

The Role of Mathematics in Spanish Military Education in the 1750's: Two Transient Cases

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Résumé : Vers la fin des années 1750, une Académie de Mathématiques fut créée au sein de l'Académie Militaire de la Garde du Corps à Madrid, dirigée par Pedro Padilla (1724-1807?) jusqu'à sa fermeture en 1760. En 1753, Padilla commença à publier son *Cours Militaire de Mathématiques* (1753 - 1756) pour l'usage de cette Académie. Le besoin de textes mathématiques en espagnol dans le domaine militaire a conduit à la création en 1757 de la Société Royale Militaire de Mathématiques à Madrid sous la direction de Pedro de Lucue (1692-1779), lui aussi directeur de l'Académie Militaire de Mathématiques de Barcelone depuis 1738. Les membres de la Société ont été chargés de l'élaboration d'un cours complet dans lequel les mathématiques étaient considérées comme essentielles à la formation militaire des officiers artilleurs et des ingénieurs militaires. La Société, supprimée en 1760, a réussi à réunir une excellente bibliothèque scientifique et technique servant à son tour à fournir des futures bibliothèques militaires. Le but de cette contribution est d'explorer et de comparer la manière dont l'étude des mathématiques a été abordée dans ces deux cas.

Abstract: Toward the end of 1750, an Academy of Mathematics was established within the Military Academy of Royal Guards of Madrid that was managed by Pedro Padilla (1724-1807?) until it closed in 1760. In 1753, Padilla authored and published his *Military Course of Mathematics* (1753-1756) for

the specific use by this Academy. The further need for mathematical texts in Spanish for military training coursework led to the founding of the Royal Military Society of Mathematics of Madrid in 1757 under the direction of Pedro de Lucuce (1692-1779), the headmaster of the Barcelona Military Academy of Mathematics since 1738. The members of this Society were entrusted with producing a comprehensive course program in which mathematics was considered and presented as essential to training of military engineers and gunners. The Society of Mathematics was dissolved in 1760 but had succeeded in building an extensive scientific and technical book depository that later served as a valuable resource supplying other military libraries. The aim of this contribution is to explore and compare how the study of mathematics was approached in these two cases.

1 Introduction

In 1711, the first Bourbon King of Spain, Philip V (1683-1746) approved the establishment of the Spanish Corps of Military Engineers. This corps was initially conceived by the Engineer General Jorge Próspero de Verboom (1667-1744) to promote the development of scientific activity for the purpose of modernizing Spain supporting the country's defense and protecting its trade activities [Galland Seguela 2008]. The military engineer was to be a specialist in scientific matters, military engineering, drawing, architecture and mathematics. This new professional could potentially be granted a double promotion, both in the military rank and in their engineering career.

As a direct consequence, the Royal Military Academy of Mathematics of Barcelona was founded in 1720 to provide scientific knowledge for military and technical training.¹ The Military Academy of Mathematics of Barcelona was ruled by royal ordinances [*ordenanzas reales*] that established the topics to be taught each academic year, outlined how they should be taught and designated the staff overseeing coursework. Two additional military academies were founded in Ceuta (1732) and Oran (1739) along the North coast of Africa, which followed the model of regulations established by what was considered the lead academy in Barcelona.

Pedro de Lucuce y Ponce (1692–1779) was appointed headmaster of the Military Academy of Mathematics of Barcelona for the periods 1738-1756 and 1760-1779.² During the time in between, he acted as director of the

1. In general, the teaching of mathematics at the Royal Military Academy of Mathematics of Barcelona has been largely studied in [Riera 1975], [Capel, Sánchez *et al.* 1988], [Muñoz Corbalán 2004], [Massa-Esteve, Roca-Rosell *et al.* 2011], [Massa-Esteve 2014].

2. On Pedro de Lucuce and his works, see [Ceballos, Núñez *et al.* 2013].

Royal Military Society of Mathematics, as we will discuss later. In 1739 a royal ordinance established regulations with the view of developing a general course program for military training. The headmaster in Barcelona chose the most useful treatises for each subject to then produce notebooks, which were later dictated by the assistants and copied down by the students, not only in Barcelona, but also in the academies of Ceuta and Oran. Following this ordinance, in 1739 Lucuce began working on his mathematical course for military training [*Curso Mathematico para la Instrucción de los Militares*]. This course, completed in 1744, consisted of eight treatises on the main fields of Mathematics, including pure mathematics (arithmetic and geometry) and mixed mathematics (cosmography, statics, hydraulics, architecture, artillery, and fortification).

