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FRENCH ARITHMETIC TEXTBOOKS DURING THE 19TH CENTURY

Valérie Legros[1]

ABSTRACT

Primary schools increased a lot during the 19th century in France. This school system was really founded with the Guizot's law in 1833. Arithmetic integrated the contents of primary teaching. At this moment, there is no detailed curriculum. Consequently, textbooks propose different matters. We chose analysing 63 books published between 1798 and 1881. Analysed schoolbooks show few theoretical knowledge in lessons. In the opposite, authors describe proceeding knowledge with a lot of details. Students have to learn arithmetic, especially learn by heart, and they have to do arithmetic. They have to count orally, and after to do written work. They train doing a lot of exercises.

Keywords: Arithmetic. Textbooks. Procedural method. 19th century in France.

RESUMO

O número de escolas primárias aumentou muito durante o século 19 na França. Este sistema escolar amparou-se, em seu início, na lei de Guizot em 1833. A Aritmética integrava o conteúdo do ensino primário. Neste momento, não existia um programa detalhado. Consequentemente, os livros didáticos propunham assuntos diferentes. Nós escolhemos analisar 63 livros publicados entre 1798 e 1881. Os livros escolares analisados mostram poucos saberes teóricos nas lições. No oposto, os autores descrevem os processos do conhecimento com muitos detalhes. Os alunos tinham que aprender aritmética, especialmente aprender de cor, e eles tinham que fazer contas. Eles tinham que contar por via oral, e depois de fazerem o trabalho escrito. Eles treinavam fazendo muitos exercícios.

Palavras-chave: Aritmética. Livros didáticos. Método processual. Século 19 na França.

INTRODUCTION

In France, in the first part of the 19th century, the government began to build primary education system. Guizot was the first primary school founder. When this school began, arithmetic was a secondary subject. But little by little, it became one of the three main subjects: reading, writing and counting. At that time, primary school learning was

[1] Maîtresse de Conférences en Sciences de l'Education à l'ESPE de l'Académie de Limoges, Université de Limoges, France. Email : valerie.legros@unilim.fr

very bad with no learned teachers and a lot of truant children. Textbooks could be good tools to help schoolmasters teaching their pupils or to help students learning this subject.

These books increased a lot during the 19th century. What are their contents? Which pedagogical method are proposed to the schoolmasters and to the students?

In this article, we want analysing arithmetic textbooks of the 19th century to know which pedagogical methods were proposed to teachers and pupils. We are interesting analysing the first books written for primary schools' pupils. Consequently, we choose to work on textbooks published between 1798 and 1881, a long period of more than eighty years. During this time, methods changed to improve the students' progress.

We begin by looking at primary schools during the 19th century and which place arithmetic occupied. Secondly, we will present the sixty-three analysed arithmetic textbooks for primary school, and some indicators. Finally, we will demonstrate how to do arithmetic in textbooks.

1 – SCHOOL AND ARITHMETIC IN FRANCE DURING THE 19TH CENTURY

We begin presenting historical context because our research focuses on the 19th century. At this moment, the state of primary instruction is very weak, especially because we are at the beginning of the primary schools development. Arithmetic becomes a new subject in the primary curriculum.

1.1 – THE SCHOOL IN FRANCE DURING THE 19TH CENTURY

In France, during the beginning of the 19th century, the royal order of the 29th February of 1816 creates committees to encourage and to look after primary instruction. This order forces towns to plan public primary instruction. However towns' interests were somewhere else.

Primary schools remain underdeveloped until the beginning of the "July Monarchy". In 1832, François Guizot is named Minister of Public instruction in France. He introduces a policy to develop the instruction for working class children. The 28th of June 1833, a law is voted to impose the towns to maintain at least one primary school. In the

same text, the *departments* had to keep alive a normal school for the primary teachers. The *Article one* of this law presents the curriculum of elementary learning: "religious and moral instruction, reading, writing, elements of french language, elements of arithmetic, and weights and measures legal system" (Guizot, 1833) This instruction is very basic, no detail is given about contents.

Guizot is very interested building a school to educate poor and working class children. For him, it's a double political aim. Firstly, instruction provides the person with the ability to better oneself and secondly, the government can control the population. Guizot thinks that "less the people are lighted, more mistake and seduction gain influence over it" (Guizot, 1816, p. 6). Instruction can pacify the people. At last, coeducation is forbidden.

Guizot builds the primary education system and creates pedagogic tools for pupils and schoolmasters. Firstly, he creates the "*Manuel général de l'instruction publique*" (*General public instruction coursebook*). In this manual, teachers can find laws and other official texts. It also includes pedagogical lessons in several subjects. This periodical was made to help teachers working. Secondly, Guizot requests the achievement of five textbooks to all public schools in the kingdom. These textbooks were written in the few different subjects of the curriculum. Among them, there is the *Petite arithmétique raisonnée à l'usage des écoles primaires (Little reasoned arithmetic for primary schools)*.

In fact, the situation in primary schools is very bad. In 1834, Lorain makes an enquiry, the results are awful: schoolmasters don't learn to teach; their level is very low; some of them don't know arithmetic or orthography, and so on. In the country, most of schoolmasters teach with individual mode. The "Statute on communal elementary primary schools" published the 25th of April 1834 recommends that schools must be divided in three courses: elementary, middle and upper. Only big primary schools can have these three courses.

The Guizot law of 1833 signalizes the real beginning of the primary instruction. The Falloux law is voted in 1850 and carries on the primary schools development. The curriculum for elementary schools doesn't change: religious and moral instruction stays the more important subject. The Falloux law insists particularly on political aspects and is preservative giving a lot of decisions to the catholic clergy. Schoolmasters are monitored by priests. The curricula doesn't change and there is no prescription about pedagogical

method. In 1852, Napoléon Bonaparte becomes Emperor and manages the state with conservative politicians.

