Fatimid Caliphate in Ifriqiya. 960: Foundation of the Song dynasty in China. West Africa: Apogee of the Ghana Empire.
IX–XI centuries (Glosses)	On the Codex Emilianense 60, between the tenth and eleventh centuries, the Glosas Emilianenses are added: interlinear and marginal annotations in Latin, Navarrese-Riojan Romance and Basque, considered the first written testimony of a peninsular Romance language (gloss 89, «the first valid of Spanish», C. García Turza, 2003).	The monastery, in the kingdom of Pamplona-Nájera, is consolidated as one of the great centers of production of codices in the Peninsula.	987 – Hugh Capet founds the Capetian dynasty in France. 1000 – Stephen I, first Christian king of Hungary. Millenarian fear associated with the year 1000; apogee of Ottonian art.	Around 1000: Viking expeditions to Newfoundland (Leif Eriksson). China: already widespread woodcut printing (Diamond Sutra, 868) and commercial splendor of the Song dynasty.
1053–1067 (11th century)	1053: King García Sánchez III of Nájera orders the relics to be transferred to Santa María la Real de Nájera; according to tradition, the oxen of the cart stop (founding miracle) and it is decided to build a new monastery in the valley, San Millán de Yuso. 1067: consecration of the church of Yuso and transfer of the relics to the main altar.	Fragmentation of Al-Andalus into kingdoms of Taifa's after the fall of the Caliphate of Cordoba (1031); territorial expansion of the Christian kingdoms of the north.	1054: Schism of East and West between Rome and Constantinople. 1066: Norman conquest of England (Battle of Hastings). Rodrigo Díaz de Vivar, "El Cid", is born around 1043. Gestation of the Gregorian reform that will lead to the Investiture Dispute.	1055: The Seljuk Turks take Baghdad. China: Improvement of printing with movable type (Bi Sheng, c. 1040-1050). Andes: Apogee of Tiwanaku and Chan Chan.
c. 1100 (twelfth century)	Around 1100 Suso ceased to function as an independent monastery and remained as a dependency of Yuso, which fully adopted the Rule of Saint Benedict; the scriptorium of Suso had continuity in Yuso.	Reign of Alfonso VI of León and Castile; 1085: Capture of Toledo, milestone of the Reconquest.	1096-1099: First Crusade and capture of Jerusalem (1099); consolidation of the Gregorian reform in the Latin Church.	China: improvement of the compass for navigation. Southeast Asia: heyday of the Khmer Empire (beginning of Angkor Wat, twelfth century).

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Table 1 Continued.....

Time / date	San Millán and the monasteries of Suso and Yuso	La Rioja and the kingdom (Navarre / Castile / Spain)	Europe	Other regions of the world
pp. XVI–XVIII	Yuso's economic heyday and the formation of its library (documents from the eleventh to the fifteenth centuries, incunabula, codices); construction of the three-nave church (sixteenth century) and the main altarpiece (seventeenth century), despite the decrease in the number of monks in the community.	Full integration into the Crown of Castile within the Spanish monarchy of the Habsburgs.	1492: Columbus arrives in America. 1517: Luther's Protestant Reformation. 1545-1563: Council of Trent. 1618-1648: Thirty Years' War and Peace of Westphalia. 18th century: European Enlightenment.	Apogee of the Ottoman Empire (Suleiman the Magnificent). European colonization of America. China: Ming and Qing dynasties.
1977	November 1977: great celebration in San Millán de la Cogolla of the Millennium of the birth of the Spanish language, on the occasion of the Glosas Emilianenses; participation of authorities, linguists and academics.	Spanish political transition after the death of Franco (1975); constituent process underway.	Cold War Middle; Spain not yet integrated into the EEC (accession in 1986).	1977: Launch of the Apple II, beginning of the popularization of personal computing.
1997	December 4, 1997: UNESCO declares the monasteries of San Millán de Yuso and Suso World Heritage Sites.	Autonomous consolidation of La Rioja within the State of the Autonomies.	Spain, a full member of the European Union since 1986.	1997: signing of the Kyoto Protocol; Hong Kong's handover to China; accelerated expansion of the Internet.
2001–2026	Since 2001: digitization of the San Millán Foundation collection (+87,000 images, 169 books). 2021-2023: projects "Pluma y Arroba" and "En torno a la Lengua" (Cilengua). 2024: critical edition of the Glosas Emilianenses and Silenses.	San Millán, an international reference for the origin of Spanish (Cilengua, Instituto Cervantes, RAE).	Digitization of European Cultural Heritage (Europeana).	2022-2026: Expansion of generative AI applied to education and digital humanities.

