

Arithmetical problems in primary school: ideas that circulated in São Paulo/Brazil in the end of the 19th century

Luciane de Fatima Bertini¹ and Andreia Fernandes de Souza²

¹Universidade Federal de São Paulo, Brazil; lfbertini@gmail.com

²Universidade Federal de São Paulo, Brazil; deianandes@hotmail.com

This article aims to analyze teaching programs, textbooks and journals of education in order to better understand the ideas that circulated in São Paulo, Brazil, in the end of the 19th century about the conceptualization and the utilization of problems for the teaching of mathematics in these documents. The research was conducted through a culture-historical approach (Chartier, 2002), which compels the researcher to have a questioning attitude towards the object of study. Thus, it was possible to observe that both the teaching program and the textbook valued the utilization of problems because both connect the concept of problem with activities presented through narratives in order for students to apply previous knowledge. On the other hand, the theme did not have the same valuation in the journal of education because it discussed that topic in only one article, which introduced the concept of problem as a synonym for a type of exercise related to calculations.

Keywords: Arithmetical problems, primary school, intuitive method.

Introduction

In the state of São Paulo, Brazil, the end of the 19th century was marked by events that would bring significant changes to primary school over the next decades and that would also be a reference for other states. In the last decade of that century the foundations of school organization – time, space and curriculum structuring - were established. In addition, *grupos escolares*, which represented the idea of a modern and quality urban school, began to be introduced in the state of São Paulo in 1893 (Souza, 2009).

Since that was a period whose proposals and determination impacted primary school nationwide over the next decades, research on the history of mathematics education has great interest in understanding the ideas that circulated in that period regarding the teaching of mathematics.

This paper aims to contribute to such understanding as it intends to analyze proposals for the utilization of problems in the teaching of mathematics by using textbooks¹, journals of education² and teaching programs³ from that period as sources.

¹ Choppin (2009) observed the existence of several expressions to name school books. Names vary according to context, use or style. In this paper the expression “textbooks” is used to name all publications written in order to be used in Brazilian primary school classrooms.

² Publications that compiled articles written by intellectuals and teachers on themes related to teaching.

Previous research done by the authors of this paper (Bertini, 2016a; Bertini, 2016b; Souza, 2016a; Souza, 2016b) shows the presence of arithmetical problems, or of proposals for their application, in several documents from different periods and with different goals. In this paper, the authors aim to conduct an analysis of these documents in order to better understand the ideas that circulated in São Paulo, Brazil, in the end of the 19th century about the use of problems for the teaching of arithmetic.

In this study, the definition of *problem* is not presented a priori because that term is understood in different ways according to the historical period in question. Thus, one of the objectives of this research work is to identify what concept of *problem* the documents contain.

Methodological and Theoretical Framework

To develop the historical production in this study, all analyses took into account the historical moments and spaces in which the documents were produced as well as the interests involved in this production. Thus, we take a culture-historical approach as proposed by Chartier (2002), which not only encourages researchers to carry out descriptive work, but also compels them to raise questions about the documents studied in order to identify how a specific reality arises and establishes itself according to the place and time in which it emerges. According to De Certeau (2001, p. 35), a historian's work is more connected to finding *meaning* and *purpose* than to simply *narrating* facts.

From that perspective, the notion of *appropriation* is crucial for a significant historical production because it proposes the existence of creative invention in the process of reception (Chartier, 2002, p. 136). Teaching programs, textbooks and journals of education will be analyzed based on that notion because, although in different manners, they all *appropriated* the ideas and determinations that circulated about the utilization of problems to teach arithmetic. Besides, throughout the process of creative invention, the authors will work to understand which ideas and determinations are produced in the documents about this utilization.

Moreover, the notion of purpose, presented by Chervel (1990), will be harnessed once it is related to the options made for teaching. The historical study that involves the use of arithmetical problems in primary school will encompass the understanding of the purposes of their use. The authors will be guided by two questions when studying the documents: How were problems harnessed in these sources? Why were they suggested that way?

