



Mathematics Books and the Motivations of Their Authors in 18th-Century Spain

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Abstract

This research examines the motivations of authors of mathematics books published in Spain during the 18th century through a comprehensive analysis of a corpus of seventeen representative works. The prologues and introductory discourses of these manuals are analysed using a historical-documentary approach to ascertain the objectives declared by their authors and to establish a connection between these objectives and the various types of mathematical production from that period. The results reveal a tripartite structure in authorial motivations: a didactic orientation, associated with elementary teaching and constituting the majority group; a professional or technical motivation, linked to mathematics applied to trades and to military or administrative institutions; and a social or moral motivation, related to Enlightenment ideology and the formation of the rational citizen. The graphical analysis of these correspondences demonstrates a historical progression from school mathematics towards applied mathematics and, to a lesser extent, towards a moralising discourse on its usefulness for social progress. This study contributes to understanding the educational role of mathematical manuals in Enlightenment Spain and provides a foundation for future research on the history of mathematics textbooks. This study contributes to understanding the educational role of mathematical manuals in Enlightenment Spain and provides a foundation for future research on the history of mathematics textbooks.

Keywords: *History of Mathematics Education; Mathematics Textbooks; 18th Century; Authorial Motivations; Spain*

Introduction

Reflection on the value and relevance of incorporating the history of mathematics into the teaching of this discipline has been developing for many decades. This interest is not new: in the United Kingdom, references and guidelines concerning the use of history in mathematics education have

appeared, though irregularly. in various official National Curriculum documents for more than a century. This intermittent presence reflects, on the one hand, the persistent perception that the historical dimension of mathematics can enrich understanding of the discipline and, on the other, the shifts in educational priorities that have influenced the greater or lesser visibility of this approach over time (Clark, 2014).

The relationship between the history of mathematics and mathematics education has been highlighted by several authors. Freudenthal (1981) argued that teachers require an “integrated knowledge” that links the historical development of mathematical ideas with educational practice. Understanding the origins of concepts and the difficulties encountered at various historical periods can enrich teaching and enhance students’ intellectual development. It should not be overlooked that the history of mathematics, as a component of students’ cultural formation and as a perspective that views mathematical inquiry as part of their cultural heritage – both generally and within the scientific domain – has become increasingly significant as we recognise the central and formative role that culture as a whole plays (Fried, 2014).

This perspective has consolidated a specific field of research: the historical study of mathematics manuals and textbooks. The importance of these studies lies in the fact that textbooks are an essential source for analyzing a society’s mathematical culture. Manuals not only transmit content but also reflect curricular priorities, pedagogical values, social expectations, and epistemological transformations (Kilpatrick, 2014; Schubring, 1987). They also make it possible to observe how mathematical knowledge is reorganized as it adapts to different audiences and educational levels (Fan et al., 2018).

In the international context, Schubring (1987) analysed mathematics textbooks used in Prussia during the eighteenth and nineteenth centuries, examining secondary school and technical academy students. He concluded that these texts played a decisive role in standardising teaching and establishing pedagogical authority. In Western Europe, Furinghetti and Radford (2008) studied algebra treatises produced between the seventeenth and nineteenth centuries and demonstrated that many textbooks included justificatory narratives linking mathematics to Enlightenment values such as progress and rationality.

In the case of the Iberian Peninsula, Pimentel (2001) analyzed Portuguese textbooks for merchants from the eighteenth and nineteenth centuries, concluding that applied arithmetic was essential for the efficiency of colonial trade. In the Latin American context, several studies have highlighted the ways in which mathematics education and the production of school textbooks were closely linked to the administrative, economic, and technical needs of each territory. Carvalho (2014), in his historical analysis of mathematics education in Latin America, demonstrated that the mathematical content introduced in schools and academies responded to emerging demands related to trade, cartography, teacher training, and the consolidation of national educational systems.

Complementarily, Valente (2010) examines the Brazilian case and demonstrates that the dissemination of practical arithmetic and textbooks for teacher training was directly linked to processes of professionalisation and the adoption of European teaching models adapted to local contexts. These studies confirm that Latin American mathematics texts played a central role in shaping educational practices and circulating scientific knowledge in the region. In Spain, González Redondo (2003) examined textbooks used in the training of engineers in the nineteenth century and demonstrated the strong connection between mathematics and technical professionalisation. Moreover, studies focused on paratexts (Maz-Machado & Rico, 2009, 2015; Oller-Marcén & Muñoz-Escolano, 2019) have revealed that prefaces and warnings are key to understanding the educational intentions of the authors.