Overall reading of the comparative chronology

Table 1 and Figure 1-3 allow us to draw several conclusions of didactic interest. Firstly, the life of Saint Millan (473-574) takes place exactly in the period of the dissolution of the Western Roman Empire and the construction of the "barbarian" kingdoms of succession – the Frankish kingdom of Clovis, the Ostrogothic kingdom of Theodoric, the Visigothic kingdom of Hispania itself – and in parallel to the reign of Justinian in Byzantium, which allows students to place a saint from La Rioja in the same chronological framework as Hagia Sophia of Constantinople or the Corpus Iuris Civilis. Secondly, the wording of the Vita Sancti Aemiliani by San Braulio (c. 650) coincides almost exactly with the birth of Islam and the dazzling expansion of the Rashidun caliphate, which explains why, only sixty years later, the region of San Millán itself was directly affected by the Muslim conquest of the Peninsula.

Thirdly, the great philological milestone of the Glosas Emilianenses – the written birth of Castilian – occurs in the same chronological horizon in which Hugh Capet founded the dynasty that would rule France until the Revolution, in which Stephen of Hungary was crowned as the first Christian king of that country, and in which the Vikings reached the shores of Newfoundland, long before 1492. And, fourthly, the foundation of the monastery of Yuso (1053-1067) is almost exactly contemporaneous with the Schism of East and West (1054) and the Norman conquest of England (1066), two processes that are at the origin of the religious and political configuration of medieval Europe as we know it today. This simultaneity, invisible in a story compartmentalized by themes or by countries, becomes a powerful didactic resource when it is represented visually, as proposed in section 9.

From the local educational project to the international framework of heritage education and AI

Much of the recent impetus to transfer the history of San Millán de la Cogolla to the classroom comes from the Pluma y Arroba project (www.plumayarroba.com), a non-profit educational innovation initiative led by José Dulac Ibergallartu, which since 2020 has published annual collective volumes on educational innovation and in 2023 devoted a monograph to the site: Around Language: project based on San Millán de la Cogolla.[31]

Beyond this local experience, the international literature offers a more robust conceptual framework for the design proposed here. Research on historical thinking has shown that students learn history more effectively when they work with evidence, causality, change and continuity, and perspective-taking than when they memorize

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isolated facts.[2–4] In parallel, the TPACK model has established that the educational value of technology depends on its articulation with disciplinary content and pedagogical knowledge, rather than on the tool itself.[12,22]

In the specific field of heritage education, augmented reality and immersive environments have been used to reconstruct historical spaces and to connect students with material remains, although their impact depends on careful instructional design and on the teacher's mediation.[23,24] Recent reviews of artificial intelligence in education reach a similar conclusion: the effectiveness of AI tools is conditional on pedagogical integration, teacher training and critical review of their outputs.[13,14,32] This body of work constitutes the direct precedent and the main methodological reference for the proposal formulated in the following section.

Artificial Intelligence applied to the teaching of the history of San Millán

Based on the state of the art described in the previous section and the comparative chronology elaborated in section 7, a set of lines of work for the application of Artificial Intelligence to the teaching of the history of San Millán de la Cogolla and the monasteries of Suso and Yuso, specifically aimed at Secondary and Baccalaureate, is proposed below:

Generating Interactive Timelines

Generative AI tools can be used to build, from a list of Emilian milestones provided by the teachers, comparative timelines such as those in figures 1 to 3, automatically generating contemporary events in Europe and in the world and adapting the level of detail and vocabulary to the age of the students. This allows the activity to be personalized for 4th year of ESO (with more general and visual events) or for 2nd year of Baccalaureate (with greater density of data and historiographical nuances).

Historical chatbots and "interviews" with sources

Conversational models can be trained or instructed (by means of instructions or prompts carefully designed by the teachers, and always citing the real sources on which they are based) to simulate a "conversation" with St. Braulio of Saragossa about the elaboration of the Vita Sancti Aemiliani, or with a copyist monk of the scriptorium of Suso on the material conditions for the elaboration of a codex, thus favoring the empathic understanding of the historical context without replacing in any case the contact with the real primary sources, which must always be presented together with the activity.