It is important to emphasize that, according to Valdemarin (2004), in the 19th century the Brazilian educational context was influenced by ideas which arose from the intuitive method. She sustains that proposals for school activities included presenting a variety of objects to the senses so that ideas would be formed as a result of a rational, concrete and active teaching style. Two ideas are presented as paramount in the proposals that followed the intuitive method: first, the notion that observation leads to reasoning; second, the belief that work prepares individuals for the future (Valdemarin, 2001).

The proposal for educational renewal opposed the abstract and little useful character that teaching had had so far and comprised a new teaching method (the intuitive method). It started to be

³ Publications that provided guidance on school organization, content and methodology.

introduced in Europe, through Pestalozzi's⁴ e Fröbel's⁵ elaborations, and in the USA, where the work "Primary object lessons", by Calkins,⁶ was first published, in 1861. Brazil was inserted in this refreshing effort in the 1880's, when the country began to adopt the new intuitive teaching method. That movement was influenced by foreign ideas but it was also an attempt to meet political demands in the country due to the end of the Empire (Valdemarin, 2001, p.159).

Dialogues with these productions on the History of Brazilian Education are considered necessary for harnessing the theoretical concepts here presented as an option for the construction of a historical narrative because it will contribute to the understanding of the context in which the documents were produced.

Teaching programs, journals of education and textbooks

The first teaching program in the state of São Paulo, as determined in Decree 248 of July 26th 1894, provided school management guidance and teaching instructions such as school organization, materials, students' attendance, reports, disciplinary procedures, school-year calendar, curricular content and methodology. The Decree was signed by Bernardino de Campos and Cesário Motta Junior, who were respectively the President of the State of São Paulo and Secretary of the Interior.

Nevertheless, besides being determined by law, all those instructions needed to be spread among both active teachers and future teachers. In that sense, journals of education were presumably a tool to transmit models of work that would help teachers appropriate the new educational proposals. In the last decade of the 19th century, the *paulista* journal "A Eschola Pública" was sponsored by the government and its editorial staff was composed of teachers, principals and school inspectors.

In addition to teaching programs and journals of education, textbooks were another tool used to guide teachers' work because they presented proposals of activities to be done by students in the classroom, as well as proposals for school organization (ordering of contents, quantity and style of activities).

Finally, in this analysis we will articulate these different documents in order to generate understanding of the ideas that circulated in São Paulo, Brazil, in the end of the 19th century regarding the utilization of problems for the teaching of arithmetic.

- **The *paulista* program of 1894**

Teaching programs are part of the norms that integrate school culture and help us understand it. However, we know that changes and innovations proposed by governments are the result of political disputes, which prevents them from happening naturally and passively (Souza, 2009, p.83-84).

In the *paulista* program of 1894 there is guidance on choosing a methodology:

⁴ Johann Heinrich Pestalozzi (1746-1827), Swiss educator.

⁵ Friedrich Wilhelm August Fröbel (1782-1852), German educator.

⁶ Norman Alisson Calkins (1822-1885), American educator. This work was translated/adapted to Portuguese by Rui Barbosa in 1886.

Article 9 – Lessons on subjects of any course year need be more empirical and concrete than theoretical and abstract, and should be conducted in order for children’s faculties to be developed in a gradual and harmonic manner. Article 10 – The teacher need aim, especially, to develop the faculty of observation by applying intuitive processes for this purpose. (São Paulo, 1894)

The expressions “lessons... more empirical and concrete” and “intuitive processes” remind us of the educational trend that was disseminated at that time, i.e., the intuitive method.

Is is possible to notice that in the program some subjects are not present in every school year. Arithmetic, however, remains in all grades/years, with contents that are graded according to their difficulty level.

Besides providing the list of subjects, the program included “more and more detailed prescriptions coming from teaching administration departments”. The 1894 program was extensive, according to testimonials by inspectors and principals of *grupos escolares*. Contents related to reading, writing, calligraphy and arithmetic were considered essential by teachers. On the other hand, the ones related to geography, history and science were of secondary importance (Souza, 2009, p. 84).

For the teaching of arithmetic, the term *problem* appears in the content list in the following expressions: “Supplementary studies: problems and practical questions”, “Easy problems”, “Problems”, “Supplementary assignments: problems, practical questions”.