The Spanish eighteenth century, marked by the Enlightenment and Bourbon reformism, constitutes a particularly relevant context for this type of analysis. At that time, the teaching of mathematics was regarded as an essential tool for the advancement of knowledge and the modernization of the country. This motivated many authors to dedicate their efforts to the creation of books that not only transmitted knowledge but also facilitated its practical application in daily life and in the most dynamic economic activities of the period.

The growing demand for professionals trained in commerce, navigation, military engineering, and surveying led to the emergence of numerous mathematics textbooks aimed at different audiences. However, many of the authors who contributed to this dissemination remain little studied. Analysing their works provides a better understanding of how mathematical literacy expanded in Spain, how it was aligned with social and economic needs, and how it contributed to the Enlightenment project of modernization.

This study examines seventeen mathematics works published between 1714 and 1797 by Spanish authors from diverse backgrounds. Its analysis complements previous studies on eighteenth-century arithmetic (Maz-Machado et al., 2023) and helps to interpret the evolution of authorial motivations, the impact of professional contexts, and the significance of these texts in the technical and educational modernization of Enlightenment Spain.

Regarding the history of mathematics applied to teaching, Freudenthal (1981) emphasises that teachers must understand the historical development of knowledge in order to identify epistemological difficulties and enrich their professional practice. This idea has been adopted and expanded by numerous authors who advocate a historical-critical approach to mathematics education. Studies on textbooks argue that they constitute a privileged object for analyzing the articulation of mathematical knowledge and its institutionalization in schools (Kilpatrick, 2014; Fan et al., 2018). Their analysis enables for the identification of curricular priorities, epistemological transformations, and links between mathematics, society, and the economy.

The international literature on mathematics textbooks provides many examples. Schubring (1987), analysing the Prussian school population of the eighteenth and nineteenth centuries, demonstrated how textbooks contributed to the standardisation and formalisation of teaching. Furinghetti and Radford (2008), in their study of European algebra texts from the seventeenth to nineteenth centuries, demonstrated that authors used paratexts to justify the inclusion of specific content and to construct a cultural identity for the discipline. In the Iberian context, Pimentel's (2001) study revealed that textbooks aimed at merchants or surveyors responded to concrete professional needs, integrating contextualized problems and promoting economic development.

In Spain, the studies by Maz-Machado and Rico (2009, 2015) analyze paratexts in eighteenth- and nineteenth-century mathematics textbooks, demonstrating that prefaces function as spaces of negotiation between authors, readers, and authorities. Madrid et al. (2019) conducted a historical analysis of eighteenth-century mathematics textbooks, employing content analysis to examine the development of the concept of the equation in Spanish books. Furthermore, Muñoz-Escolano and Oller-Marcén (2020) corroborate these findings by demonstrating how authors explicitly state their pedagogical intentions and justify the necessity of their works. Madrid et al. (2017) analyze the examples used in sixteenth-century textbooks and their relationship to the everyday situations of the period.

This theoretical corpus underscores the importance of examining Spanish eighteenth-century mathematics textbooks: these texts allow for the observation of the intersection between technical training, numerical literacy, professional interests, and Enlightenment projects of modernization.

Methodology

This study employs a qualitative and documentary approach, based on the historical analysis of primary and secondary sources. Its aim is to examine the motivations expressed by the authors of mathematics works published in Spain during the eighteenth century and to establish the relationship between their professional contexts and the didactic or practical purposes of their texts.

The search for these works was carried out in Spanish open-access digital repositories and libraries, prioritising collections that preserve printed holdings from the seventeenth and eighteenth centuries. In particular, the Biblioteca Digital Hispánica (managed by the National Library of Spain), the Biblioteca Virtual del Patrimonio Bibliográfico (BVPB), and the institutional repositories of Spanish universities (such as those of Córdoba, Salamanca, Valladolid, Granada, and Valencia) were consulted. These platforms provide facsimile copies, catalogue records, and metadata that ensure the authenticity of the editions examined.