While it would never be published, Lucuce's course was used in the context of the Academy of Barcelona for over forty years and was effectively preserved in the students' notebooks of the time.³ It is for this reason that in the present work, we consider Lucuce's course work as a landmark of unity, albeit one that could theoretically be regarded somewhat superficial given the fact that a number of reformist initiatives emerged that were largely supported by Zenón de Somodevilla (1702 – 1781), the 1st Marquis of Ensenada. First as Minister of Finance, War, Navy and the Indies (1743-1746), chosen by Philip V, and then as Chief Minister (1746-1754) under the kingdom of Ferdinand VI (1713-1759), the Marquis of Ensenada envisaged launching the ambitious project of overhauling and modernizing training programs within both the Army and the Navy.⁴ As part of his reforms in the 1750's, several new military academies for scientific and technical training were established, among which are the following two cases that are the focus of this study. The first is the Academy of Mathematics that was founded in 1750 as a part of the Military Academy of Royal Guards (*Cuartel de Guardias de Corps*). This Academy was governed by the same regulations as the Military Academy of Mathematics of Barcelona until its closure in 1760. During the period from 1753-1756 Pedro Padilla y Arcos (1724-1807?), the Academy's headmaster until it was dissolved, published a military course of mathematics for the specific use by this Academy. The need for mathematical texts in Spanish for the purpose of military training led to the creation in 1756 of the second case studied in this paper: the Royal Military Society of Mathematics (1757-1760) that was directed by Pedro de Lucuce.

The aim of this paper is to explore how the study of mathematics was approached in these two transient cases of military training contexts, to

3. For a thorough account of such notebooks and, in general, of the mathematical aspects of Lucuce's course, see [De Mora & Massa-Esteve 2010], [Massa-Esteve, Roca-Rosell *et al.* 2011].

4. Between 1751 and 1756 the Marquis of Ensenada had planned to allocate more than 55% of the State budget to the Army and 18% to the Navy [Galland Seguela 2008, 71].

compare how each institution integrated Pedro Lucuce's course into their mathematics curriculum and to identify specific aspects of unity and disunity.

2 Pedro Padilla and the *Military Course of Mathematics* (1753-1756)

In 1717 Philip V established the Military Academy of the Royal Guards of Madrid, mirroring the French *garde du corps du roi*. Intended mainly for noblemen, it was an elitist institution where all members held the rank of officers and benefitted from substantial privileges.⁵ Towards the end of 1750, an Academy of Mathematics was created within the Academy of the Royal Guards under the patronage of the Marquis of Ensenada. Chief Minister at the time, Ensenada undertook several initiatives to improve and standardize the level of scientific knowledge integrated into military training. Among other projects, the Marquis of Ensenada encouraged the production of educational works in Spanish that would raise the level of education in a more uniform manner across all military academies [Capel, Sánchez *et al.* 1988, 161].

Despite being a rather small academy (with around fifteen students per year, one headmaster and two assistants), the financial budget of the Academy of Mathematics was much higher than that granted to other larger academies, a fact made evident by its extensive library.⁶ Closure of the Academy in 1760 was most likely due to budget cuts.⁷

Up until that point, the Academy was under the direction of Pedro Padilla,⁸ who in 1753 began publishing his *Curso Militar de Mathematicas, sobre partes de esta ciencia, para uso de la Real Academia establecida en el Cuartel de Guardias de Corps* [Military Course of Mathematics, which in part addresses the mathematical sciences, for use by the Royal Academy established as a part of the Military Academy of the Royal Guards], and dedicated to the King Ferdinand VI (Figure 1). Padilla's *Curso* can be regarded as an outcome of the reforms carried out at the time by the Marquis of Ensenada.

The preface of his first volume shows that Padilla's primary aim was to show that understanding the basic principles of each branch of mathematics

5. On the creation and organization of the Academy of Mathematics of the Royal Guards, see [Blanco 2013], [Hidalgo 1991], [Lafuente & Peset 1982].

6. It is worth mentioning that, upon the closure of the Academy of Mathematics of the Royal Guards, part of its library was transferred to the library of the Naval Academy of Cádiz.

7. In fact, a number of new academies were created around 1751, which, due to budget cuts, were deemed redundant and, consequently, closed around 1760, with the exception of the Military Academy of Mathematics of Barcelona and the Academy of Artillery of Cádiz [Lafuente & Peset 1982], [Capel, Sánchez *et al.* 1988, 181–182], [Hidalgo 1991].

8. On Pedro Padilla, see [Capel, Sánchez *et al.* 1988], [Cuesta Dutari 1985, 136–137], [Garma 2002].

CURSO MILITAR
DE
MATHEMATICAS,

S O B R E
LAS PARTES DE ESTAS CIENCIAS,
pertenecientes al Arte de la Guerra, para el uso de
la Real Academia establecida en el Quartel
de Guardias de Corps.

DEDICADO
AL REY NUESTRO SEÑOR
DON FERNANDO SEXTO,

POR MANOS DEL EXCmo. SEÑOR DON CENON
de Somodevilla, Marqués de la Encinada, Cavallero de la Infigne
Orden del Toysón de Oro, y de la Real de San Genaro, Comenda-
dor de Piedra-Buena, y de Peña de Martos en la de Calatrava, Cava-
llero Gran Cruz de la Religión de San Juan, del Consejo de Estado
de S. M. Secretario de Estado, y del Despacho Universal de Guerra,
Marina, Indias, y Hacienda, Superintendente General de ella, y
con Honores de Lugar-Theniente General del Almirantazgo
General de España, y de las Indias, &c. y Protector
de la misma Academia.

POR DON PEDRO PADILLA Y ARCOS, CAPITAN,
y Ingeniero Ordinario de los Exercitos, Flotas, y Fronteras
de S. M. y Director de la referida Academia.