At the end of the Second Empire, the minister Duruy maintains interest about primary schools development. In 1868, Gréard, the Director of the primary schools in the Seine's department, proposes a text organizing the elementary instruction: *Organisation pédagogique pour les écoles primaires publiques de la Seine (Pedagogical organization for Seine's public primary school)*. This text prefigures organization which will be applied during the Third Republic. In this article we end our study before the huge development of primary instruction happening during the Third Republic.

1.2 – ARITHMETIC IN CURRICULUM

Arithmetic becomes essential in local primary schools during the 18th century. By the beginning of the 19th century, compute can be learnt at school after reading and writing. Some pupils never learn arithmetic because they don't stay at school long enough. From the middle of that century, children can learn counting, reading and writing at the same time; that's new (D'Enfert, 2006, 71). During the first half of the 19th century, arithmetic becomes an essential school subject and enters into the school curriculum in 1833 with the Guizot's law. Arithmetic fits into intellectual education, now allowing the intellectual faculties to develop, particularly with the power of reasoning.

In most of arithmetic textbooks, the subject is defined. For instance, in 1831, Bergery asks:

> Demand. What is Arithmetic?
> Answer. This is the science of counting.
> D. On which is exerted the count? Which the count is exerted on?
> A. On numbers., etc.
>
> (Bergery, 1831, p. 3)

Arithmetic contains numeration – the ability to compose and dissect numbers – and the four basic operations: that's the basic syllabus. Moreover, some authors add other contents: the rule of three and its associated ones – especially the rule of interest and the rule of society –, the fractions, and sometimes, the square roots and cube roots. Algebra never appears, because it's reserved for secondary instruction.

With arithmetic, the curriculum contains the weights and measures legal system. By the edict of the 22nd October of 1839, all the schoolmasters must teach this subject. The problem is that people continued using old weights and measures in their daily life. From 1840, books integrate conversion tables to help pupils. Lastly, just a few textbooks include geometry, surveying and levelling, which are very important subjects in the country.

Indeed, arithmetic is an essential subject of the primary instruction, in particular to develop cognitive faculties, but especially to learn knowledge applicable to the daily life. Politicians and teachers insist on this issue. For instance, in 1850, Ritt says about his own book: "The *New primary school Arithmetic* is not a complete Arithmetic reference book. It's a book conceived and written for practical learning, in which the theory is reduced to several rules easily applicable to arithmetic operations" (Ritt, 1850, III). Other examples also show implementation of arithmetic knowledge into daily life: one author integrates some "models of principal acts concerning commercial transactions" (Dessez, 1839, V). Finally, arithmetic books contain different subjects but the most interest is their application to daily life.

In the first half of the 19th century, famous pedagogues (Gerando, 1832; Jomart, 1816; La Salle, 1838 for instance) distinguish "oral calculation" (or "memory calculation") from "written calculation", and they are taught in this order, the first preparing the second. Learning by heart, creating automatisms are the necessary first steps to learn arithmetic and to progress reasoning.

These pedagogues propose a simple method, indeed a simplistic one. They suggest that pupils have to "learn", to "express", to "know" numbers and figures, and to "study" numeration and four basic operations. They must acquire an "automatic knowledge". This isn't just peculiar to arithmetic; it's the same for the teaching of letters, syllables and reading. From around the middle of the 19th century, some pedagogues introduce a new method imported from Switzerland: the Pestalozzi's method.

2 – ANALYSED ARITHMETIC TEXTBOOKS

Textbooks and their use hugely progress throughout the 19th century. Some editors develop their business at this moment, like Hachette who won a lot of money with

schoolbooks publication (Mollier, 1999). Textbooks edition increase according to primary school development. So we have now to study these books more precisely.

After studying characteristics of the primary schools in this period, we have to define and determine which books we will analyse: what is a textbook, especially at this moment, which way we used to select analysed books and which characteristics they present.

2.1 – SCHOOLBOOK AS A PEDAGOGICAL TOOL

Textbooks are commonly books for students. Pupils use them to learn. "Didactic tool, its first aim is to decline in organized and progressed matter, knowledges of the *National Education* official curriculum; pedagogic tool, it provides (teaching and learning) support to teachers and pupils for specified curriculum knowledge and skills acquisitions." (Sere, Bassy, 2010, p. 6). Schoolbooks gather contents on every subject, so they are compilation and carrier of knowledge. They also are transmission tool of ideological knowledge that students must acquire. Nathalie Denizot says: "Teaching and learning tools, textbooks are intermediate speeches proposing interpretation of the curricula" (Denizot, 2015, p. 41). Indeed, during the 19th century in France, there is no detailed curricula, like we saw. Textbooks can propose a curriculum for schoolmaster even if they don't have official program. So schoolbooks can show the school syllabus.

Nowadays, teachers' textbooks help them to organize their contents and progressions, to choose exercises for pupils' training. Here, textbooks are didactical tools to help them teaching. During the 19th century, this textbooks category is very weak. Mostly, textbooks are intended to help students. They can read the lessons with or without the teacher, they can do exercises following the teacher. Pupils have a textbook on each subject and a new one at each level. Used by the students, schoolbooks are clearly daily tools designed to help students learning.

> But understandable books for pupils miss schools, and they facilitate the pupils' study and improve the masters' work. In a word, it needs books made for ignorant people and not for learned people, commonly like classic books are. As long as elementary books are not practical and understandable for pupils, by their clearness, simplicity, and especially cheapness, the primary instruction will languish.
>
> (Chardon, 1845, unnumbered page)

This discourse of Chardon in 1845, is clearly a critique of textbooks at this moment. Therefore we try to expend on this object. What is a textbook during the 19th century?