The process of searching for and delimiting the corpus was supported by previous bibliographic research quantifying eighteenth-century Spanish mathematical production. Arenzana (1987) carried out the first systematic count, noting that approximately 170 mathematics works were published in Spain between 1700 and 1809. This information provides an overview of the publishing scale of the period and situates the works analysed here within a context of significant scientific and educational dynamism. More specifically, Maz-Machado et al. (2023) identified fifty arithmetic books published between 1700 and 1800, held in the National Library of Spain, the Biblioteca Virtual Miguel de Cervantes, the Digital Library of Madrid, and various university repositories. These findings confirm the importance of arithmetic as a fundamental discipline in Spanish mathematical culture during the Enlightenment.

The primary corpus analysed in this study comprises seventeen mathematics works published between 1714 and 1797, selected for their representativeness and inclusion of paratexts – prefaces, warnings, or dedications – that enable the identification of authorial motivations. The works were classified by author, year of publication, profession, stated purpose, and thematic orientation (basic training or technical application).

The analysis of the seventeen selected works was carried out using a critical reading methodology focused on paratexts, in line with Genette's theory (1987), which considers these elements as spaces of mediation between author and reader. Prefaces and warnings were examined to identify the stated motivations (pedagogical, professional, social, or institutional) and their connection to the publication contexts.

In order to facilitate the interpretation of the results, the works were organised chronologically into three periods: early years (1714–1763), intermediate years (1764–1785), and late years (1786–1797). This temporal classification enabled observation of the evolution of educational objectives and the increasing shift from basic instruction to practical applications and technical training. The data were systematised using summary tables and descriptive charts reflecting general trends in eighteenth-century Spanish mathematical production.



Figure 1. Front covers of some of the books analyzed

Results

The temporal development demonstrates a gradual shift from basic instructional texts to increasingly applied and technical treatises, reflecting the growing social integration of mathematics during the Spanish Enlightenment.

In the first period (1714–1763), texts focused on elementary instruction predominate. The authors, mainly teachers and clergymen, declare in their prefaces that their aim is to facilitate the learning of arithmetic and geometry for beginners. These works are notable for their progressive structure, use of simple numerical examples, and the emphasis on linguistic clarity. There is a clear interest in addressing the lack of accessible textbooks and in providing teaching materials for schools and seminaries. This type of production corresponds to what Arenzana (1987) described as an initial expansion phase, during which school mathematics began to consolidate as a distinct discipline within the Spanish educational system.

In the second period (1764–1785), a significant shift in the orientation of the works is evident. The texts increasingly address professionals and technical trades, such as merchants, surveyors, sailors, and accountants. The motivations expressed in the paratexts emphasise the practical utility of mathematical knowledge for economic and occupational purposes. The emergence of manuals on “commercial arithmetic” or “practical geometry” demonstrates that mathematics was regarded not only as part of intellectual formation but also as a tool for commercial efficiency and improved administration. This trend corresponds with the reformist context of the reign of Charles III, marked by the promotion of technical academies and professional training schools.

In the third period (1786–1797), mathematical production reflects a process of intellectual maturity and technical specialisation. The authors are often military officers, architects, or engineers, and their works address the application of geometry, trigonometry, and calculus to specific fields such as fortification, navigation, and architecture. The prefaces of these works convey a modern vision of teaching, focused on training competent professionals and improving public instruction. Additionally, there is an explicit intention to contribute to social progress through the dissemination of mathematical knowledge, an ideal fully consistent with Enlightenment discourse.

Taken together, the results indicate an increasing diversification of Spanish mathematical production during the eighteenth century. According to Arenzana’s (1987) overall estimate, around 170

mathematical works were published in Spain between 1700 and 1809. The analysis by Maz-Machado et al. (2023) confirms that, within this corpus, 50 works are specifically devoted to arithmetic, highlighting the centrality of this discipline in both school and professional training at the time. The corpus analysed here—17 works representative of that broader set – reflects the same trend: 47% are elementary texts, 35% are works applied to professional contexts, and 18% are advanced technical treatises.