It is important to emphasize that the term *problem* is present from the second year on, always in the end of the list of contents. As years/grades advance, the words “easy” and “practical questions” join the term *problem* in expressions.

- **Journal “A Eschola Pública”**

Journals of education are extremely rich and varied sources (Monarcha, 2004). The author reveals a chronological list of *paulista* journals of education, which includes three titles that were published in the last decade of the 19th century. Out of those three publications, the UFSC Digital Repository⁷ has two: “Revista do Jardim da Infância” and “A Eschola Pública”, respectively *Kindergarten Journal* and *Public School*, in free translation. As this paper aims to analyze primary school, we will focus on articles published in “A Eschola Pública”. This journal of education was first published in 1893. Its early stage, which lasted until 1894, comprises eleven issues. The second publishing stage started in 1896, with its final issue published in the following year.

This journal is the result of a council formed by people who had graduated at Escola Normal da Capital⁸ (*Capital’s Normal School*, in free translation) and actively took part in political and cultural movements at the time. After that publishing period, many of its council members held important offices in the government, for example Oscar Thompson, who was named General

⁷ Database fed by GHEMAT researchers, where theses, dissertations, articles, textbooks, education journals and students’ notebooks are available. Available in <https://repositorio.ufsc.br/handle/123456789/1769>

⁸ First Normal School in the state of São Paulo, called Caetano de Campos today. It was founded in 1894 and prepared future teachers.

Manager of State Public Education (*Diretor Geral da Instrução Pública do Estado*), and Arnaldo Oliveira Barreto, who was a teacher at *Escola-Modelo do Carmo* (Carmo Model School, in free translation), in 1894, and the inspector of the associated schools of São Paulo.

According to Monarcha (2004), the publication had 21 issues. Nevertheless, only 18 issues are available at the UFSC Repository, whose digital database is fed by the GHEMAT researchers. All over the 18 issues, only 15 articles feature the teaching of arithmetic and only one, which was written by Arnaldo Oliveira Barreto in 1897, referred to the term *problem*.

In addition to being a teacher at Escola-Modelo do Carmo, the first *grupo escolar* in São Paulo, in 1894, Arnaldo Oliveira Barreto (1869-1925) reorganized Grupo Escolar de Lorena, São Paulo. In the period between 1902 and 1904, he was editor-in-chief of *Revista de Ensino* (*Journal of Teaching*, in free translation). He was also part of Sociedade de Educação de São Paulo (*Education Society of São Paulo*). Throughout his career, he produced several books, articles and guidebooks.

In an article published in March 1897⁹, the author provides suggestions regarding the order of the work a teacher needs to perform in the classroom: “write the exercises”, “students with their arms crossed”, “distribute all necessary material”, “ring the bell for work to start”, “divide your board” and copy “all problems and then do them” (Barreto, 1897, p.38).

In this article, the author talks about the utilization of calculations involving all four fundamental operations whose results are not higher than 20. Some examples of calculations presented in the article are as follows: $3 + 2 =$, $4 + 3 =$, $6 \div 3 =$, $4 - 2 =$, $6 \times 2 =$ (p. 40). He also suggests two different correction procedures: individual and collective. For the collective correction, he recommends that each student reads his/her problem:

- Three plus two makes five.
- Four plus three makes seven.
- Two and two are four.
- A six has two threes, etc. (Barreto, 1897, p.39)

To refer to the proposed calculations, the author alternates between the term “exercise” and the term “problems”, as we can observe in the final part of his article: “provide daily variation in the exercises, which is most convenient, and I emphasize that the problems should always be about the four fundamental operations” (Barreto, 1897, p. 39).

- **“Practical arithmetic”**

In the period between the end of the 19th century and the beginning of the 20th century there was a “close relation between the public primary expansion and the publishing expansion in the state of São Paulo” (Razzini, 2004, p. 1), which was originated with the establishment of the Republic in 1889. The textbook was set as one of the necessary aspects for implementing the proposal of *grupos escolares*.