Alain Choppin, an old textbook's specialist, says in the title of his article that schoolbooks are "a false historical evidence" (Choppin, 2008). "Like all research subjects, the textbook isn't fact, but it is the result of intellectual building: it is not possible to have just one definition" (Choppin, 2008, p. 58). Indeed we can see diversity in schoolbooks body, on form and substance. Especially, they don't indicate the class level until the last third of this century. Mostly, instead of above, some are used by the pupils and some by the students and the schoolmasters. Choppin adds that textbooks have also an ideological and cultural function: they are the main tool to spread "ideas, language, culture and upper social class values" (Choppin, 2005, p. 39-40), but we don't care of this aspect here.

In France, few laboratories lead studies about textbooks and old ones. Researches progress near patrimonial funds collecting old textbooks, like at Montpellier and Poitiers-Angouleme. Mostly, researchers analyse the sociological and cultural contents. For instance, Vincent (1980) describes social environment in France from arithmetic textbooks since the 19th century until the Second World War: he insists about the workers' world description but he doesn't speak about arithmetic pedagogical method. Brugeilles and Cromer lead researches about gender stereotypes in mathematics textbooks at the beginning of the 21th century (Brugeilles, Cromer, 2005 and others).

Others researchers focuse about didactical approach not especially on mathematics or arithmetic (Bianchini, Moyon, 2014). The University of Limoges possesses a Fund of education history, and researchers work on its old textbooks. Some projects associated teams of Limoges and Angouleme. The last publication of this program speaks about methodology to analyse old textbooks (Perret-Truchot, 2015). Another project associates French teams and Brazilian ones, particularly on textbooks published during the Third Republic in France, so after our period (for instance Siquieira Filho, Legros, 2016).

2.2 – METHODOLOGICAL CHOICES

Our aim is analysing arithmetic textbooks published during the 19th century, namely when the primary instruction developed. Ultimately the study reports on 63 old arithmetic textbooks published during the 19th century, from 1798 to 1881. We have to show firstly which way we used to select textbooks for primary schools, and secondly the periodization and the indicators we chosen to analyse them.

2.2.1 – ARITHMETIC BOOKS FOR PRIMARY SCHOOLS SELECTION

Firstly, we selected only books including arithmetic or calculus in their title. With these two words, we can find a lot of books. The corpus contains only arithmetic books. Single textbooks including arithmetic knowledge and other contents – alphabet primer, short phrases to learn reading, elements of geography or history, fables, etc. – have been excluded.

Secondly, we selected only books "for primary school use". Two cases exist. Easily, some books show in their title for whom they are intended, e.g. "primary school" (Anonyme, 1823; Vernier, 1834; Bergery, 1845), "public schools" (Reboul, 1807), or "Christian schools" (Anonyme, 1816; G. M. F. B., Th. Le G. F. B., 1861; C. P. F. J., 1863). Next, others books are intended for others people, e.g. the *Arithmétique décimale du père de famille (Decimal arithmetic of family father)* is intended for the "fathers" and "all children". But the author specifies in a note: "Messrs primary teachers can use as they wish, pass through at first, or resume later the small print" (Blanchard, 1851, unnumbered page). It means that primary teachers have been identified as books users. Some textbooks have several intended users: schoolmasters, fathers or mothers in rich families, and also young ladies when they stayed in their home to be taught. We kept all books intended for primary schools or schoolmasters, whatever their main designation.

Ultimately, we selected 63 arithmetic textbooks for analyse. This article reports analyse of these 63 schoolbooks.

2.2.2 – PERIODIZATION

Louichon (2015, p. 27) distinguishes different kinds of periodization: social, scientific and epistemological, didactical, media and technological, or based on teaching history. Like said above, the primary teaching increases a lot during the 19th century. We choose an historical periodization because for us, it's interesting to see if books and methods evolve over the period.

The analysed books body begins at the end of the French Revolution, the oldest book dates from 1798. It ends just before the vote of the great republican laws which were initiated by Jules Ferry and the Republicans. All textbooks are sorted out in four periods which are constructed according to the great texts on primary school, above cited (the Guizot law published in 1833, the Faloux law voted in 1850 and the *Organisation pédagogique pour les écoles primaires publiques de la Seine* published by Octave Gréard in 1868).

Our 63 textbooks distribute in four periods: 1798 to 1833: 10; 1834 to 1850: 20; 1851 to 1868: 21; and 1869 to 1881: 12 books.

2.2.3 – ANALYSE INDICATORS

We need to look at different elements to lead analyse.

We begin reading books' prefaces or forewords because some authors explain their aims or the pedagogical method they chose. We after carry on looking at the tables of contents when they exist. It they don't, we red all the book to extract the knowledge organization inside lesson. Some textbooks have a clear structure used in each lesson. Others don't show organized lesson plan: the knowledge presentation is linear. We can compare these two data kinds to know if author's purpose, shown in preface, is corresponding with the contents organization.

Books layout is another indicator of the used pedagogical method. Choppin (1992, p. 142-144) distinguishes four old textbooks forms. Two of them are more important, existing in our corpus: the "catechistic model" is used in 21% of our books; and the "juridical model" used in 69,3% of them. Other books (9,7%) are problems and exercises collections.

The catechistic model shows an organization where contents are set out through questions and answers which follow. Demands constitute a rhetorical proceeding to move

forward: a pupil is supposed to ask the schoolmaster, and his answer explains new arithmetic knowledge. To simplify matters, writers make short questions and short answers. This model was created for the catechism learning, it forces children to learn by heart all the contents (questions and answers) to be recited to teacher.