Based on the sample examined, eighteenth-century mathematical production demonstrates clear thematic and functional diversification, which can be organised into four major analytical categories derived from features identified in the prefaces, introductory notes, and contents of the works.

a) Basic or formative instructional works

This group includes manuals intended for elementary teaching of arithmetic and geometry, characterised by accessible language, gradual structure, and an explicit educational purpose. The authors – teachers, clergymen, or primary school instructors – conceive mathematics as a tool for intellectual and moral literacy. Approximately 47% of the corpus belongs to this category, represented by works such as those by Cortés (1714) and Aznar de Polanco (1727). These works align with what Arenzana (1987) identifies as the initial phase of the institutionalisation of mathematics education in Spain.

b) Professional or technical application works

In the second half of the eighteenth century, manuals related to occupational contexts and specialised trades, such as commerce, navigation, or surveying, began to appear. These texts combine theoretical content with practical problems, and their authors are often sailors, accountants, or surveyors. Approximately 35% of the works analysed fall into this category. The paratexts emphasise the economic utility of mathematical knowledge and its role in the rationalisation of productive tasks. Representative examples include the treatises by Echevarría (1758) and Hualde (1776), which integrate geometry and trigonometry into technical training.

c) Advanced technical and scientific training works

These works, produced in the final decades of the century, were written by engineers, architects, or military officers and display a more specialised focus. They include content on applied geometry, fortification, trigonometry, or calculus, aiming to support the technical modernisation of the State. They make up approximately 18% of the corpus. Authors such as Verdejo González (1795) and Romero y Serrano (1797) regard mathematics as strategic knowledge, indispensable for administration and engineering, in keeping with Bourbon reforms and Enlightenment ideals.

d) Works of a moral or institutional nature

A small subset of texts, comprising less than 10% of the total, explicitly conveys an ethical or formative dimension of mathematics teaching. The authors – often clergymen – advocate the moral utility of studying arithmetic and geometry to cultivate orderly reasoning and civic virtues. Examples such as Cordero (1737) and Serrano (1793) link mathematics with the pedagogical ideals of Christian Enlightenment, reinforcing its role as a discipline that shapes both mind and moral character. The coexistence of these categories confirms a gradual evolution in the role of mathematics in eighteenth-century Spain: from a pedagogical and moral function, tied to literacy and basic instruction, to a pragmatic and professional function, associated with the country's economic, technical, and scientific development.

These typologies correspond to the findings of Maz-Machado et al. (2023), who emphasise the expansion of mathematical knowledge as an expression of modernity. In this regard, the works analysed provide tangible evidence of the Enlightenment effort to integrate education, technical expertise, and rationalist morality into a single project of social progress.

Table 1.
Authors' motivations according to their profession

Grouping by profession	Author	Motivation
Teachers and educators	Diego Narciso Herranz y Quiroz; Francisco Cassany; Lucas María Romero y Serrano; Francisco Xavier García; Juan Antonio González Cañaveras	The motivations focus on providing clear and accessible educational resources to facilitate student learning, both at basic levels and in specific areas of mathematics.
Mathematicians and scientists	Gerónimo Cortes; Claudio Aznar de Polanco; Francisco Verdejo González; Antonio Gregorio Rosel y Viciano	They emphasize the improvement of educational quality and the simplification of complex concepts to make them more accessible.
Clergy	Joseph Biel; Manuel de Hinojosa; Miguel de Jesús María Hualde; Manuel de Zubiar y Eizaga; José Ventura Cordero	They are often motivated by instruction and service to the community, with an emphasis on accessibility and clarity in the teaching of mathematical concepts.
Technical professionals	Francisco de Bareda; Xavier Ignacio de Echevarria	Their motivations tend to be practical, focusing on the application of mathematical knowledge in their respective professional fields.
Others	Felix García de la Fuente	They are interested in improving efficiency and clarity in their areas of work, such as accounting.

Author's motivation according to the purpose of the work

The analysis of the paratexts, prefaces, dedications, and warnings makes it possible to identify a broad set of motivations that guided the production of mathematical works in eighteenth-century Spain. These motivations, explicitly expressed by the authors, reveal both the pedagogical purpose of mathematics education and its growing connection to professional interests and aspirations for social progress. In general, the justifications can be grouped into three main dimensions: didactic, professional-practical, and social or institutional.

Didactic motivations are the most common reason authors give for publishing their works. Most texts present themselves as tools designed to improve the teaching and learning of mathematics, particularly arithmetic. The authors state their intention to provide clear, systematic materials suited to beginners, aiming to facilitate understanding and address deficiencies found in earlier manuals. The emphasis on clarity, order, and pedagogical usefulness reflects the Enlightenment ideal of accessible knowledge, according to which education should reach a wider public, extending beyond academies and

seminaries. In many cases, authors seek to address the scarcity of manuals in the Spanish language or to improve the quality of instruction through comprehensible language and graduated exercises. These motivations, predominant in works published in the first half of the eighteenth century, reveal the pedagogical and reformist character of the mathematical literacy promoted during the period.