⁹ Available in <https://repositorio.ufsc.br/xmlui/handle/123456789/126750>

Costa (2011), in a study about arithmetic textbooks in *grupos escolares* in São Paulo, states that Ramon Roca Dordal's work titled "Arithmetica escolar – exercícios e problemas para escolas primárias, famílias e collegios" (*School Arithmetic – exercises and problems for primary schools, families and other schools*, in free translation), which is composed of six books, circulated in public schools in the state of São Paulo in the end of the 19th century and beginning of the 20th century. The first four parts of his work were analyzed in this paper. However, after an extensive search, the two final parts could not be obtained.

In addition to the title, a highlight to the fact that the work is composed of exercises and problems is also present in the introduction done by the author himself. Although there is no clear indication of what is understood by "exercise" or "problem", the order of the activities featured in each lesson is pretty similar and seems to focus on the following: introduction of the rule, exercises and problems. Therefore, the term "problems" seems to be associated with a narrative of a daily life situation.

Lesson XI from the second book, for example, introduces the rule "When the sum does not provide exact tens, one should write the exceeding units in the sum and the tens should join the following order" (p. 11), followed by operations (Figure 1).

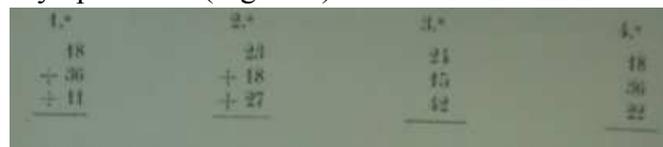


Figure 1: Operations featured in Lesson XI of the second book.

Finally, problems are presented as a final part of each lesson:

5th – A traveler has covered 25 leagues on a train, 14 leagues on a horse and 44 by ship; how many leagues has he covered?

6th – From Santos to São Paulo there are 16 leagues, from São Paulo to Jundiaí there are 12 and from Jundiaí to Campinas there are 9; how many leagues are there between Santos and Campinas?

Another point that Roca Dordal highlighted about the use of problems was that it was necessary to use easy problems, which should compose short lessons, so that children would remain interested and attentive, which is paramount for the success of the teaching process.

The first three books feature all problems that involve the addition operation and the fourth contains problems which are all related to subtraction. The situations featured in the problems have as backgrounds mostly children's everyday life situations (school, shopping, etc) and also adult life situations (distance between two cities, populations, etc).

Conclusion: ideas that circulated

From observing the three sources selected for this study, it is possible to characterize some ideas that circulated in the state of São Paulo, Brazil, in the end of the 19th century about the use of problems in the teaching of arithmetic.

In that historical period the use of problems in classrooms to teach arithmetic was highly valued, which is characterized by the presence of problems in almost every teaching program for primary

school (except for the first year/grade) and also by the presence of the term *problems* on the cover of Ramon Roca Dordal's work. Textbook covers somehow try to introduce some of the work contained inside so that it is more likely to be bought, adopted or used. Therefore, the presence of the term *problem* on the cover seems to endorse the notion that it was valued by those who would make use of it or recommend it (institutions or teachers).

Despite the high regard observed in the teaching program and in the textbook under analysis, discussions over the utilization of problems do not seem to have been a serious debate topic in the articles featured in the journal that circulated in São Paulo at that time. The teaching of arithmetic was the theme of fifteen journal articles but the term *problem* was referred to in only one of them. Still that one article did not discuss effectively the understanding of what a problem actually is. In that article, the term *problem* was applied as a synonym for exercise and referred to the calculations proposed using numbers and operation signs.

Nevertheless, a different understanding is expressed both in the teaching program and in the textbook. In these two documents, even though there is no clear exposition of what a problem is, they seem to be more related to proposals of activities based on narratives, which somehow approach daily life topics, just like the situations contained in the textbooks by Ramon Roca Dordal. The use of the expression "practical questions" alongside the term *problem* in the teaching program may also be related to everyday life or to the utilization of objects to be presented to the senses for the formation of ideas, once the program represents ideas based on the intuitive method.

