A COMPARATIVE STUDY OF EDUCATIONAL PRACTICES FOR SCHOOL MATHEMATICS IN BRAZIL AND ARGENTINA IN CONNECTION WITH THE CREATION OF THE MODERN STATE

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ABSTRACT

This aim of this article is to create a comparison between the educational practices used to teach mathematics in schools in Brazil and Argentina. The methodology used in this study was Comparative Research in Education (CRE), based on comparative studies already conducted between Brazil and Portugal by the Mathematics Education History Research Group (Grupo de Pesquisa História da Educação Matemática - GHEMAT). The central discussion in this paper is the historical construction of mathematics education in school (in Brazil and Argentina) and attempts to denaturalize school mathematics. In this work, we argue that political changes, i.e., the construction of the "Modern State" with its bureaucratic bias, have contributed to the creation of a specific type of mathematics: "Modern Mathematics." During the colonial period, under the Jesuit aegis, there was no requirement for a high degree of specialization in school mathematics in Brazil and Argentina. The Modern State, represented in an elucidative manner by the French Revolution and the English Revolution, allowed the instruction to expand beyond the need for mathematics with a higher degree of specialization. In Brazil and Argentina, a particular form of state began to appear in the 1960s: The Modern, Bureaucratic and Authoritarian State, which was closely tied to a form of mathematics proposed by the Bourbaki group; a form of mathematics that concerned unity in itself with alleged neutrality and little social perspective.

Keywords: Comparative Research; School Mathematics; Modern Mathematics; Modern State; History of Mathematics.

RESUMO.

O objetivo do presente artigo é fazer um comparativo entre as práticas educativas em Matemática Escolar no Brasil e na Argentina. A metodologia utilizada foi a Pesquisa em Educação Comparada (PEC), a partir de estudos comparados já realizados pelo Grupo de Pesquisa História da Educação Matemática (GHEMAT) entre Brasil e Portugal. A discussão central é a construção histórica da Matemática Escolar (Brasil e Argentina) na busca de desnaturalizar a Matemática Escolar. Defendemos, no presente trabalho, que as mudanças políticas, ou seja, a construção do Estado Moderno em seu viés burocrático contribuiu para um tipo específico de Matemática, a Matemática Moderna. No Período Colonial sob a égide Jesuítica não havia necessidade de um alto grau de especialização na Matemática Escolar no Brasil e na Argentina. O Estado Moderno representado de forma elucidativa pela Revolução Francesa e Revolução

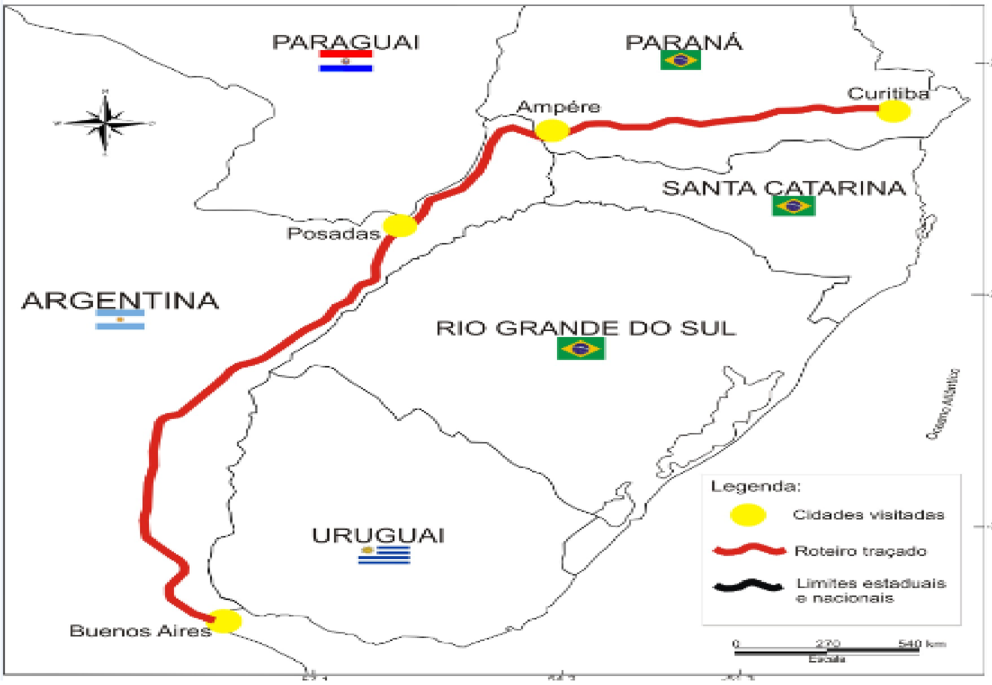
Inglesa, possibilitou ampliação da oferta de instrução além da necessidade de uma Matemática com maior grau de especialização. No caso brasileiro e argentino, a partir dos anos 1960 uma forma particular de Estado se apresenta: O Estado Moderno, Burocrático e Autoritário com estreita relação com uma Matemática Proposta pelo Bourbaki de unidade em si mesma, de pretensa neutralidade e de pouca perspectiva social.
Palavras-chave: Pesquisa Comparada; Matemática Escolar; Matemática Moderna; Estado Moderno; História da Matemática.