Secondly, motivations of a professional or practical nature are identified, becoming more prominent in the second half of the eighteenth century. In these works, mathematics is presented as knowledge applicable to concrete problems in commerce, navigation, surveying, and engineering. The authors justify publishing their texts by appealing to the need to provide calculation and measurement tools useful for professional practice and economic management. Thus, commercial arithmetic, practical geometry, and nautical trigonometry are presented as essential instruments for labour efficiency and the improvement of public administration.

This motivation reflects the progressive integration of mathematics into economic and professional life and demonstrates a transition from theoretical instruction to a functional and utilitarian conception of scientific knowledge. Ultimately, it represents a mathematization of everyday practices, consistent with the Enlightenment ideal of the rationalisation of work and the utility of knowledge.

Lastly, although to a lesser extent, motivations of a social, institutional, or moral nature also appear. In these cases, authors emphasise the formative value of mathematics as a means to cultivate reasoning, intellectual discipline, and civic virtues. Mathematical learning is presented not only as a vehicle for instruction but also as a moral exercise that strengthens the mind and contributes to social order. Some authors highlight the importance of mathematics for the collective progress of the nation and for the education of rational and virtuous citizens.

In other instances, publication is justified by institutional commissions, such as those issued by academies, seminaries, or military schools, revealing the growing incorporation of mathematics education into the educational and political structure of the Bourbon state. These motivations express the ethical and social dimension of the Enlightenment, in which science and education are conceived as instruments of moral improvement and the consolidation of rational order.

Taken together, the didactic, professional, and social motivations reflect a transformation in the cultural role of mathematics during the eighteenth century. What was once knowledge reserved for school and religious training evolved into learning with technical, economic, and civic implications. The authors of mathematical manuals thus appear as mediators between scientific knowledge and the practical needs of society, and their works serve as a testament to the Enlightenment effort to integrate education, labour, and virtue into a unified project of progress.

By establishing the correspondences between the categories, the authors, and their motivations, we obtain Figure 2, which demonstrates a clear distribution of the seventeen eighteenth-century mathematical works analysed, allowing us to see how the authors cluster around different motivations and types of production. In the lower left area is the greatest concentration of works, corresponding to instructional manuals with primarily didactic motivations. These texts are intended for elementary teaching, aimed at students or self-taught readers, and are designed to facilitate access to arithmetic, geometry, and basic mathematical foundations through clear explanations and elementary exercises. Within this group, there is a predominance of schoolteachers, members of the clergy, and authors connected to the educational sphere, confirming that a substantial portion of the mathematical works printed in eighteenth-century Spain addressed basic educational needs.