DE ORDEN DE S. M.

EN MADRID, en la Imprenta de Antonio Marin,
año de M.DCC.LIII.

Figure 1 – Title page of the *Military Course of Mathematics* [Padilla 1753-1756].
Source: Biblioteca Digital Hispánica (Biblioteca Nacional de España).

could be useful to not only infantry and cavalry regiments, but could serve engineers, artillery and navy personnel [Padilla 1753-1756, Preface].

Through his work, Padilla introduced what represented a pivotal change in the pedagogical methods thus far [Blanco 2013, 772]. As mentioned above, Lucece's course was dictated by assistants and copied down by students at the Military Academy of Mathematics of Barcelona, hence following the royal ordinances [*ordenanzas reales*]. By making printed versions of his *Curso* available, Padilla aimed to relieve students "from the annoyance of writing, incompatible with their daily duties", so that they could "make greater progress in the studies" [Padilla 1753-1756, Dedication to the King].⁹

Table 1 displays the contents of the treatises of Padilla's course, according to the index in the first volume. Of the twenty mathematical treatises that Padilla originally intended to develop, only the first five would be published in the end (in four volumes).¹⁰ His approach to the general division of

Table 1 – Contents of Padilla's course

Part I	Arithmetic and Geometry 1. Ordinary arithmetic; 2. Elementary (Euclidean) geometry; 3. Elementary algebra; 4. Higher geometry, or geometry of curves; 5. Differential and integral calculus, or the method of fluxions; 6. Logarithms; 7. Plane trigonometry; 8. Spherical trigonometry
Part II	Mechanics 9. General principles of mechanics; 10. Statics or solid mechanics; 11. Hydraulics or fluid mechanics
Part III	Sphere 12. General principles of astronomy; 13. Geography; 14. Chronology; 15. Gnomonics
Part IV	War 16. Fortification and military buildings; 17. Artillery; 18. Tactics
Part V	Military Drawing 19. Perspective; 20. Plans, sections and military elevations

mathematics, which he discusses at length in the preface, appears to be a direct echo of D'Alembert's *système figuré* in the *Discours Préliminaire* of the *Encyclopédie* [D'Alembert & Diderot 1751, I]. Hence, for instance, according to Padilla, algebra could be divided into elementary algebra and infinitesimal

9. All the translations are ours unless otherwise indicated.

10. Although the first treatise was reprinted in 1807, the project of reprinting the remaining volumes was eventually given up.

algebra, the latter in turn being divided into differential calculus and integral calculus [Padilla 1753-1756, Preface, § 21], as displayed in the *système figuré*.¹¹

Fully aware of the elementary nature of his course, Padilla encouraged those readers willing to progress in the study of mathematics to complete and improve his *Curso* [Padilla 1753-1756, V, § 86]. The *Curso* was regarded as auxiliary to the teaching program, which placed greater emphasis on lectures and discussions conducted in the classroom [Padilla 1753-1756, Preface, § 17].¹² This approach contrasts radically with the teaching regulations in the military academies in Barcelona, Ceuta and Oran where teaching assistants were obliged to rely exclusively on the notebooks provided and developed by the headmaster, and to not deviate from their content without the headmaster's approval [Portugues 1765, VI, 907–911]. Contrary to these regulations, Padilla's work was presented more as a guide, an introduction to all branches of mathematics that could be expanded and completed, if necessary.

The Spanish mathematician Jorge Juan (1713-1773) expressed his approval of all the published treatises included in Padilla's *Curso*. Juan praised the clarity, extension and order with which Padilla treated the different branches of mathematics and consequently he recommended the work as a useful addition to teaching curriculums. This is particularly remarkable given Juan's interest in improving science teaching in Spain, and the substantial level of institutional support he had received to further this mission, notably from the Marquis of Ensenada. A scientist, mariner and naval officer, Juan was one of the most worldly Spanish nationals of the time. In 1752, he took charge of the Academy of Marine Guards at Cadiz, the Spanish military school for naval officers, where he promoted modernizing mathematics by means of producing and publishing scientific and technical works, among other initiatives [Ausejo & Medrano Sánchez 2015], [Garma 2002].

Since Padilla began his studies at the Military Academy of Mathematics in Oran,¹³ and later became an engineer in 1744, his own course was no doubt influenced by the mathematics course by Pedro de Lucuce [Blanco & Puig-Pla 2014], [Blanco & Massa-Esteve 2018]. Padilla's treatises generally correspond to the books included in Lucuce's course, although he sometimes presented them in a different order.

However, when comparing the contents, the most remarkable difference concerns calculus, which was not included in Lucuce's course. In fact, Padilla's treatise (V) was the first educational book on calculus to be written in Spanish, see [Ausejo & Medrano Sánchez 2010], [Blanco 2013], [Cuesta Dutari 1985].

11. On the division of mathematics, see [Blanco 2013, 774], [Blanco & Puig-Pla 2014], [Puig-Pla 2002].

12. See [Blanco 2013] for a discussion about Padilla's views on pedagogy.

13. As mentioned above, the Academy of Oran relied heavily on courses offered by the Academy of Barcelona. Since the Academy of Oran offered only the first-year curriculum, students were often prompted to move to Barcelona to complete their studies. See, for instance, [Massa-Esteve, Roca-Rosell *et al.* 2011, 241].