1. Initial Considerations

This article's methodological strategy is Comparative Research in Education (CRE) and its research object is school mathematics. Researchers have been investigating this topic in recent years in relation to Brazil and Argentina. With regard to CRE, Bonome (2008), in his doctoral thesis, presents the relationships between the church and state in Brazil and Argentina. Berchansky (2008), in his doctoral thesis, compared higher education reforms made by the Lula (Brazil) and Kirchner (Argentina) governments. Aita (2009) wrote her dissertation on public policies that were implemented in Brazil and Argentina following the 1990 reforms. Luz (2009), in her doctoral thesis, studied the business sector's participation in education in Brazil and Argentina beginning in the 1990s. Cristofoldi (2010) compared advances and setbacks in teaching Portuguese to Argentines and Spanish to Brazilians in recent decades. Pereira (2011) wrote a comparative dissertation on the Program for International Student Assessment (PISA) in Brazil and Argentina beginning in the year 2000.

The accepted format of CRE has at least five defining categories: (a) An international tendency. CRE is a study of different National States. (b) The principle of alterity. In this case, strengthening the ability to put oneself in another's position, enabling a better understanding of Brazilian education by examining the peculiarities of other states; (c) The concept of totality. Here, comparative studies warn of the close relationship between a national education system and international education policies; (d) The cooperative effort. The researcher seeks to contribute to the country in which the research is conducted, avoiding becoming a purely predatory character, i.e., removing a collection of information from the country to study and not returning results; and (e) New observational tactics. Comparing does not mean copying, condemning, or glorifying the other, but rather questioning in what situation and under what conditions states have adopted practices and strategies in their education system.

Figure 1- Geographic scope of sources and contacts.



Source: Adapted from Map Data @ 2014. https://www.google.com.br/maps/@-21.6903953,-52.9766893,6z

The School Subjects Historical Research Group (Grupo de Pesquisa História das Disciplinas Escolares - GPHDE) is located in Curitiba, the capital of Paraná, under the aegis of the Pontifical Catholic University (Pontifícia Universidade Católica - PUC). This university is coordinated by Professor Neuza Bertomi Pinto[1] who, beginning in 2005, integrated the international cooperation project "Modern mathematics in schools in Brazil and Portugal: Comparative historical studies"[2].

Numerous studies were developed relation to this project, resulting in many dissertations, theses, books, and articles on Modern Mathematics in Brazil and Portugal[3]. One study by two important representatives of this movement, Osvaldo

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[1]The GPHDE is linked to the Mathematics Education History Research Group (Grupo de Pesquisa História da Educação Matemática – GHEMAT), coordinated by Professor Wagner Rodrigues Valente – UNIFESP.

[2] This project, developed by GHEMAT under the direction of Wagner Rodrigues Valente - Brazil, and José Manuel de Matos – Portugal, was funded by Capes/Grices in 2005 and extended until 2011. It involved dozens of Brazilian and Portuguese universities, including the Pontifical Catholic University of Paraná, and involved researchers from the Graduate Program in Education.

[3]Among the numerous productions of the project, see: VALENTE, W. R. (Orgs.). *Oswaldo Sangiorgi: um professor moderno* [*Oswaldo Sangiorgi: a modern professor*]. São Paulo: Annablume, 2008; OLIVEIRA, M.C.; ARRUDA, J.P. A; FLORES, C. (Orgs). *A Matemática Moderna nas escolas do Brasil e Portugal. Contribuições para a história da educação matemática* [*Modern Mathematics in schools in Brazil and Portugal. Contributions to a history of mathematics education*]; São Paulo: Annablume, 2010; LEME DA SILVA, M. C.; VALENTE, W. R. (Orgs). *O Movimento da Matemática Moderna: história de uma revolução curricular* [*The Modern Mathematics Movement: history of a curricular revolution*]. Juiz de Fora: Ed. UFJF, 2011.