Analysis and visualization of the Glosas Emilianenses

Language processing tools can help to visually compare the evolution from Latin to Castilian Romance through real examples taken from the Glosas Emilianenses,[8,29] connecting this linguistic transformation with the contemporaneous political processes – the fragmentation of Al-Andalus, the rise of the kingdom of Pamplona – described in Table 1.

Visual reconstructions and the didactic metaverse

Following the line opened by recent research on immersive heritage environments,[23,24] generative image AI can be used – with the rigorous supervision of teachers and avoiding any historical distortion – to produce visual recreations of the original Visigothic monastery, the medieval scriptorium or the Yuso construction process, as support for explanations that are otherwise very abstract for students.

Formative assessment through adaptive questionnaires

Finally, AI allows the generation of self-assessment questionnaires adapted to the level of each student on the comparative chronology, specifically reinforcing the understanding of historical simultaneity – the true didactic objective of this work – and not only the memorization of isolated dates.

In all cases, an inalienable methodological principle must be maintained, as recent research on artificial intelligence in education has repeatedly stressed:[14,32] AI should be understood as a didactic mediation tool that facilitates access to sources and their contextualization, never as a substitute for historiographical rigor or primary sources and specialized bibliography on which this work is based.

Discussion

The results presented confirm that the history of San Millán de la Cogolla and its monasteries, far from being a local or peripheral episode, is constantly intertwined with the great processes of European and world history: the fall of Rome, Islamic expansion, the monastic reform of Cluny, the Schism of 1054, the Norman conquest or the first crusade. This finding coincides with what has been pointed out by the general historiography of the High Middle Ages of the peninsula,[9–11] which underlines the full insertion of the Christian kingdoms of the north of the peninsula in the European dynamics of their time, and reinforces the value of San Millán as an ideal "laboratory" for the teaching of comparative history.

At the same time, the work highlights the limits of all comparative chronology: the dating of many early medieval milestones —the very beginning of Yuso's works, the exact dating of the Glosas Emilianenses or the precise origin of Suso's monastery— is the subject of historiographical debate (Díaz y Díaz, 1979),[27–29] so that the proposed chronological correspondences should be understood as reasonable approximations at the service of didactic understanding, and not as exact synchronicities verified with absolute precision.

Regarding the use of Artificial Intelligence, the international evidence on educational technology and AI suggests that the key to success does not lie in the technology itself, but in its integration within a solid didactic sequence, supported by primary sources and the critical review of teachers, as recent research has stressed.[13,14,32] The proposal made in section 9 should, therefore, be the subject of piloting and evaluation in future editions of this same congress Annex.[33–38]

Conclusion

I. San Millán de la Cogolla and the monasteries of Suso and Yuso condense almost fifteen hundred years of continuous history, from the eremitical life of the saint (473-574) to the declaration of World Heritage Site (1997) and the current digitalization and educational innovation projects.

II. The synchronous contextualization of each Emilian milestone with the contemporary events of La Rioja, Spain, Europe and the world —systematized in Table 1 and in Figures 1-3 of this work— constitutes a didactic resource of great value, barely exploited until now in the available bibliography.

III. Episodes such as the birth of Saint Millán, the writing of his biography by Saint Braulio, the writing of the Glosas Emilianenses or the foundation of the monastery of Yuso are almost exactly contemporaneous with European and world processes of the first order – the fall of Rome, the Islamic expansion, the Schism of 1054 or the Norman conquest – which

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allows the local history of La Rioja to be integrated into the great stories of general history.

IV. The integration of heritage education, historical thinking and artificial intelligence, within a solid didactic sequence and under the critical supervision of teachers, constitutes the most solid methodological basis currently available to transfer this approach to the classroom.[2,12,14]

V. Artificial Intelligence offers specific tools – generative timelines, historical chatbots, linguistic analysis of the Emilian Glosses, visual recreations and adaptive evaluation – to reinforce the understanding of historical simultaneity, always subordinated to the rigor of primary sources and specialized bibliography.

VI. It is recommended that future educational congresses on San Millán de la Cogolla incorporate pilot classroom experiences that allow the real impact of these tools on students' understanding to be evaluated.

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Conflicts of interest

The author declares there is no conflict of interest.

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