The juridical model is the most used in our corpus of analysed books. In this layout, contents are explained on knowledge wordings. These knowledge wordings are "wordings with theorizing and defining purposes or explaining practical rules" (Legros, 2013, 197). Learning is ordered one after another. Some writers number them, especially at the beginning of the century.

After detecting the global structure of each lesson, we want to identify what the pupils have to do during the lesson. We further carry on analyse identifying verbs used to describe students' tasks. A lot of authors make clear what students have to do: "read", "count", "write", "learn by heart", and so on. We can detect which students' abilities authors want to develop.

We have now clear indicators to collect data in arithmetic textbooks. Before presenting analyse results, we have to make a short description of analysed books.

2.3 – SHORT TEXTBOOKS DESCRIPTION

Some characteristics can describe our textbooks corpus. Firstly, the writers belong to different kinds. Some books are entirely anonymous, about 17,4%. At the beginning of the 19th century, a lot of books don't have an author, this figure decreases throughout the century. We also find another kind of anonymous writer, the "Saint-Gabriel Brothers" (*Complément*, 1855) and the "Providence Sisters" (*Abrégé*, 1848) both produced books for their schools with no named author. In the second case, books indicate some initials, like F. P. B. (1849, 1856, 1865), the famous Frère (Brother) Philippe Bransiet, writer of a lot of textbooks for the schools managed by the Christian schools' Brothers.

Secondly, before 1868, schoolbooks don't indicate the class level: everyone can use books, whatever their age or level. After this year, writers mention one level defined by the *Pedagogical Organization for Seine primary public schools*: "elementary course", "middle course" or "upper course". In this case, authors often indicate that books can be used for the middle or upper course. At last, textbooks can be used for multiple years by

pupils. They have often only one book for the duration of their studies, when they can get it.

When schoolbooks appear, they were written for schoolmasters, they were proposed to pupils later. Among all analysed books, no title contains the word “textbook”. Analysed books can be classified in five categories according to their title:

“*Abrégé*” (Concise guide). This class is often used during the first half of the century. This concise guide aims to describe contents in their condensed form.

“Treatise” is a book which presents a subject systematically and pedagogically. Treatises contain more complex contents than other textbooks.

“Courses”, “Lessons” and *“Conversations”* insist on the knowledge learning mode.

“Arithmetic”. It’s considered like a comprehensive survey of all basic and necessary knowledge discipline. Some books are named “Little arithmetic” which introduce low level. Little arithmetic seems to fit primary school level. The category of “*Arithmetic”* increases the most over the century. At the end of our period, almost 60% of textbooks designate the subject in their title.

“Others” books are brought together. Among them, there are a lot of *Exercises and Problems collections*.

Finally, typography contributes to pedagogical form. At the beginning of the 19th century, typography is very basic, layout is very simple and the text is shown in one column. There is no illustration, due to its expense. Sometimes, different characters sizes appear: the taller printed characters are intended for beginner pupils, and the smaller characters are intended for more learned pupils. In some cases, the characters size shows which contents must be learned by heart by the pupils. At last, typography is limited in our analysed books, during this century.

Now, we have to look deeper book to show up what pedagogical and learning methods are proposed by the writers.

3 – METHOD: HOW TO DO ARITHMETIC IN TEXTBOOKS

In textbooks, pedagogical method can be defined as: “the whole ways used by a master, to ensure and hasten his pupils’ progress” (Daligault, 1851, p. 119). Use of this

method allows making pupils' work easier and intellectual abilities' development. A lot of authors justify their pedagogical methods' choice in the book preface. Sometimes, writers think that arithmetic is a hard discipline. Consequently, they want to propose a good method; it has to be a short, clear and easy method, with few reasoning and no theory (Anonyme, 1823, p. 3), or "ingenious to smooth away difficulties that children meet when they're studying this arithmetic part" (Lepage, 1829, p. 6).

3.1 – THEORETICAL KNOWLEDGE AND PROCEEDING KNOWLEDGE

According to these general intents, the theory occupies a very short place in textbooks lessons. Definitions are explained in two or three lines. Some vocabulary descriptions follow. Immediately questions or knowledge wordings appear to show calculation method. For instance:

> D. What is Subtraction?
> R. Subtraction is an operation which it takes away a number from another.
> D. How do we call the result of this operation?
> R. It is called the remainder, excess or difference.
> D. How do you do to calculate it?
> R. To calculate this subtraction, we must write the smaller number (subtrahend) under the bigger one (minuend) […].
>
> (Bouillet, 1834, p. 18-19)

In this example, theory is minimal as in almost all the analysed textbooks. Then we can said that theory is not expounded for working classes children. This result appears throughout our period, until the 1870s. We wonder if writers think that the public are not interested or that children cannot understand it.

After theoretical wordings, the situation is opposed about the proceeding knowledge. To continue the previous quotation:

> R. To make this operation, we must write the smaller number [subtrahend] under the bigger one [minuend], in the matter that ones-digits, tens-digits and hundreds-digits line up in columns, and after draw a line under the second [bottom] number; we subtract each digit from the digit above, and then we write the results underneath each column where it's operating, or zero if there is no remainder.
> Example:
> We propose to subtract 59486 from 99897. This is how it is written:

> 99897
> 59486
> Remainder ……. 40411
> Beginning with the ones-digits column, I say: 6 taken from 7 equals 1, which I write at the bottom of this column. I pass to tens-digits column and I say: 8 taken from 9, equals 1, which I write at the bottom of this column. […]
> D. Which rule must be followed if the subtrahend is bigger than the minuend?
>
> (Bouillet, 1834, p. 19)

This quotation shows that texts can be very complicated. Especially for novice pupils, it's very difficult to understand them. Some wordings are explained in detail and they need good mental abilities to be understood. They become complicated as soon as the difficulty level increases. Sometimes, these explanations cover a full page, and appear very discouraging.