Sangiorgi, in Brazil, and Sebastião José da Silva in Portugal, analyzed, both historically and comparatively, actions undertaken to disseminate the Modern Mathematics movement in Brazil and Portugal. This research indicated differences in the dissemination and implementation of Modern Mathematics in the school system. “A rapid, emergency proposal, like that of Brazil, or a long-range project, like that of Portugal, appear to have been the only cards held by the movement's leaders at the time to intervene in the population’s scientific education.” (PINTO, 2007, p. 120)

In this comparative study of school mathematics in Brazil and Argentina, discussions at the Faculty of Ampere (Brazil) and the National University of Misiones (Argentina) established the first connections in the border regions. In order to devise a list of sources, an inventory relating to school mathematics was compiled at the Biblioteca Nacional del Maestro [Professor's National Library], in Buenos Aires (Argentina).

2. Brazilian and Argentine School Mathematics in the Colonial State

Certain elements can define what a State is: (a) demarcated territory; (b) an official language; (c) the recognition of other states; (d) and a general education system. The colonial state is a specificity where the occupant has rights over that which has been occupied. In this case, the Portuguese and the Spanish occupied Brazil and Argentina, respectively, and they traditionally maintained a non-native language and imported school education policies that were gradually adapted to the local specificities.

In Brazil, the colonial period lasted from 1500 to 1822, while in Argentina it began in the early decades of the sixteenth century and lasted until 1816, when they achieved their independence. Under the Jesuit aegis, Brazilians and Argentines had a different education system for the colonial elite and for indigenous people. The former received a classical education and the latter received catechesis.

More specifically, with respect to school mathematics in the colonial states, the *Ratio Studiorum* is particularly illuminating. Franca (1952) says that this document was published in 1599, despite its having been written at least half a century before. The school curriculum of the Jesuits included the *trivium* (grammar, dialectics, and rhetoric) and the *quadrivium* (arithmetic, geometry, astronomy, and music). Valente (2007) states that we know almost nothing about the teaching of mathematics in the Jesuit colleges of Brazil, but it is reasonable to assume that the curriculum began with a lesson on numbers, basic operations and classes on the Sphere. The Jesuit argument was that spending time on the sciences and mathematics would take important time from teaching humanities, which they considered relevant to a person’s education.

In the *Ratio Studiorum* (1599), the rules for mathematics teachers include some evidence of what mathematics classes would have been like at the time.

> For physics students, explain Euclid’s Elements for ¾ of an hour in class; after two months, when students are already somewhat familiar with these explanations, add something relating to geography, the Sphere, or other subjects they like to learn about, and do that simultaneously with Euclid, on the same day or on alternate days [...] Every month, or at least every other month, in the presence of an audience of philosophers and theologians, ask one of the

> students to solve a famous math problem; and, then, if it looks correct, explain the solution [...] with respect to repetition, once a month, generally on a Saturday, rather than a lecture, publicly repeat the main points explained during the month (RATIO STUDIORUM, 1599).

It is possible to assume, since they were under the same Jesuit aegis, that Brazilians and Argentines in the colonial period would have experienced a similar kind of mathematical education. Classical or traditional Jesuit mathematics, from the standpoint of instruction, followed a rigorousness based on the writings of Euclid. With regard to learning, it was suggested that the students repeated the exercises and publicly explained the solution of some problems prepared by the teacher. It would be the teacher's responsibility to organize the lessons, choose material, assign exercises, conduct repetitive lessons, and organize possible debates on theses based on Euclid's elements.

The level of mathematical skill required in a colonial state did not far exceed Arithmetic and Euclidean geometry as agrarian and export societies require less specialization in mathematics. We also must consider that, during the colonial period, the circulation of school mathematics had not yet incorporated the progress of science and its discoveries that were established after the seventeenth century. Valente (2008) raises another element of Brazilian school mathematics during the colonial period. He claims that mathematics began to be considered as a military strategy.

> It is the year 1699. Concerned with defending the colony, the Portuguese Crown decides to boost the training of military personnel on lands overseas. In Brazil, it was necessary to have officers trained in handling artillery and capable of building forts. The Brazilian coast, immense, required numerous buildings to preserve the conquered lands and prevent the wealth from being extracted from it. An *Artillery and Fortifications Class* was thus created. (VALENTE, 2008, p. 13)

3. Brazilian and Argentine School Mathematics in the Modern State

The Modern State is based on two elements: in the political field, it references the French Revolution, which established new forms of government with greater political participation and a reduction of social inequalities; and the English Industrial Revolution, which established new patterns of production and consumption in capitalist societies.