There is yet another difference concerning the structure of the courses or, rather, their views on the division of mathematics. While Lucuce included only two chapters dealing with algebra in Book II (*On the literal algorithm*) of his treatise on arithmetic (Chapter 1: “On basic operations regarding literal quantities”, and Chapter 2: “On literal fractions”), arithmetic and algebra were presented in two different treatises in Padilla’s course. Treatise III of Padilla’s course focused exclusively on algebra, was broader in scope and included the study of series in Section III.

As Ausejo & Medrano Sánchez [2015, 157–158] pointed out, Padilla’s course was, however, not enough to compensate for the overall lack of works published in Spanish designed for scientific and technical training, specifically works that addressed the military context. To promote and enhance the production of a concrete mathematical treatise in Spanish, in 1757 Pedro Pablo Abarca de Bolea y Ximenez de Urrea (1719-1794), 10th Count of Aranda, started organizing what would become the Royal Military Society of Mathematics, which we examine in the next section.

3 The Royal Military Society of Mathematics (1757-1760)

In 1756, a unification of the two military corps (artillery and engineers) took place under the command of a general director, the Count of Aranda. Only the year before the same initiative aimed at uniting both bodies was attempted in France. Finally, King Louis XV of France ordered the joining together of the two bodies (December 8, 1755). They did so under the denomination of “Corps Royal de l’Artillerie et du Génie”. Their union would be short lived, since a new ordinance (May 5, 1758) separated them a second time [Daniel 1773, 172–173]. The unification of artillery and engineers aimed to reduce costs, to promote efficiency and to allow the Minister of War to take over the artillery by avoiding the appointment of a new Grand Master of the artillery [Galland Seguela 2008].

The Count of Aranda had undertaken military studies in Italy. After the king appointed him Field Marshal, he visited several European courts (France, Prussia...) to further his training. In France he met D’Alembert, Diderot and Voltaire, among others. It is not unlikely that the merging of the two military bodies in France gave rise to the idea of undertaking a similar initiative in Spain. In the end, the decision was made to change the structure of the engineering corps and combine it with the artillery corps, to have both then fall under the command of a man who belonged to neither, the Count of Aranda. His mission was to rationalize the artillery’s organization by reducing the number of departments and increasing the number of engineers in the corps to match the number of gunners [Galland Seguela 2008].

On September 21, 1756, the Count of Aranda proposed to both King Ferdinand VI and the Minister of War, Sebastián de Eslava (1684-1759) that this could be achieved by creating a Society of gunners and engineer officers in Madrid under the direction of Pedro de Lucuce.

The main objective of this Society, according to Aranda, would be “the elaboration of a Course of Mathematics, adapted for military training, extensive and critical, to have in our language, all what the foreigners and the nationals wrote, thus improving the teaching of the military schools in Spain” [AGS, bundles 3005 & 3011]. In his extensive proposal, he developed his ideas. He claimed that: “Spain has never excelled in mathematics”; “the books are those who form men” [AGS, bundle 3005]. Aranda was convinced that “Mathematics is the instructive and necessary science for war” and defended in his proposal with “it is necessary to write an extensive and critical course in which is approved what is well founded and reproved what is wrongly produced” [AGS, bundle 3005].

His project was to create a team of engineers and gunners—“the best in Mathematics”— equipped with textbooks, mathematical instruments and a cabinet with models and machines for instruction. The following month (October 23, 1756) the King approved the appointment of five engineers and five artillery officers for that purpose. Shortly after, on November 1, 1756, a team was appointed under the direction of Pedro de Lucuce. This team consisted of four engineers and four gunners: Charles LeMaur (or Carlos Lemaur), engineer; John Garland (or Juan Garland), ordinary engineer; Antonio de Córdoba (or Cordoba), extraordinary engineer; Bernardo Fillera, drafting engineer; Francisco Cardoso, ordinary commissioner of Artillery; Lorenzo Laso (or Lasso), extraordinary commissioner of Artillery; Manuel de Rueda, extraordinary commissioner of Artillery and José Dátoli, provincial commissioner of Artillery.¹⁴

14. *Carlos Lemaur* or *Charles LeMaur* (Montmirail 1721 – Madrid 1785) was a French engineer with expertise in roads and bridges. In Paris he met Antonio de Ulloa (1716-1795) and Francisco Pignatelli (1687-1751), Ambassador of Spain. In 1750 he came to Spain on the proposal of Pignatelli and was hired by the Marquis of Ensenada and appointed ordinary engineer. He participated in developing public works, such as the construction of roads and canals, notably the projects of constructing the canal of Castilla and that of Campos (1752). *John Garland* (Dublin? – in Caribbean Sea 1775) was an Irishman who emigrated to Spain and joined the regiment of Irish infantry “Hibernia” in 1738. He was with the Edinburgh dragons (1740) and entered the Corps of Engineers in 1751. In 1747 *Antonio de Córdoba* (or *Córdoba*) (Figueres 1729 – Cadiz 1765) was at the Cadet Infantry Regiment in Marseille. Six years later his name appears on the records of the Corps of Engineers as a draftsman (1753). He remained two years with Antonio de Ulloa (captain) and worked on the dam and the quay of El Ferrol. Additionally, he was commissioned as an admissions examiner for officers and cadets wishing to enter the Corps of Engineers and Gunners. *Bernardo Fillera* (1731– ?), appointed Design Engineer in 1753 (or 1755) was hired as drawing engineer for the Principality of Catalonia. His mission was to draw the plans for the models. *Francisco Cardoso* (? – 1784) was made Second Lieutenant in 1740 and