In these knowledge wordings, there is always one example at least. In the previous quotation, the example allows more concrete explanation throughout demonstration. That's a model that pupils have to take again and apply for other operations. As the book progresses, the reasoned demonstration disappears and just the operation and its result stay. At the end of the lesson, authors introduce the proof (la preuve en français) that's always the last step in the reasoning.

A last point has to be noted in the previous quotation example. The subtraction lesson starts with this example: 99897 – 59486 = 40411. Bouillet begins with a subtraction with five-digits numbers: there is no progression. The worse cases is observed in the *Arithmétique des campagnes à l'usage des écoles primaires* (*Country arithmetic for primary school)*: "Supposing that we want to subtract from the number 356427 the number 231233412" (Anonyme, 1823, p. 14). Here, pupils start the subtraction learning with huge numbers. How can they conceive such big numbers when they are just at the beginning of their own learning? And we wonder what's the use of such huge numbers in the children daily life. We can find the same way to learn each basic operation: addition, subtraction, multiplication and division.

Some authors propose easier examples to start learning operations, but they exist particularly during the last period, that is after 1868. Then, children can begin with examples using simple numbers, adding up units. In this group, some authors take time to progress in the teaching. Among them, Rivail (1824a, 1824b) is a Pestalozzi's student and

he uses his method in his own books. This last point shows that pedagogical thought is just at its infancy, and that didactical progression appears sometimes.

A few theoretical wordings, a lot of proceeding wordings, no progression: this is how can be defined method used in arithmetic textbooks. We can qualify it as a procedural method because procedural wording are the most present throughout lessons.

3.2 – PUPILS' TASKS

In books, what tasks required of students? What do they do to learn arithmetic?

At first, pupils have to say and write. In the previous part, we saw that some pedagogues recommend oral work and memory calculation. This work is not really present in textbooks. We can see a differentiation in the exercises between "oral exercises" and "written exercises". But there is no theory, no knowledge wording on oral work. Just one author, Bailly (1870) has written a *Méthode de calcul oral* (*Oral calculation method)*. In his method, students are gathered in front of the blackboard and the schoolmaster manages the lesson. He can use some little things to show the different numbers: tokens, coins, beans, etc. Rauber (1855) uses boards especially to teach.

Students have to repeat each number after the master. They repeat also tens and hundreds. Then they repeat the first operations: first additions, first subtractions, and so on. Pupils have to know all these things by heart perfectly, even if Bailly says: "Children should not be satisfy just saying it mechanically" (Bailly, 1870, p. 27). The master has to ensure that pupils understand addition principle.

This oral method is explained in detail by Bailly. It's a preparation to the other learning. It is based on repetitions and memorizing in order to prepare for understanding. Some other authors speak about "memory calculation", conversely the written exercises or problems.

In textbooks, oral work continues to be used in upper learning, especially to prepare mental calculation. Saying aloud seems to be the preceding step before silent calculation. When pupils count aloud, masters can observe if they have understood, if they use good procedures. Indeed, into reasoned demonstrations of operations, the students have to "say" like said in the previous quotation. Oral work helps pupils before the written work.

The written work has a great importance if we consider all exercises and problems proposed by authors. Duhaut listers all written tasks for pupils: “write, in numbers, and put the comma at its right place (…) write, in numbers, the following decimal digit relative to measures units (…) making additions in following problems (…) exercising and repeating following multiplications” (Duhaut, 1854, p. 17, 21, 27, 31 and 44). We will come back to written work with exercises and problems.

Secondly, pupils mostly have to learn by heart. Memory constitutes one of the biggest mental abilities, it’s needed to exercise other skills. For instance, memory is used while calculation. In analysed books, each author uses learning by heart; they think that it’s necessary to learn. Pupils know when they are able to recite the lesson. Parts to be learnt off by heart are set by the master.

When must memory be used? Generally speaking, students have to learn by heart “definitions, propositions, and rules” (Allion, Jullion, 1854, p. VI). More precisely, Cochard says “theoretical summaries will be learnt off by heart by pupils and explained by the master” (Cochard, 1834, p. 87). Forty-four years later, Demkès (1878, p. 4) says exactly the same. It proves that learning by heart still is an essential way to learn even at the end of the 19th century.

In textbooks lessons, we often find a “questionnaire”. It gathers questions on lesson knowledge wordings. C.P.F.J. asks to pupils: “How can we do a subtraction? What do we do when the subtrahend is equal to the minuend? And when the upper number is less than its corresponding lower?” (C.P.F.J., 1863, p. 30) The questionnaire is a tool to help students learning. They have to learn by heart questions and answers. Sometimes, questions are numbered and each number have corresponding knowledge wording. So, pupils can easily find both, and correct answer. This method is very simple for the young students. But sometimes, authors add difficulty. For instance, C.P.F.J. says that: “the master requires that pupils give an example supporting each answer.” (C.P.F.J., 1863, p. 1).

The questionnaire is given at the end of the lesson or at the bottom of each page. In analysed textbooks, Rivail (1824a) is the first author using questionnaire – according Pestalozzi’s method. But this tool is more used in the second half of the 19th century. If idea is the same, its name can be different depending on authors: e.g. Bos (1872) proposes “Summary”; Leyssenne (1875) says “theoretical exercises”. From the middle of the century, authors show what students have to memorize and learn off by heart. But no one explains the best way to learn by heart. At last, pupils have to learn theoretical and

proceeding knowledge wordings. Memorizing is an important part of learning. In the procedural method, memory helps to understand rules and proceedings easily and better.

