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Tachymetry as Resource for Teaching Mathematics in Brazil at the End of the Nineteenth Century

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ABSTRACT

This article deals with the history of educational materials for the teaching of mathematics in Brazilian education in the last years of the 19th century. The assumption is that the production and use of these resources are related to the methods and other elements of school practices and cultures. The objective is to describe historical elements of the diffusion of the tachymetric method in Brazil, indicated for the teaching of mathematics, from the French influence. It was observed that, faced with the challenge of the expansion of popular primary education, there was a tendency to value material resources created in the diffusion of the intuitive method, strongly prioritising the sense of vision and admitting the possibility to obtain almost immediate results, without presupposing the axiomatic formalisation and deductive. Among the educational materials of the time were those of the tachymetric method that wanted to facilitate the study of mathematics in primary elementary schools.

Keywords: Didactic materials; Intuitive method; Material Culture; Didactic resources; Didactics of Mathematics.

A Taquimetria como Recurso para o Ensino da Matemática no Brasil no Final do Século XIX

RESUMO

Este artigo trata da história dos materiais didáticos para o ensino da matemática, na educação brasileira dos últimos anos do século XIX. Parte-se do pressuposto de que a produção e o uso desses recursos estão relacionados aos métodos adotados e a outros elementos das práticas e culturas escolares. O objetivo é descrever elementos históricos da difusão do *método taquimétrico* no Brasil, indicado para o ensino da matemática, a partir da influência francesa. Constatou-se que diante do desafio da expansão da instrução primária popular, houve a tendência de valorizar recursos materiais criados no quando de difusão do método intuitivo, priorizando fortemente o sentido da visão e admitindo a possibilidade obter resultados quase imediatos, sem pressupor a formalização axiomática e dedutiva. Entre os materiais didáticos da época estavam os do método taquimétrico que pretendia facilitar o estudo da matemática em escolas primárias elementares.

Palavras-chave: Materiais didáticos. Método intuitivo. Cultura Material. Recursos didáticos. Didática da Matemática.

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INTRODUCTION

Tachymetry as a method of teaching elementary mathematics and the materials provided for its use were invented by the French engineer Édouard Lagout (1820-1885), head of the city's Paris bridges and sidewalks service, at the beginning of the second half of the century XIX. The main objective of this article is to describe historical elements of the production and dissemination of this method, marketed by French companies of the last decades of the nineteenth century, including collections of manuals, accompanied by a box with illustrative pictures and concrete materials and instruction sheets for teachers.

Without considering the merits of the originality of the material, considering how much it was in tune or not with the postulates of the intuitive method or the lessons of things, it should be noted that this engineer, inventor of the material, was close to an influential group of other engineers, astronomers and mathematicians. This observation is justified because different figures of the material, used as a means to learn with the support of the vision, have long been present in the long history of textbooks and texts used in the traditional teaching of school mathematics. Although disclosed as a method to teach different parts of mathematics, the tachymetry discussed in this article refers more to the case of elementary geometry, disclosed as a resource to highlight properties of geometric figures, quickly and accessible by viewing manipulable material or through illustrations reproduced in the book or chips.

The main characteristic attributed to the method was the possibility of students of elementary schools or professional schools to grasp quickly and directly the properties of geometric figures and the statements contained in the theorems. This supposed quality of the material invented by Lagout is expressed by the Greek prefix *taqui*, which means fast, fast, realised in a short time, in the composition of the word used to denominate the teaching method.

Regarding the origins of the so-called *tachytechnique*, the pioneering writers mention the desire to make D'Alembert's plan viable, in order to provide a basis for building a mathematics accessible to all and thereby broaden the learning of the arts and crafts. At that moment, there was a debate among the intellectuals about the necessary conditions for the expansion of popular school education, idealised by the Encyclopaedists, in order to prepare the population for the coming new century.

THEORETICAL REFERENCE

As far as the pioneerism of Édouard Lagout, as creator of the method, we find a detailed description on the subject in the book of professor Jules Dalsème, titled "*Enseignement de l'arithmétique et de la géométrie*" [Teaching of Arithmetic and Geometry], edited by the Official Press of France, Paris, in 1889. It is a manual for primary elementary education, focusing on practical aspects, with the application of numbers and elementary arithmetic operations and problems with plane and space geometry, with calculations of areas and volumes.

In the context of the pedagogical theories spread in the late nineteenth and early twentieth centuries, the creation of the tachymetric method expresses the way in which its creator appropriated the more superficial principles of the intuitive method and the lessons of things (Schelbauer, 2006). Faced with the references of this pedagogical context, the author formalised strategies to enable the teaching of mathematical disciplines from elementary level to popular public education and vocational schools. Thus, in order to deal with the abstract dimension of mathematical concepts, the resources of the tachymetry were directed towards the "visualisation" of concepts through figures and objects.

METHODOLOGY

In professional education schools, tachymetry was widely publicised as an efficient and safe way to provide geometric knowledge to construction masters, in charge of the construction of houses, stained-glass windows, gradients, sidewalks, fountains, squares and public thoroughfares.

In this sense, the courses taught with the method explore aesthetic aspects of symmetry of the geometric figures, as well as properties of similar and congruent figures. Although it was created to teach all the mathematical contents, the method was better known in Geometry teaching, aiming at the possibility of obtaining faster learning, of a practical and direct nature, without prioritising the theorising of the usual deductive logic in the mathematical demonstration.

In order to analyse the conditions that underpinned the function attributed to the method and its functionality, in the line proposed by Chervel (1990), it is necessary to focus the context of the last decades of the nineteenth century, when there was an expansion of the supply of the popular primary education. Paris was the focal point of the lights of modernity. Several technologies were being manufactured and made available in a market hitherto never seen by capitalism. A convergence of interests has decided to foster the creation of popular primary schools.