Table 2 – Members of the Society and the treatises assigned to them

Member	Treatises
Carlos Lemaury	Treatise of Mechanics
Juan Garland	Treatise of Military Architecture
Antonio de Córdoba	Treatise of Algebra
Bernardo Fillera	Treatise of Speculative and Practical Geometry
Francisco Cardoso	Treatise of Artillery
Manuel de Rueda	Treatise of Arithmetic
Lorenzo Laso	Treatise of Cosmography
José Dátoli	Direction of the construction of machines and models

The eight officers under the command of Lucuce arrived in Madrid in March 1757 [Cuesta Dutari 1985, 207]. Members of the Society were authorized by the Inquisition to read books that had previously been banned. They contacted Gregorio Mayans (1699-1781), a Spanish historian and linguist, for the purpose of developing a scientific vocabulary in Castilian. Initially, in theory, the members of the Society were asked to dedicate 5 hours of study per day (3 hours in the morning and 2 hours in the afternoon).

The yearly handwritten reports by Pedro de Lucuce (1757, 1758 & 1760), found in the General Archive of Simancas (AGS) in Valladolid, are the most revealing source for understanding how the Society of Mathematics evolved and progressed (Figure 2).

Lucuce assigned the task of writing on a topic (i.e., drafting a treatise) to all of the members except Dátoli, who was in charge of directing the construction of models for all machinery (see Table 2).

was based in Tarragona as commander of a detachment of the Royal Regiment of Artillery. In 1751, he would become First Master of the School of Cartagena and in 1755, Senior Master of the Cadiz School (pilots). He proposed a new program “to achieve the purpose of the Institute of this school to instruct the appellants in all parts of Mathematics belonging to the perfect understanding of navigation” [Arroyo 1994, 21]. *Manuel de Rueda* (Salamanca 1730 – Madrid 1771) was Cadet at the Burgos Regiment in 1751 and four years later he was appointed commissioner draftsman of the Royal Corps of Artillery with the rank of second lieutenant. Rueda worked at the School of Mathematics of Artillery of Cadiz, where he demonstrated his interest and knowledge of mathematics and drawing. *Lorenzo Laso de la Vega* was second class Regent Teacher at the Cadiz Artillery School around 1751. *José Dátoli* (or *Dattoli*) was Neapolitan. He took part in the service of the monarchy on the Italian territory, first in the Neapolitan artillery and after in the Iberian Peninsula. He came from Zaragoza to join the Society. For more about these officers see [Capel, García *et al.* 1983], [Puell 1994], [Galland Seguela 2008].

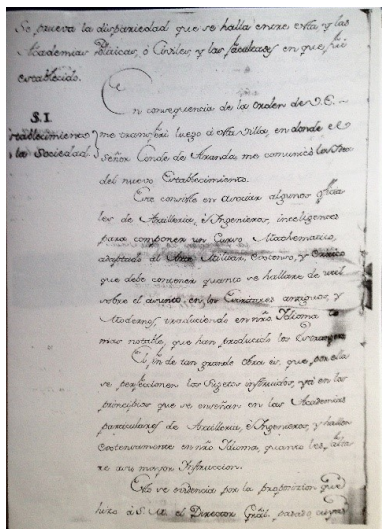


Figure 2 – *Examen de la verdad* (or *Review of the truth*) handwritten report drafted by Pedro de Lucuce for the Minister of War, Sebastián de Eslava (December 2, 1758) Source: General Archive of Simancas [AGS, bundle 3004].

A remarkable difference between Lucuce's Mathematical Course and the Society's project was that the latter contained a treatise specifically dedicated to algebra. That is, again, algebra and arithmetic can be found in two different volumes. In his first report (1757) Lucuce claimed that Córdoba was preparing a treatise on algebra containing fifteen sections¹⁵ including series and exponential calculus [AGS, bundle 3005], [Cuesta Dutari 1985, 195]. From this report, we can infer that this treatise was intended to cover a broader scope than Lucuce's course. In addition, according to Lucuce's report, Córdoba had prepared several notes on differential and integral calculus. It is worth pointing out that, here again, calculus seems to be connected with algebra.

15. The fifteen sections were the following 1) Four first quantity rules; 2) Four first rules of irrational quantities; 3) Powers of literal quantities; 4) Root extraction; 5) Quantities and its distribution in various orders; 6) Explanation of replacements; 7) How to find the divisors of a number and make formulas; 8) Calculation of infinite series; 9) Calculation of summable series; 10) Composition of arithmetic and geometric progressions; 11) Nature of the exponential calculus; 12) The equations of 1st and 2nd degree with applications to arithmetic and geometry; 13) Application of 3rd and 4th degree equations to geometry and use of second degree geometric loci; 14) Use of 3rd and 4th degree geometric loci; 15) Difficulties in applying solid problems.