3.3 – DOING A LOT OF EXERCISES

To ensure good learning, pupils have to practise. After memorizing, they have to apply the theoretical proceeding knowledge. Textbooks gather lots of pages with application exercises. Different kinds of exercises exist in the lessons.

At first, "the master must perform the calculation by students, giving them the start of the lesson, oral answers they have to say with quickness" (G.[eorges], 1850, p. IV). Differentiation between oral exercises and written exercises comes later, around the middle of the century. Like Bovier-Lapierre (1868, 19-20) says: oral calculation are necessary to prepare for mental calculation. Everyone needs mental calculation in their daily life. This author is the only one proposing strategies to perform mental calculation and helping pupils. For example: "Add up 26 and 45. We observe that 40 and 20 are 60, that 5 and 6 are 11, and so we find 71. Add up 26 and 49. In this case, it's simpler to add 50 and 26, being 76, and subtract 1, and then it is 75" (Bovier-Lapierre, 1868, p. 124).

Two points must be underlined about mental calculation. Firstly, the operations have to be practised by students without the help of written notes; all the reasoning is mental. Secondly, the speed has also to be worked on. For instance, Leyssenne is very demanding; he says and repeats: "Like with addition, we must quickly get used to operate rapidly, pronouncing less words as possible" (Leyssenne, 1875, p. 39) Counting paperless, just mentally, is faster; and in the daily life, men often need quickness, for example when they buy or sell.

After practising oral calculation, pupils must pass written practise. The work begins with writing numbers. Students are quick to deal with numbers, and do small operations. It begins with a few exercises and then, little by little, it grows. Throughout the century, authors of textbooks propose more and more exercises. In his books, Vernier (1834, p. 44) gives nine problems to train addition. Twenty years later, Allion and Jullion (1854) propose, just for addition training, more than seventeen pages composed with fifty additions of two three-digits numbers, and twenty additions of six nine-digits numbers! Another way to train is to use one huge exercise, like this: "Find the quotient of

42545503982662686018 by 607009" (Chastel, 1868, p. 95). But we wonder how to use this kind of examples in the daily life.

Training can be given by doing exercises, or also solving problems. But what is a problem? A lot of authors answer in their own textbooks. For instance, Bergery says that a problem is "a question, in which we ask one or several unknown numbers, giving their relations with known numbers. Solving the problem is answering the question, establishing unknown number or numbers. Found numbers constitutes the solution" (Bergery, 1837, p. 54). Solving a problem is a complex task and needs reasoning, cognitive proceedings to produce an answer.

To achieve this complex task, some authors can help students, proposing some strategies. For example, in 1876, Grimon and Tilmant explain with more details: "Before starting a problem resolution, and after having clearly recognized the set down question, the first demand is to know which numbers are necessary to find the unknown one, then, examine if the wording explicitly contains these figures, to apply the right operation. When necessary numbers are contained just implicitly in the question, we must begin to find them using their relations with known numbers, then using them like it is said just before" (Grimon, Tilmant, 1876, p. 8). So, the first step to solve a problem is to find the right numbers and then after apply the right rule.

But why have pupils to solve problems? Bouillet think that it increases mental reasoning: "Knowing arithmetic theory, discerning its subjects are not enough to know perfectly this science: also we have formed problems collects to support theory, improving by this way, intellectual abilities students" (Bouillet, 1834, p. 4). This reason is not used by other authors. They give other reason, according with Daligault: "an excellent way to make practical arithmetic teaching is to present more often operations as problems relating to ordinary questions" (Daligault, 1851, p. 170-171). These "ordinary questions" in problems allow the introduction of some fictitious characters, like a mother, a man, a baker, and so on. These characters make easier representation of situation and entry in problems.

At the beginning of the 19th century, schoolbooks propose a few problems. We already said that Vernier (1834) adds some "questions" at the end of each lesson. Others words can be used: "examples", "preparatory exercises", "exercises", or "demands". Whatever its name, these problems appear later. In 1845, Bergery and Bouillet introduce "problems" in their own books. In the second half of the 19th century, problems are given more often. There appears to be competition between authors to propose more problems.

For example, Chardon (1845) gives “400 exercises and 400 problems”; Bellugou (1859) introduces “900 exercises and problems”. The most is given by Besançon-Robinet (1860) who proposes “1800 easy problems relating of all life ordinary uses”, like said in title.

The systematic use of problems in textbooks by the end of the 19th century proves an evolution of pedagogical practices in primary schools. Training is more and more present in arithmetic learning. But did students do all exercises? That is not known. Another reason can explain the increasing number of problems: preparation to achieve a diploma. At the end of primary school, some students can prepare for the “Primary studies certificate”, others can also try preparing the “Abilities certificate” to enter into Primary normal schools. Obtaining one of these certificates is often difficult, needing a lot of training. Textbooks propose this training.

But why are all these problems used during the training? Sarrazy proposes his point of view: “didactic tools at the beginning, it becomes little by little a teaching object which is supposed to have intrinsic didactical properties independent of knowledge useful to its solving” (Sarrazy, 2003, p. 87). Sometimes, solving a problem is useful to… solving a problem, and its peculiar property can be forgotten.

At last, it can said that, for pupils, *learning* arithmetic is *doing* arithmetic, because children have to do a lot of exercises and – after – solve a lot of problems. The final aim of its proceeding method is to know how to use operations and rules in their daily life.

CONCLUSION

Generally, pedagogical method used in textbooks is a procedural method. It almost ignores theoretical knowledge, and it develops proceeding knowledge. Authors answer mostly these different questions: how to make an addition? How to perform a subtraction? And so on. Textbooks show full pages with description of proceedings, sometimes it’s very difficult to understand them. Moreover first examples given in lesson are composed with big numbers, sometimes eight-digits numbers. The method proposed in schoolbooks gathers definitions, some lexical precisions, and rules. Immediately an example and the description of its proceedings follow. In each lesson step, a demonstration shows how to operate with an example (sum and reasoning to do it). The lesson ends with the proof and the questionnaire.