The term "national" can be added to the concept of the Modern State. In this case, there is a sense of belonging. In Brazil and Argentina, the colonial states became "Modern National States." School instruction was relevant in this process. The Brazilian Constitution of 1824 presents an important element: the possibility of expanding education. Article 179 of its civil rights states that primary education is free to all citizens. The way to secure these rights is through instruction at colleges and universities, "where elements of science, letters and fine arts will be taught." The term "citizen" is evidently still restricted but, in any case, it seems to signify some progress in terms of affording a greater number of students the opportunity to access education. The Argentine Constitution (1819) gave congress the power to create uniform education plans and to provide a means of supporting them.

Thus, the Modern National State had to structure an educational system that granteds access to a more substantial number of citizens. In Brazil, the first expansion initiatives were what Saviani (2007) calls Schools of the First Letters, made official in 1827, which used the “mutual teaching method” to spread low-cost education, reaching large numbers of students. The mutual or “Lancasterian” method was based on using more advanced students as teaching assistants in large classes. It assumed predetermined rules, strict discipline, and a hierarchical distribution of students. It allowed up to two hundred students to be instructed by a single teacher.

Observing Law no. 1420 of 1884, expansion of this policy can be seen in relation to the attempt to create a national education system in Argentina. Article 1 presents the three axes that schools should cover: moral, intellectual, and physical development. It defines the separation between public and private schools and predicts the use of state power to compel school-age children to attend school, with fines for parents who do not comply with this requirement. The moral axis involves habits and customs, with an insistence on necessary hygiene, advocating how schools should be built with an entire inspection system as prescribed in Article 13, warning, “that when constructing school buildings and furniture, hygiene specifications should be consulted; a medical and hygienic inspection is mandatory, with vaccination and revaccination of children at certain times.”

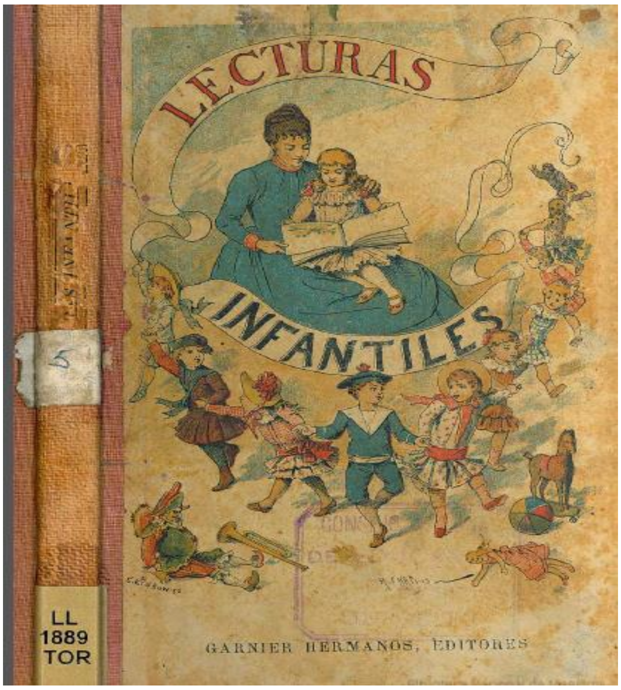
In Argentina, school mathematics constitutes the intellectual axis. Article 6 of Law no. 1420 presents the “minimum compulsory instruction” concerning reading and writing; arithmetic; the particular geography of the republic and universal geography; the particular history of the republic and general history; mathematical, physical, and natural sciences; and music and drawing.

One observation relating to the Primary Argentine School of Mathematics of the eighteenth century stated that, “we are still based on arithmetic. The book, First Childhood Readings: Moral Stories, Useful Knowledge, Notions of Arithmetic and Geography (1889), is in circulation”. This book (Figure 02) was donated by School no. 19 in Buenos Aires. It constructs, in two sections, a moral with stories about how children "sin" and the consequences they face, and another section, with no apparent relation to the first, which contains what is called useful knowledge, particularly in relation to arithmetic.