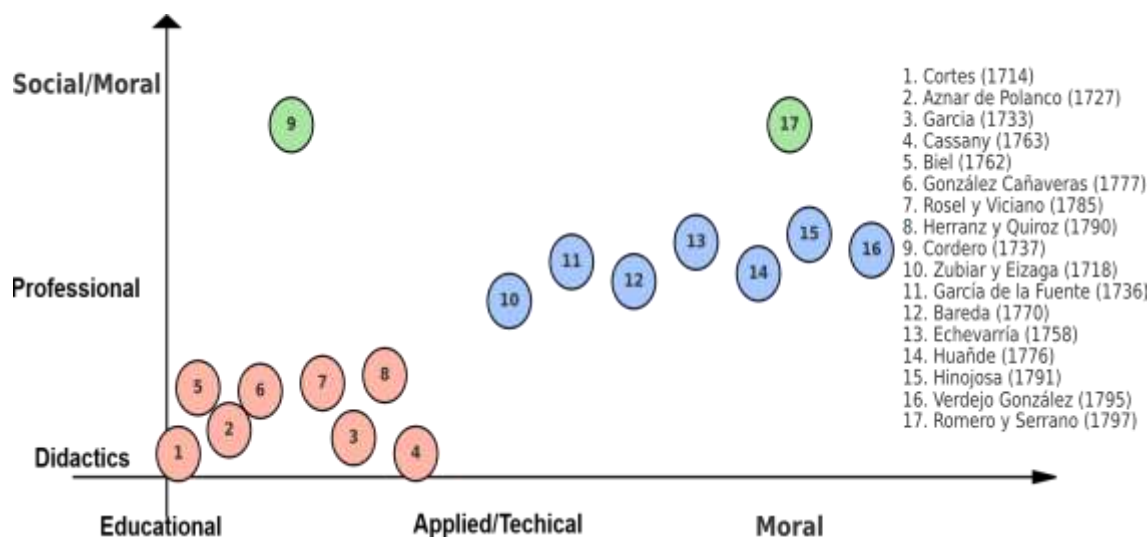


Figure 2. Correspondence between categories, authors, and motivations.

Towards the centre of the graph, a clearly defined cluster of applied or technical works emerges, predominantly motivated by professional concerns. In these texts, the authors regard mathematics as a set of indispensable tools for performing specialised occupations, from land surveying and commerce to navigation, practical geometry, artillery, and military architecture. The visualisation reveals a particularly consistent grouping: works in this category align along the horizontal axis, reflecting their applied orientation, and in the intermediate band of the vertical axis, corresponding to professional motivation. This pattern highlights a sector of mathematical production closely linked to the practical needs of the Bourbon state, engineering, and administration, and confirms that, throughout the eighteenth century, a type of manual aimed at executing technical and operational tasks with precision and efficiency became firmly established.

In the upper section of the graph, two cases display distinctly social or moral motivations. Unlike the others, these works are not justified solely by educational or professional needs; instead, they incorporate a broader discourse aligned with Enlightenment thought. In these texts, mathematics is presented as a means of fostering rationality, intellectual discipline, and societal progress. These authors form a small yet significant group that links mathematical instruction with civic, moral, and institutional purposes, indicating that, towards the end of the century, some writers conceived the discipline as part of a broader project of cultural and social reform.

The overall configuration of the graph reveals an interpretive diagonal suggesting a historical progression from elementary mathematics to applied mathematics and, in some cases, to a form of mathematics with a moral or social dimension. In the early decades of the century, didactic texts predominate; in the middle of the century, technical treatises gain prominence; and towards the end, works appear that articulate the value of mathematics in relation to the education of the enlightened citizen. This arrangement reveals a tripolar structure in eighteenth-century mathematical production: a predominant pedagogical pole, an expanding technical pole, and a minority social-moral pole with a noteworthy symbolic function. The combination of these three axes reflects a diverse mathematical culture in which the discipline simultaneously fulfils educational, practical, and civic functions, capturing the complexity of the Spanish Enlightenment.

Conclusions

The results demonstrate a sustained evolution from basic instructional works, focused on the elementary teaching of arithmetic and geometry, to works of professional and technical application, and finally to specialized scientific treatises. This progression indicates that mathematics became a tool of practical utility and an essential component of Enlightenment technical culture. Such a transformation aligns with the broader modernization efforts that characterized Bourbon Spain and with educational policies that promoted the teaching of disciplines useful for commerce, engineering, surveying, and navigation.

A comparative analysis with other European and Ibero-American contexts, particularly the studies by Schubring (1987), Furinghetti and Radford (2008), Carvalho (2014), and Valente (2017), situates the Spanish case within an international trend of institutionalizing mathematics education and expanding the readership. Although the Spanish development was slower and reliant on individual initiatives, the manuals studied here share the same pedagogical and social ideals: clarity, utility, progress, and rationality.

From a historiographical perspective, this study contributes to revaluing the role of eighteenth-century Spanish authors in the construction of a modern mathematical culture. Their works, many of them forgotten or little studied, constitute a testimony to the circulation of scientific knowledge during a period of transition between scholastic tradition and modern science. Moreover, they prove that the teaching of mathematics responded not only to formative purposes but also to projects of economic and social transformation.

A future direction will be to expand this analysis by incorporating larger corpora, including manuals on algebra, geometry, and calculus, as well as works translated or adapted from European authors. Furthermore, it is necessary to establish the relationship between mathematics and other Enlightenment disciplines, such as physics or architecture, and to explore their influence on nineteenth-century education. This study confirms that the history of mathematics textbooks constitutes a privileged avenue for understanding the interaction between knowledge, society, and education, and provides a valuable framework for reflecting on the origins of contemporary mathematics education.

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