Two kinds ok work are proposed to students, first is oral calculation and second is written work. At first, pupils have to train with oral calculation so they have to repeat numbers and operations proceeding, sometimes using boards. This work is a preparation of mental calculation and written work. Students have also to learn by heart a lot of contents; definitions, wordings, rules, etc. The questionnaire tests the knowledge pupils have learned – by heart.

After, students have to practise. Exercises and problems are proposed to train the lesson subject. First pupils have to train mentally and orally. Secondly they have to train written practise. At the end of our period, textbooks propose a huge number of exercises and problems. Training is very important to ensure pupils are learning and to mechanize some proceedings. Some authors add that students have to operate as quick as possible. Finally, the arithmetic learning must help pupils to resolve some problems, arithmetic problems and daily life problems. Because the arithmetic aim is giving students some tools useful for their future life.

Rare textbooks propose using another method: the intuitive method. In corpus, Rivail (1824a, 1824b) is the main representative. This method allows learning arithmetic very slowly, beginning with concrete exercises in which children have to count numbers, and play with different things. The intuitive method appears during the 19th century in France. It will be interesting to study it more precisely in textbooks.

Arithmetic schoolbooks are rather indistinct. Some questions stay: how are they used in the classrooms? Are they intended for pupils or for schoolmasters? How masters did use them? Reading page after page or choosing certain pages or exercises? Etc. But these books show a part of the arithmetic learning during the 19th century.

ANALYSED TEXTBOOKS CORPUS (IN CHRONOLOGICAL ORDER):

1. Delile J. Cl. : *Abrégé de l'Arithmétique Méthodique et Démontrée à l'usage des écoles primaires et pour les jeunes citoyennes*. Paris : Chez l'Auteur et chez des libraires. 1798. 120 pages.
2. Reboul Antoine-Joseph : *Traité élémentaire d'arithmétique à l'usage des écoles publiques et des jeunes gens qui se proposent de subir des examens*. Avignon : Seguin Frères. 1807. 264 pages.
3. Anonyme : *Abrégé d'Arithmétique à l'usage des écoles chrétiennes*. Lille : L. Lefort. 1816. 89 pages.
4. Anonyme : *Abrégé d'Arithmétique, suivi du calcul décimal à l'usage des écoles primaires*. Avignon : Jean-Albert Joly. 1816. 115 pages
5. Anonyme : *Arithmétique des campagnes à l'usage des écoles primaires*. Paris : Bachelier, et Metz : Vve Thiel. 1823. 116 pages.

6. Rivail H. L. D. : *Cours pratique et théorique d'Arithmétique, d'après la méthode de Pestalozzi, avec des modifications*. Tome Premier. Paris : Pillet Aîné. 1824a. 192 pages.
7. Rivail H. L. D. : *Cours pratique et théorique d'Arithmétique, d'après la méthode de Pestalozzi, avec des modifications.* Tome Second. Paris : Pillet Aîné. 1824b. 396 pages.
8. Anonyme : *L'Arithmétique nouvelle dans sa véritable perfection*. Epinal : Pellerin. 1826. 24 pages.
9. Lepage A. : *La clef de l'arithmétique ou Livret à l'usage des écoles élémentaires*. Paris : Louis Colas. 1829. 28 pages.
10. Bergery C. L. : *Arithmétique des écoles primaires ou Leçons populaires sur le calcul*. Metz : P. Wittersheim. 1831. 156 pages.
11. Anonyme : *Abrégé d'Arithmétique décimale, à l'usage des écoles primaires*. Nouvelle Edition. Paris. Chabert et Cie. 1834. 96 pages.
12. Bouillet J. : *Eléments d'Arithmétique théorique appliquée, sur un plan méthodique*. Paris : Bachelier, et Hachette ; et Metz : Mme Thiel. 1834. 370 pages.
13. Cochard A. : *Entretiens sur l'Arithmétique ou Premier livre de lecture et de calcul, à l'usage Des Familles et des Ecoles élémentaires.* Montmédy : Henry. 1834. 246 pages.
14. Vernier H. : *Petite Arithmétique raisonnée à l'usage des écoles primaires*. Paris : L. Hachette, Firmin Didot Frères et P. Dupont. 1834. 144 pages.
15. Baget J.-J. : *Leçons élémentaires d'arithmétique raisonnée, à l'usage des écoles primaires, des classes élémentaires*. Laon : Chez l'Auteur, au Collège, et chez Lecointe, et Paris : Hachette. 1836. 272 pages.
16. A[deline] : *Abrégé d'arithmétique décimale, pour les commençants*. Bar-sur-Aube : Millot. 1837. 36 pages.
17. Bentz L. : *Premiers éléments d'Arithmétique*. Paris : Delalain, Poilleux, Marie-Nyon ; Lyon : Giberton et Brun ; Nancy : Vidart. 1837 (4e édition). 167 pages.
18. Bergery C. L. : *Compléments de calcul des écoles primaires*. Metz : Mme Thiel ; et Paris : Bachelier, Chamerot, Hachette et Delalain. 1837. 228 pages.
19. Dessez N. : *Traité élémentaire d'arithmétique, à l'usage des écoles primaires*. Deuxième édition. Toul : Ve Bastien. 1839. 72 pages.
20. Elèves de l'école Normale des Hautes-Alpes : *Abrégé d'Arithmétique*. Gap : J. Allier et Fils. 1839 (2e édition). 99 pages.
21. S….. : *Abrégé d'Arithmétique décimale, à l'usage des écoles primaires*. Nouvelle Edition. Paris : J. Moronval. 1839. 120 pages.
22. A. G.-C. : *Une première année d'arithmétique*. Saint-Calais : Peltier-Voisin. 1843. 50 pages.
23. Bergery C. L. : *Arithmétique des écoles primaires*. Metz : Mme Thiel, Varion, et Paris : Hachette, Chamerot. 1845. 220 pages.
24. Chardon C. A. : *Arithmétique primaire élémentaire*. Paris : Hachette, J. Moronval, Maugars ; Lyon : Vve Chardon. 1845. 120 pages.
25. Elèves de l'école Normale des Hautes-Alpes : *Abrégé d'Arithmétique*. Gap : J. Allier et Fils. 1847 (4e édition). 107 pages.
26. Eysséric [Antoine-Dominique] et Gautier J. P. : *Petite arithmétique des écoles primaires*. Vingt-huitième édition. Paris : Delagrave et Cie. S.d. [entre 1847 et 1859]. 168 pages.
27. Anonyme : *Abrégé d'arithmétique par demandes et par réponses, Destiné aux écoles dirigées par les Sœurs de la Providence.* Deuxième édition. Raon-l'Etape : J.-C. Docteur. 1848. 70 pages.
28. F. P. B. (Frère Philippe Bransiet) : *Nouveau Traité d'Arithmétique décimale*. Quarantième édition. Tours : Ad Mame et Cie ; et Paris : Poussielgue-Rusand. 1849. 334 pages.
29. Lambert et Faye : *Arithmétique mise par demandes et par réponses*. Saint-Mihiel : Casner. 1850. 84 pages.
30. Ritt G.[eorges] : *Nouvelle arithmétique des écoles primaires*. Nouvelle édition. Paris, L. Hachette et Cie. 1850. 308 pages + IV.
31. Blanchard T. : *L'Arithmétique décimale du père de famille*. Clermont-Ferrand : Thibaud-Landriot Frères. 1851 (3e édition). 131 pages.