There is an attempt to connect this morality with arithmetical problems. Problem 125 says that “Miguelito received 12 precious stamps from his teacher as a reward; he gave three to his brother, Fernandito, and six to his sister, Isabelita. How many are left?” Problem 126 is even more compelling. “When I left the church, there were four poor people at the door. My mother gave them one peso. How much did each of them receive?”

In the section relating to useful knowledge, where arithmetic is located there is a description of the names of the numbers and their formation. Then, there is a table of numbers, an addition table, a multiplication table, simple application problems, instructions on telling the time, and a study of the metric system. To elucidate this, here are two examples from the book. The first is a simple problem. “Pedro has 5 apples, Juanita has 5 and Antonio has 7. How many do they have altogether?” The second is from the addition table.

Figure 2 – Primeras lecturas infantiles. Historias morales, conocimientos útiles: nociones de Aritmética, Geografía.[First childhood lectures. Moral stories, useful knowledge: lessons on arithmetic and geography.]



Source: GÓMEZ, Miguel de Toro (1889, p. 43). Available at the Biblioteca del Maestro.

With regard to mathematics education, Brazilian mathematicians of the early nineteenth century were not oblivious to the problems related to teaching mathematics and opted to use an intuitive method, and neither were the Argentines. In the journal *O Monitor da Educação Comum* [*The Common Education Monitor*], published on March 15, 1894 at the National Council of Argentine Education, Dr. Juan de Vedia and Dr. Antonio Atienza harshly criticized the methods of teaching mathematics. They suggested an intuitive method where “the teacher begins with the names of the students in the class, the objects in the classroom, the trees, flowers, animals [...] we can only add things of the same species; soon it is understood that five balls and three bands are not eight balls nor eight bands.” The suggestion is to use the pedagogy of Pestalozzi, leading children from fragmentary and superficial insights to the most clear and distinct intuitions.

Costa (2010), in his thesis on *Aritmética Escolar no Ensino Primário Brasileiro (1890 – 1946)* [*School Arithmetic for Brazilian Primary Teaching (1890 – 1946)*], upon observing textbooks, concludes that they prioritized the intuitive method, where the acquisition of knowledge was derived from the senses and observation. He shows that some textbooks in Brazil followed Pestalozzi’s logic, especially the numerical tables. Our study found that the intuitive method and Pestalozzi’s tables were used in both Brazil and Argentina.

3.1 Modern Mathematics for a Modern State. Brazil and Argentina

The twentieth century consolidated a particular type of state in both Brazil and Argentina: the Modern State. Two forms of authority are evident. The first is a kind of national state that has a charismatic form of authority, epitomized by Getúlio Vargas in Brazil and Juan Perón in Argentina. The second form of authority is called the "Bureaucratic State."

The Bureaucratic and Authoritarian State were predominant in both countries from the 1960s until 1985 with their specificities. This type of state assumes the figure of a civil servant (in this case, the teacher) and follows a clear hierarchy. It is committed to the production of documents. As a result, the level of expertise required of students is higher in order to acquire the necessary skills to occupy positions. What defines what can or should be done is a system of laws that prescribe what and how to teach.

In this case, what is important are the relationships and agreements established by the national state with other national states in the dissemination of an educational policy. In the case of Brazil and Argentina, the presence of international organizations, such as the United Nations (UN), through bodies responsible for education, i.e., the United Nations Educational, Scientific and Cultural Organization (UNESCO), synthesized and prescribed educational actions in both countries under the policy of a "lasting peace."

These organizations were presided over by the United States of America (USA), which provided resources such as scholarships and training programs in order to create a new system of mathematical education. Brazilian (in greater numbers) and Argentine researchers creatively understood the new mathematical ideas and the need to implement them in their own countries.

We can see that the discourse on Modern Mathematics accompanied the discourse on modern society versus traditional society. Búrigo (1986) says that in the origin of Modern Mathematics there is a reference to the internal evolution of the discipline itself over the last 100 years. This particularly applies to the production of the Bourbaki group, but it also had other connotations. One was the sense of updating teaching to meet the needs of a society undergoing rapid technological growth. Another reference was in relation to questions from the latest research in the field of psychology and didactics. Modern Mathematics also concerned effectiveness, with good quality occasionally opposing the traditional. This expression was charged with positive feelings, where the dominant manner of thinking was related to technical progress that would help find solutions for social problems.