The recommendation to use easy problems is one more idea which is highlighted both in the teaching program and in Ramon Roca Dordal's textbook. This aspect is clearly revealed in the way that the documents are written and also in how their utilization is suggested. In the teaching program, for example, there is no proposal for the use of problems in the first year/grade, which suggests that first children need to acquire knowledge of the four operations, know their signs and be able to perform calculations with objects or numbers before being able to make use of this knowledge to solve problems. Likewise, in the book by Ramon Roca Dordal, problems are introduced only in some of the lessons, which happens after children have exercised their knowledge of the operations. One needs to have knowledge of how an operation is done to be able to apply that knowledge in problem solving, which points to a suggestion that the purpose of the problems was the application of previously acquired knowledge. This interpretation is reinforced when we observe that all problems featured in the book are related to the topics contained in the lesson in which the problems are shown or in previous lessons.

References

- Barreto, A.O. (1897). Aritmética. *Revista A Eschola Publica*, 2 (5).
- Bertini, L. F. (2016a). O Manual do Ensino Primário, de Miguel Milano: que problemas? *Revista de História da Educação Matemática*, 2 (1).
- Bertini, L. F. (2016b). *Os problemas na 'Serie graduada de mathematica elementar' de René Barreto*. Paper presented at the Encontro Nacional de Educação Matemática. São Paulo, pp. 1-10.

- Carvalho, M. M. C. (2000). Modernidade pedagógica e modelos de formação docente. *Revista São Paulo em Perspectiva*, 14 (1), 111-120.
- Choppin, A. (2009). O manual escolar: uma falsa evidência histórica. (M. H. C. Basto, Trans.) *História da Educação*, 13 (27), 9-75.
- Costa, D. (2011). Aritmética escolar pelos livros didáticos dos grupos escolares de São Paulo: fim do século XIX e início do século XX. *Rev. Diálogo Educ.*, 11 (34), 731-750.
- Chartier, R. (2002). *A história cultural – entre práticas e representações*. (M. M. Galhardo, Trans., 2th ed.). Lisboa: Difel; Rio de Janeiro: Bertrand Brasil S.A..
- Chervel, A. (1990). História das disciplinas escolares: reflexões sobre um campo de pesquisa. *Teoria e Educação*, 2, 177-229.
- De Certeau, M. (2011). *A escrita da história*. (M. L. Menezes, Tans., 6th ed.), Rio de Janeiro: Forense.
- Monarcha, C. (2004). *Revistas de educação e ensino, São Paulo (1892-1944)*. Paper presented at the III Congresso Brasileiro de História da Educação, 2004. PUCPR, Curitiba.
- Razzini, M. de P. G. (2004). *A Livraria Francisco Alves e a expansão da escola pública em São Paulo*. Paper presented at the Seminário brasileiro sobre o livro e história editorial, 1, 2004, Rio de Janeiro.
- Roca Dordal, R. (1891). *Arithmetica escolar: exercícios e problemas para as escolas primarias, familias e collegios*. Primeira serie, primeiro, segundo, terceiro e quarto caderno. São Paulo: Teixeira & Irmãos.
- São Paulo. Decreto nº 248, de 26 de julho de 1894. Aprova o regimento interno das escolas públicas. Assembleia Legislativa do Estado de São Paulo, 1894.
- Souza, A. F. (2016a). *A revista “A Eschola Publica” como caixa de utensílios: orientações para as aulas de matemática*. Paper presented at the Encontro Nacional de Educação Matemática. São Paulo, pp. 1-11.
- Souza, A. F. (2016b). *O método intuitivo nos manuais escolares e nas revistas pedagógicas: orientações para utilização de problemas nas aulas de aritmética*. Paper presented at the XIV Seminário Temático – Saberes Elementares Matemáticos do Ensino Primário (1890-1970). Rio Grande do Norte, pp. 1-15.
- Souza, R. F. (2009). *Alicerces da pátria: História da escola primária no estado de São Paulo (1890-1976)*. Campinas: Mercado de Letras.
- Valdemarin, V. T. (2001). Ensino da leitura no método intuitivo: as palavras como unidade de compreensão e sentido. *Educar*, 18, 157-182.
- Valdemarin, V. T. (2004). *Estudando as lições de coisa*. Campinas: Autores Associados. (Educação contemporânea).