In 1758, according to Lucuce's second report¹⁶, Córdoba "studied works of the *Académie Royale des Sciences of Paris and one part of the Leipzig Acts, and other authors*" [AGS, bundle 3005], [Cuesta Dutari 1985, 201].

Apparently, the progress of the work commissioned was slow. Aranda was faced with the challenge of presenting ideas that were initially difficult for both the engineers and the gunners to understand. He also faced certain opposition to his authority from the Minister of War, Sebastián de Eslava, who interfered with his orders. The combination of these two dynamics eventually led to Aranda's resignation on February 4, 1758.

Jaime Masones de Lima (1696-1778) was appointed for the post of general director [Capel, Sánchez *et al.* 1988, 180]. However, since he was ambassador in Paris at that time, Marshal Maximilien de La Croix, a gunner and the most senior officer of two corps, served as interim general director until April 20, 1761 [Salas 1831, 67]. La Croix introduced a change of orientation in the Society of Mathematics. While Aranda envisaged a Society that could prepare manuals and develop technical activities, La Croix believed that the scientific society should be expanded to include men of science and men of letters. In fact, he was worried about the future of the specialist corps and he wanted to transform the Society's regulations with a view of simplifying the office depending on the corps under his command.

Prompted by La Croix's views, the Minister of War, Sebastián de Eslava, proposed a reform due to the fact that very few results were being produced by the Society. La Croix developed a complementary regulation to that of Aranda's stipulating that the role of Lucuce be considerably reduced to that of a mere "dean" without authority or initiative. Lucuce criticized the new regulation as being illegal and forgave the delay in completing the tasks entrusted to the Society.

In his last global report (October 14, 1760) Lucuce commented on the conflictual nature of his interactions with the temporary command of Maximilien de La Croix. Among other things, he said that La Croix's ideas "have nothing to do with the ideas of Mr. Count of Aranda" and that "he tried, under his own authority, to change everything" [AGS, bundle 3011].

Finally, it was decided by a Royal decree (November 17, 1760) first, to close down the Society of Mathematics (December 1, 1760), secondly, to reassign its members¹⁷ and, thirdly, to distribute its books and instruments (and those of

16. The second report of Lucuce, under the title *Relation of what the individuals of Royal Society of Mathematics did ... in this year of 1758* was written on December 31, 1758 [AGS, bundle 3005].

17. The members of the Society were assigned to different positions. Pedro de Lucuce became director at the Cadiz Artillery Academy (but soon returned to Barcelona); Carlos Lemaury went to Galicia; Juan Garland was appointed to a post in Chili as a second engineer; Antonio de Córdoba headed for the Academy of Cadiz; Bernardo Fillera was forced to leave for the Academy of Cadiz as director of the drawing department; Francisco Cardoso would relocate to Seville; Manuel de Rueda

the extinct Military Academy of the Royal Guards) to Barcelona and Cadiz Academies [Cuesta Dutari 1985, 217].

Why did the Society fail? To begin with, certain tensions had developed between gunners and engineers, which the unification of the two Corps by Aranda failed to resolve. The fact is that Lucece himself was an engineer and engineers outnumbered gunners within the Society. Although the Royal Treasury made a considerable financial investment by allocating 100,000 reals per year or 60.97% of the overall budget provided by the Treasury for the teaching of mathematics to army officers and cadets enrolled in Spanish military academies¹⁸, the results were almost null [Puell 1990, 451]. Disputes that had erupted between La Croix and Lucece, as well as the conflicts between Lucece and Lemaur and the affinity of La Croix and Lemaur (both French) all contributed in important ways to the Society's failure as an institution and its ultimate closure.

On December 6, 1760, La Croix went further by proposing that Lemaur and Cardoso remain in Madrid to write the mathematics course that should serve as a model for the mathematics courses offered by the military academies. His proposal, however, was eventually rejected.

As would happen later to other Spanish military academies established over the course of the 18th century (such as those in Avila and Ocaña), the Society ultimately dissolved when its greatest promoter, the Count of Aranda, fell from power. Count Aranda's fall from grace necessarily involved the failure of the initiatives he had championed; developing the Society of Mathematics represented a project that relied heavily on personal perspective or vision, and handing it off to those who did not share the initial vision of the project would lead to its closure [Abián 2017].

Despite the fact that the Society of Mathematics failed to succeed, it did produce a number of noteworthy results. Its very creation highlighted the need for modern mathematical texts produced in Spanish and Lucece did effectively succeed in building a substantial scientific and technical library, which served to supply future military libraries [AGS, bundle 3004]. Lucece's inventory (September 30, 1760) of the books that were purchased¹⁹ by the Society since its creation shows no less than 1,278 volumes (249 works).²⁰ Among them there were several mathematics courses (by Béliador, Camus, Dechaies, Wolff and others), works of Descartes, Newton, Maclaurin, Ozanam,

was appointed to the Academy of Barcelona, and, like Lorenzo Laso and José Dátoli, would eventually go to Badajoz [Galland Seguela 2008, 85].