In general, this modernism concerned overcoming the agro-pastoral society of the old economies and advancing to an industrial society. However, it intertwined with social rights issues, such as the modern woman who must work outside the home environment and the modern student who is concerned with the theoretical sciences of his time. School subjects, in their own way, have used this concept in Brazil. The term "modern" is featured in volumes of the Brazilian Journal of Pedagogical Studies from 1951 until 1966 in different articles written by teachers. As the subject of "Modern Languages" opposes the teaching of Latin in favor of English or French, what was particularly modern about the mathematics circulating in the west?

It seems reasonable to assume that, as of the mid-twentieth century, the most relevant mathematics production was that of the Bourbaki group. Hernández (1999) says that Nicolas Bourbaki is the pseudonym under which some of the best French mathematicians, including Henry Cartan, Jean Dieudonné, Claude Chevalley and André Weil, in the early 1930s, a series of books with the innocuous title, *Elements of Mathematics*. The Bourbaki group claimed to offer a systematic exposition of an important area of mathematics. This program has developed since then, producing a long list of books and secondary writings, including historical notes. The most relevant and simplified finding is from Jacques Borowczyk, when he wrote *Bourbaki et la Touraine*: "…in 2007, Bourbaki exists; using Google, I found 860,000 occurrences for this name, 640,000 for N. Bourbaki, 154,000 for Nicolas Bourbaki and 474,000 for General Bourbaki."

Pires (1996) presents some elements inherent to the Bourbaki group in regard to the production, focus, and ordering of mathematical knowledge: (a) they are avidly critical of Euclid's work, especially Dieudonné; (b) they have a limited interest in probability; (c) they have a lack of interest in physics as an application of mathematics; (d) they regard mathematics as a unit in itself; (e) resuming the work of Galois (algebraic structures), Cantor (set theory), and Hilbert (axiomatic), Bourbaki's main objective was to reconstruct the mathematical whole in a unified study of new intelligibility where the idea of structure, axiomatic method, and unity were essential.

There is good evidence that Bourbakian thought circulated in Brazil and Argentina. In Brazil, the University of São Paulo received some of these mathematicians for intermittent periods, including André Revuz. In Argentina, Santaló translated Modern Mathematics and Living Mathematics (1963) into Spanish, the link between French thought and Argentine teachers regarding what circulated in Modern Mathematics. Santaló (1966) went further, warning that what mathematicians of the seventeenth and eighteenth centuries had produced was still not included in school mathematics.

> Mathematicians took over twenty centuries to understand that Euclid's system was not logically perfect. They lacked the assumptions that Euclid admitted without explicitly stating (for example, the postulate of the continuity of the line); various definitions (for example, "point" and "line") had little or no meaning. Point is what does not have parts. Line is length without width. SANTALÓ (1963 p. 24)

Revuz manifests his thinking on Modern Mathematics and Traditional Mathematics thusly:

> This Greek mathematics seemed perfect for a long time, but it actually was not. First, its domain was very limited, and it would be so absurd to reproach the Greeks for not having done it all, to believe that after them there would be nothing else to do. Second, the foundations of the Euclidian edifice lacked sharpness. [...] Algebra had been developed in 1800; there were negative numbers, the irrationals that astonished the Greeks. Descartes had created analytic geometry (geometry of the ancients and algebra of the moderns), Fermat with works of analysis, Newton and Leibniz with differential and integral calculus, also Euler, Lagrange and Laplace, the latter with the theory of probability. REVUZ (1963, p. 27)

Here, we have constructed some categories to describe the beliefs of the Bourbaki Group. The first category is formalization**.** For the Bourbaki group (1954, p. 1), a sufficiently explicit mathematical text could be expressed in conventional language, with a small number of invariable words brought together in a synthesis with some inviolable rules. What is this formalization? Question and answer, for example the usual notation for a game of chess or a table of logarithms, or algebraic calculation formulas as formalized texts. It would be as if we had completely codified the rules governing the use of parentheses; if we could go beyond the "DNA of mathematics."

Another category with which to describe the concepts of Bourbaki is the criticism of the use of intuition that would cause errors of reasoning and the fact that intuition without formalization was not advised. Intuition would have meaning within established rules, i.e., a limit of the scope. This process differs from validating the student's opinion as the most important element in learning.

The Bourbaki (1954) texts present rigor as a foundation for formalization. "It is an exercise in patience and, in some cases, is very painful." Pires (2006) presents a statement by Revuz (1996), who claimed that Bourbaki is undoubtedly elitist and consciously so. "There is a very deep dogmatism and the reader is never inclined to share the doubts and hesitations of the author; he did his job with a professionalism worthy of honors."