32. Anonyme : *Arithmétique théorique et pratique, d'après le programme donné Aux écoles de Lyon.* Cours de Première année. Edition de l'élève. Paris : Dezobry et Magdeleine. 1853. 70 pages.
33. Anonyme : *Arithmétique théorique et pratique, d'après le programme donné Aux écoles de Lyon.* Cours de Deuxième année. Edition de l'élève. Paris : Dezobry et Magdeleine. 1853. 106 pages.
34. Coton L. : *Recueil de 1200 problèmes d'Arithmétique*. Lyon et Paris : Périsse Frères. 1853. 52 pages.
35. Anonyme : *Arithmétique théorique et pratique, d'après le programme donné Aux écoles de Lyon*. Cours de Troisième année. Edition de l'élève. Paris : Dezobry et Magdeleine. 1854. 124 pages.
36. Allion Augustin et Jullion Victoire : *Nouvelle Arithmétique élémentaire théorique-pratique, à l'usage des écoles primaires des villes et des campagnes*. Anzin : Boucher-Moreau. 1854. 72 pages.
37. D.[Duhaut] J. : *Arithmétique usuelle des villes et des campagnes*. Troisième édition, Lunéville : Chez l'Auteur, et chez les Libraires. [1854]. 216 pages.
38. Anonyme : *Complément d'Arithmétique élémentaire théorique et pratique. A l'usage des Ecoles, dirigées par les Frères de Saint-Gabriel*. Vannes : Lamarzelle. 1855. 212 pages.
39. Rauber J. B. : *Tableaux d'arithmétique ou Introduction à l'étude pratique et théorique du calcul*. Metz : M. Alcan ; Paris : Borrani et Droz. 1855. 24 tableaux.
40. Chardon C.-A. : *Traité pratique d'Arithmétique usuelle. A l'usage des Ecoles des Marchands, des Agriculteurs et des Ouvriers*. Paris : Hachette ; Delalain ; L. Colas ; Maire-Nyon ; Périsse ; Pélagaud et chez l'Auteur. 1856 (9^{e} édition). 290 pages.
41. F. P. B. : *Abrégé d'arithmétique décimale*. Tours : Mame et Cie, et Paris : Poussielgue-Rusand. 1856. 72 pages.
42. Bellugou J. G. : *Arithmétique des écoles rurales*. Livre de l'élève. Pézenas : Eugène Richard. 1859. 141 pages.
43. Besançon-Robinet : *Arithmétique pratique des écoles primaires*. Paris : Ch. Fouraut ; Langres : M. Dallet ; et Chaumont, M. Simonnot-Lansquenet. 1860. 227 pages.
44. G. M. F. B. et Th. le G. F. B. : *Abrégé d'Arithmétique à l'usage des écoles des Frères de l'Instruction chrétienne*. Vannes : Libraire De Lamarzalle ; Rennes : Hauvespre et Thébault ; Saint-Brieuc : Huguet ; Lorient : Charles. 1861. 105 pages.
45. Bechet J. F. : *Traité d'arithmétique à l'usage de l'enseignement primaire*. Deuxième édition. Paris : Cantel, Hachette et Maugars, et chez l'auteur. 1862. 298 pages.
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55. Xavier : *Petite arithmétique simple et facile*. Lyon : Ch. Palud, Librairie de l'académie et des écoles. 1875 (2e édition). 25 pages.
56. Auvert U. : *Arithmétique et système métrique. 1.500 Exercices et problèmes*. Cours moyen. Paris : Gedalge Jeune. 1876. 80 pages.
57. Grimon B. et Tilmant M. V. : *Enoncés des problèmes d'Arithmétique*. Paris : Librairie classique d'Eugène Belin. 1876. 119 pages.
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