18. Academies of Mathematics in Barcelona, Orán and Ceuta; Academy of Artillery of Barcelona; Academy of Artillery of Cádiz; Academy of Royal Guards and Military Society of Mathematics of Madrid.

19. Already in 1757, works were acquired through the booksellers Angel Corradi, Juan Barthelemy, Josep Orzel, Francisco Manuel de Mena and others [Puell 1990]. The Society obtained dozens of volumes of the Academy of Paris and other works were also collected from Saint Petersburg, Bologna, London, etc.

20. These volumes were transferred to the Academies of Barcelona and Cadiz.

Maupertuis, Tosca, Zaragoza or Deidier, and books of relevant authors such as: D'Alembert, Agnesi, Acevedo, Bernoulli, Bion, Boscovich, Le Clerc, Clairaut, Cramer, Chafiron, Dedier, Dechaes, Desaguliers, Euler, L'Hôpital, Maupertuis, Mariotte, Napier, Rolle, Varignon, Vauban, and many others.

4 Final remarks

The two transient cases selected here illustrate two contrasting approaches towards developing more effective course curriculums for teaching mathematics in the context of Spanish military instruction during the 1750's. While an integrative approach can be seen in beginning stages of both cases, specific aspects of each underline how they would evolve very differently. A context of unity is perhaps best illustrated by Lucuce's course developed following the Royal Ordinance of 1739 and its use at the Academy of Barcelona, whereas a more polarized approach can be seen in Padilla's course and the position of the Society of Mathematics.

The first publication of Padilla's course as an early initiative was done so during a time when the tradition of dictating was still very strong. While dictation as a teaching method was used for more than forty years for teaching Lucuce's course, Lucuce himself was also involved with the Society of Mathematics and contributed to its endeavour of producing a printed version of a mathematics course in Spanish. In this way, the two cases presented here show how two pedagogical systems or teaching strategies existed at the same time: teaching through dictation and teaching using printed texts.

Similarly, studying these cases allows us to identify key differences concerning the contents and structure of the course in question. The first being the very different role algebra appears to play in the two courses. Lucuce's course contained just a few pages on algebra as a part of his treatise on arithmetic. By contrast, Padilla and the Society of Mathematics included a treatise on algebra that was presented independently of the treatise on arithmetic, both of which were broader in scope than what Lucuce's course included. The second striking difference is that Padilla's course, unlike Lucuce's course, included a treatise on calculus. That said, there is evidence to suggest that the Society of Mathematics intended the treatise on algebra to include at least some sections on calculus, which tells us that Padilla and the Society of Mathematics appear to have shared the same viewpoint regarding the division of mathematics, in particular, the idea that calculus should be considered as a branch of algebra.

Finally, examining these two cases brings to light two lines of conflict between military engineers and gunners, notably divergences between the Navy and the Corps of Military Engineers, and approaches to teaching mathematics.

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Bibliography

- ABIÁN, David A. [2017], La instrucción de la oficialidad de infantería y caballería. Las academias militares en los reinados de Fernando VI y Carlos III, *Revista Universitaria de Historia Militar*, 6(12), 85–103.
- ARROYO, Ricardo [1994], Las enseñanzas de náutica en el siglo XVIII, *Revista de historia naval*, 46, 7–30.
- AUSEJO, Elena & MEDRANO SÁNCHEZ, Francisco Javier [2010], Construyendo la modernidad: nuevos datos y enfoques sobre la introducción del cálculo infinitesimal en España (1717-1787), *Llull*, 33(71), 25–56.
- [2015], Jorge Juan y la consolidación del cálculo infinitesimal en España (1750-1814), in: *Jorge Juan Santacilia en la España de la Ilustración*, edited by A. Alberola, R. Die, & C. Mas, Alicante: Publicaciones Universidad de Alicante/Casa de Velázquez, 155–178.
- BLANCO, Mónica [2013], The mathematical courses of Pedro Padilla and Étienne Bézout: Teaching calculus in eighteenth-century Spain and France, *Science & Education*, 22(4), 769–788, doi: 10.1007/s11191-012-9537-6.
- BLANCO, Mónica & MASSA-ESTEVE, Maria Rosa [2018], La matemática pura en los cursos militares de matemáticas de Pedro Lucuce (1739-44) y de Pedro Padilla (1753-56), in: *Ciencia y técnica en la universidad trabajos de historia de las ciencias y de las técnicas*, edited by D. Ruiz-Berdún, Alcalá de Henares: Universidad de Alcalá, vol. II, 167–178.
- BLANCO, Mónica & PUIG-PLA, Carles [2014], Pedro Padilla and his *Mathematical Course* (1753-1756): Views on mixed mathematics in eighteenth-century Spain, in: *Scientific Cosmopolitanism and Local Cultures: Religions, Ideologies, Societies. Proceedings of 5th International Conference of the European Society for the History of Science*, edited by G. Katsiompura, Athènes: National Hellenic Research Foundation; Institute of Historical Research, 336–342.
- CAPEL, Horacio, GARCÍA, Lourdes, et al. [1983], *Los Ingenieros militares en España, siglo XVIII: repertorio biográfico e inventario de su labor científica y espacial*, Barcelona: Ediciones Universidad de Barcelona.