Revuz (1968, p.33) is in agreement with Bourbaki when he says that intuition only makes sense if it is not separated from rigor. Rigor brings solidity to the solution and, when the solution is solid, it can and should be intuitively applied. With this collaboration, a rigorous approach also requires intuitive insight when previously unseen situations are encountered. As intuition is passive, it can be applied in conjunction with a rigorous approach. Simplifying is not the same as omitting. To simplify is to obtain a synthetic vision combining both rigor and discipline.

Another category attributed to Bourbaki (1954) is the axiomatization defined as the art of writing, whose formalization is easy to draw. It can be considered to be something evident, manifest, undisputable, and unquestionable. This invention is not new, according to Bourbaki, but its routine use as an instrument of discovery is one of the unique features of contemporary mathematics. It is not important that one is writing or reading a formalized text, which attributes certain meanings to the words or signs of this text, all that matters is the proper observation of syntax (the logical relationship of these meanings).

Bourbaki raises the need for generalization. To deduce is to show. Although Bourbaki treats Aristotelian logic as secondary, in this case, deductive reasoning is recommended, which is characterized by presenting conclusions that should, necessarily, be true if all the premises are true and if reasoning suggests a logically valid form. Beginning with principles recognized as true (the major premise), the researcher establishes relationships with a second proposition (minor premise) in order to, based on logical reasoning, discern the truth of what is proposed (conclusion).

Unity and simplicity are other categories presented by Bourbaki (1954, p. 95. Ch. 22). Beyond the evidence that "2 + 2" equals 4, one must consider the commutative properties in addition and multiplication, providing a definition for addition and multiplication using the fundamental properties (associative, commutative, distributive, neutral element, inverse).

According to Bourbaki, in the past this mathematical unity depended on “particular intuitions that provided him with concepts of truth, where each formalized language belonged to its own branch. Today one can speak logically, to obtain much of current mathematics from one source: Set Theory. This logic is not one of philosophy, but a mathematical logic obtained from a fragment of a subject and which brings unity.”

Precision is another mark of Bourbaki (1954, p.74). It is necessary to escape conclusions, being concerned with the issue of non-contradiction. “We say that a mathematical theory is contradictory when it is, at the same time, both a theorem and its negation within the usual rules of reasoning that are the foundation of formalized languages. A theorem that is true and false loses interest. If we are unconsciously driven to a contradiction, we cannot survive without draining this theory.”

4. Final considerations.

In this article, we presented some similarities between the mathematics of Brazilian and Argentine schools. Mathematics as a school subject is produced and transposed from a situation. Colonial society had less demand for specialization, emphasizing Euclidean geometry and arithmetic.

The level of demand increasesds with the Modern State, mathematics being one of the sciences in evidence. We must also add the need to expand a teaching system and methods for effective learning. The intuitive methods of the eighteenth century lost ground to non-intuitive methods of the mid-twentieth century.

Beginning in 1960, the Modern State was established in both countries. This resulted in the influence of a bureaucratic organization in the educational system and the participation of international organizations in the decisions of local governments. Consequently, modern mathematics found “fertile ground” for its circulation.

There is evidence that the modern mathematics circulated and was suitable in Brazil and Argentina. Pires (2006) stated that some Bourbaki mathematicians, such as André Weill, were initially welcomed in the USA by a Rockefeller Foundation program whose intention was to save French scientists from Nazi attacks. This foundation had already conducted similar exercises with Polish intellectuals. The author shows that Bourbaki mathematicians such as Weill, Jean Dieudonné, Jean Delsarte, Alexander Grothendieck, Laurent Swartz, Charles Ehresmann, Samuel Eilenberg, and Jean-Louis Koszul were later occasionally present at the University of São Paulo (Universidade de São Paulo - USP).

Due to the geopolitics of the time, the situation in Brazil was more favorable to the French scientists than in Argentina. Búrigo (1986) says that professor Osvaldo Sangiorgi presented his thesis, Classical Mathematics or Modern Mathematics, at the II International Congress in Porto Alegre, where the author “timidly” showed that both disciplines had to be taken into account and that modeling is necessary, but in a gradual way. “The first is based on simple elements, while the second uses an operating system, that is, a series of structures (Bourbaki) on which the mathematical edifice rests.”

In regard to the dissemination of Bourbaki’s works in Brazil, Pinto (2006) presents interviews with the protagonists involved in creating the Center for the Study and Dissemination of Mathematics Teaching (Núcleo de Estudos e Difusão do Ensino da Matemática - NEDEM) in the province of Paraná, who would have access to Bourbaki’s writings. However, there are two obvious examples of how Bourbakian concepts entered Brazil, firstly through the participation of the mathematicians themselves at USP and, secondly, indirectly through Brazilian researchers who had completed scholarships in the USA.

At the V Brazilian Congress of Mathematics Teaching held in São José dos Campos (SP-BR), coordinated by the Center for the Dissemination of Mathematics Teaching (Núcleo de Difusão do Ensino da Matemática - NEDEM), Professor Osvaldo Sangiorgi presented evidence of the circulation of Bourbaki’s ideas. Let us examine a fragment of his speech.

> The introduction of axiomatic concepts in mathematics research and the reformulation of mathematics itself with the Conjunctivist-Bourbakian spirit, combined with the advanced achievements of the International Center for Genetic Epistemology, directed by the eminent psychologist Jean Piaget, raised complex pedagogical problems regarding the content of the mathematics to be taught to the children of the current generation. (ANAIS DO V CONGRESSO, 1966, p. 22).

Other groups that studied mathematics created, methodological legacies, similar to that of Bourbaki. The difference is that the groups created in Brazil were more related to the teaching and dissemination of modern mathematics while Bourbaki was concerned with the production of new knowledge in mathematics. We have as examples: the Mathematics Teaching Studies Group (Grupo de Estudos do Ensino da Matemática - GEEM) in São Paulo; the Center for the Dissemination of Mathematics Teaching (Núcleo de Difusão do Ensino da Matemática - NEDEM) in Paraná; the Mathematics Teaching Studies Group of Porto Alegre (Grupo de Estudos do Ensino da Matemática de Porto Alegre - GEEMPA) in Rio Grande do Sul; and the Mathematics Education Research and Studies Group (Grupo de Estudos e Pesquisas em Educação Matemática - GEPEM) in Rio de Janeiro.

In Argentina, access to Bourbaki’s materials was conducted more individually, particularly through the participation of their teachers in Inter-American Conferences. There is no evidence of the creation of study groups in Argentina to discuss Modern Mathematics. The professors interviewed at the National University of Misiones (Universidade Nacional de Misiones - UNAM–AR) warn that group work in Argentina had a subversive connotation and was an uncommon practice in all circumstances. Even so, the modern mathematics proposal spread (Table 01).

Table 01: Regional courses in Modern Mathematics.

Year	Course name	Location	Participants.

1968	Functions. Binary operations. Algebraic Structures.	Corrientes.	28
	Zonal Course in development for secondary mathematics teachers.	Entre Ríos.	25
	Zonal Course in Mathematic Development.	Trenque Luquen.	18
	Modern Mathematics.	Rosário.	32
	Modern Mathematics.	Rosário.	33
	Modern Mathematics.	Córdoba.	34
1969	Mathematical Analysis.	Córdoba.	28
	Development and improvement in mathematics.	Entre Ríos (Basavilbaso).	25
	Development and improvement in mathematics.	Entre Ríos.	25
	Modern Mathematics.	Santa Fé.	50
	Modern Mathematics.	Corrientes.	25
1970	Modern Mathematics.	Córdoba.	30
	Teacher development in Modern Mathematics.	Entre Rios.	66
1971	Modern Mathematics.	Sargento del Estero.	90
1972	Modern Mathematics.	Jujuy.	15
	Modern Mathematics.	La Rioja.	20

Source: Adapted from the Third Inter-American Conference on Mathematics Education. Argentina (1972, p. 215).

In Argentina, training was more progressive. This directness is presented under the aegis of the National Institute for Improving Science Teaching (Instituto Nacional para o Melhoramento do Ensino das Ciências - INEC). The strategy used related to scientific and pedagogical development and training courses in different provinces in Argentina (Table 01).

Modern mathematics was the “backbone” of this training. The subjects addressed were: (a) algebraic structures; (b) linear algebra; (c) sets and numbers; (d) methodological seminars; (e) algebraic calculation; (f) general algebra; and (g) mathematics teaching. In summary, content was based on algebra and the methodologies were studied in seminars concerning the teaching of mathematics. In fact, a number of symposia and seminars were held on the subject. In 1970, there were two in Buenos Aires; in 1971, one in Rosário and one in São Luís and; in 1972, one was held in Santa Fé. There were also foreign conferences, including one with George Papy in 1968 on Modern Mathematics and another with Marshall Stone in 1970 on the Reform of Mathematics, also featuring O. Dodera, who addressed the Mathematics Olympics.

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