- CAPEL, Horacio, SÁNCHEZ, Joan Eugeni, *et al.* [1988], *De Palas a Minerva: la formación científica y la estructura institucional de los ingenieros militares en el siglo XVIII*, Barcelona: Serbal; CSI.
- CEBALLOS, Manuel, NÚÑEZ, Juan, *et al.* [2013], Pedro de Lucuce y Ponce y las instituciones matemático-militares españolas del siglo XVIII, *La Gaceta de la RSME*, 16(1), 147–168.
- CUESTA DUTARI, Norberto [1985], *Historia de la invención del análisis infinitesimal y de su introducción en España*, Salamanca: Ediciones Universidad de Salamanca.
- D’ALEMBERT, Jean le Rond & DIDEROT, Denis [1751], *Encyclopédie ou dictionnaire raisonné des sciences, des arts et des métiers*, Paris: Chez Briasson, David, Le Breton, Durand.
- DANIEL, Gabriel [1773], *Abrégé de l’histoire de la milice françoise*, vol. II, Paris: s. n.
- DE MORA, Mary Sol & MASSA-ESTEVE, Maria Rosa [2010], On Pedro de Lucuce’s Mathematical Course: Sources and Influences, in: *Styles of thinking: Proceedings of the 3rd International Conference of the European Society for the History of Science (ICESHS)*, edited by H. Hunger, Vienna, 869–878.
- GALLAND SEGUELA, Martine [2008], *Les Ingénieurs militaires espagnols de 1710 à 1803: étude prosopographique et sociale d’un corps d’élite*, Madrid: Casa Velázquez.
- GARMA, Santiago [2002], La enseñanza de las matemáticas, in: *Historia de la ciencia y de la técnica en la Corona de Castilla*, edited by J. L. Peset, Valladolid: Siglo XXI de España Editores, vol. IV, 311–346.
- HIDALGO, Encarna [1991], El aula de matemáticas de los Guardias de Corps (1750-1761), in: *Actas del V Congreso de la Sociedad Española de Historia de las Ciencias y de las Técnicas*, edited by M. Valera & C. López Fernández, Murcia: DM-PPU, vol. II.
- LAFUENTE, Antonio & PESET, José Luis [1982], Las academias militares y la inversión en ciencia en la España ilustrada (1750-1760), *Dynamis: Acta Hispanica ad Medicinae Scientiarumque Historiam Illustrandam*, 2, 193–209.
- MASSA-ESTEVE, Maria Rosa [2014], La Reial Acadèmia de Matemàtiques de Barcelona (1720-1803). Matemàtiques per a enginyers, *Quaderns d’Història de l’Enginyeria*, XIV, 17–34.

- MASSA-ESTEVE, Maria Rosa, ROCA-ROSELL, Antoni, *et al.* [2011], "Mixed" mathematics in engineering education in Spain: Pedro Lucuce's course at the Barcelona Royal Military Academy of Mathematics in the eighteenth century, *Engineering Studies*, 3(3), 233–253, doi: 10.1080/19378629.2011.618188.
- MUÑOZ CORBALÁN, Juan Miguel [2004], *L'Acadèmia de Matemàtiques. El llegat dels Enginyers Militars*, Barcelona: Secretaria General Tècnica del Ministerio de Defensa.
- PADILLA, Pedro [1753-1756], *Curso militar de mathematicas, sobre partes de esta ciencia, para uso de la Real Academia establecida en el Cuartel de Guardias de Corps*, Madrid: Antonio Marín.
- PORTUGUES, Joseph Antonio [1765], *Colección General de las Ordenanzas Militares, sus Innovaciones, y Aditamentos, dispuesta en diez tomos y con separación de clases*, vol. V–VI, Madrid: Imprenta de Antonio Marín.
- PUELL, Jesús [1990], Caudales y cuentas de un Proyecto fallido. La Real Sociedad Militar de Matemáticas de Madrid (1757-1760), *Anuario jurídico y económico escurialense*, 22, 405–453.
- [1994], *La Real Sociedad Militar de Matemáticas de Madrid (1757-1760)*, Ph.D. thesis, Departamento de Historia Moderna, Facultad de Geografía e Historia, Universitat Complutense de Madrid, Madrid.
- PUIG-PLA, Carles [2002], Sobre el significat del concepte matemàtiques: matemàtiques pures i mixtes en els segles XVIII i XIX, in: *Actes de la VI Trobada d'Història de la Ciència i de la Tècnica*, edited by J. Batlló, P. Bernat, & R. Puig, 151–169.
- RIERA, Joan [1975], L'Acadèmia de Matemàtiques a la Barcelona Il·lustrada (1715-1800), in: *Actes del II Congrés Internacional d'Història de Medicina Catalana*, Barcelona: s. n., 73–128.
- SALAS, Ramon [1831], *Memorial histórico de la artillería española*, Madrid: Imprenta que fue de García.