The methods of copying, memorising, of catechetical type, were no longer adequate for the schooling of the new century that was being heralded. It was at that moment that the broad diffusion and valorisation of the intuitive method and the lessons of things began, opening space for the production of didactic materials for the school disciplines. Large companies from France and other countries started to produce the most varied materials for primary schools. According to catalogues for the sale of school materials available on Gallica's website, the National Library of Paris, companies started to market collections of materials, stored in glass-enclosed cabinets. These sets were called "compendia", which then started to "compete" with the compendia in the sense of books with the essential part of teaching.

The tachymetric method was produced in the pedagogical context of exploration of the information coming from the sensation of the human body in relation to the outside. Among the different types of intuition, the approach explored by Lagout was more

focused on the visualisation of the figures and their elements. In other words, it is a more immediate and direct methodological path, without necessarily requiring the abstractions typical of the axiomatic reasoning, supported by the so-called deductive logic, especially in the initial moments of learning.

The possibility of learning geometry with the method remained an open question since its creation seems not to be associated with the production of teachers in contact with the classroom. On the other hand, there are signs of the emergence of a strong market resulting from the opening of large numbers of popular primary schools in different countries. In general, among the tachymeter books written by Lagout, about two tens, one can find some with up to 400 pages. However, most of them had a reduced number of pages. These little books were called treaties, at affordable prices for governments that intended to open primary schoolchildren. Some were accompanied by a box of materials, to be used according to the guidelines described in the manuals.

The books were affordable if compared to the voluminous treatises for secondary education.

There was a potential market for low-cost products to enable the strategy of expanding the number of popular primary schools. The author had among his academic credentials the experience of having studied at the Polytechnic School of Paris. The diploma obtained in the renowned institution assured to him the public position of engineer of the corps of officers of the Empire in charge of the services of sidewalk bridges of the city of Paris.

Édouard Lagout had a vast culture in the field of the arts, literature, humanities, as well as passing through the positive sciences and distinctive taste for elegant architectural projects. With these credentials, the author writes about *equations of beauty, algebraic sensations, numbers of perfect proportions*, among many other subjects that allowed a "new look" on the austere, logical and rigorous Euclidean geometry. The tachymetric teaching method allowed the primary teacher to "demonstrate" theorems or geometric properties only by leading students to contemplate figures or to manipulate some concrete materials.

Like other authors who wrote about the tachymetric method, Édouard Lagout prioritised the study of practical applications of mathematical contents, with the difference of emphasising aesthetic elements of geometric figures, with the numerical treatment of the different types of proportions, including the so-called divine proportion. As to this specific aspect, we find in the digitised collection of the *Gallica* project, maintained by the National Library of Paris, the work of its authorship, with 16 pages, titled *Esthétique Nombrée ou Justesse des Proportions*. [Measurement of Aesthetics or Accuracy of Proportions], published in 1862 and edited by the author, identified as an engineer in the service of building bridges and sidewalks in Paris.

In the exercise of his position in the imperial body, Édouard Lagout taught a course in Italy to train qualified professionals in the construction of bridges, sidewalks, squares and fountains. As stated in the introductory part of the book mentioned above,

Italian professionals should complete the course with a much-reduced workload. Thus, in the short time available, he should strive to convey practical geometric and algebraic knowledge. It was this challenge that led him to idealise the method with a strong appeal to the visual aspect.

A query in the digitised collection of the National Library of Paris allows affirming that among the principal authors who wrote on the tachymeter, in fact, is engineer Édouard Lagout. Nevertheless, the creation of the method would have *the competition of mathematicians, university professors and engineers associated with the national body of mines*. In this sense, it is possible to highlight the name of the French mathematician and astronomer Urbain Le Verrier (1811-1877) and the engineer Charles Lefébure de Fourcy (1815-1904) who served as inspector general of the Paris bridges and sidewalks service.

RESULTS AND ANALYSES

Concerning the circulation of the tachymetric method in France and the strategies used in the diffusion of the material, we find in the French newspaper *La Croix*, of Paris, edition of December 5, 1884, a commercial of the work *Takitechnie Encycloplédie des Mathématiques Élémentaires*,[1] authored by Edouard Lagout (Figure 1). This material was composed of a four-volume collection, a type of brochure, accompanied by a box containing the materials needed to use the method, which is a more economical model of teaching compendium, at a total price of 20 francs. When comparing this price with other advertisements of the time, it is perceived that it is a more affordable value, in relation to the price of scientific or literary texts.

At the time considered the term "compendium", in addition to being used to designate a school text gathering the essential part of the contents to teach, it was also used to name collections of didactic materials, usually marketed in boxes or cabinets of different sizes, indispensable for the teacher to follow the modern methods that were in vogue. In other words, there was a vast world market that encouraged the creation of companies specialised in the manufacture of school materials. Digitised catalogues of these products can be found on the *Gallica* platform, maintained by the National Library of France.

As a strategy for the dissemination of the material, it was announced that Édouard Lagout had sent in a report to the Minister of Public Instruction, explaining his reflections on the reform of teaching methods that were being prepared by the Superior Council of Public Instruction. In this sense, it is perceived that the appropriations of the author of the principles of the intuitive method were in line with a favourable conjuncture in the face of the expansion of popular instruction. Aiming to convince the experts, the author stated that it would be possible to assimilate the method with only 3 conferences and 20

[1] Tachytecnics Encyclopaedia of Elementary Mathematics.

lessons to fulfil the official program of one year of studies. In this case, it seems that the lessons for pupils with conferences for teachers are confused.

There is a further feature of the invention in the disclosure of the invention. The author donated the material, through the ministry of public education, to the libraries of Paris and to another 184 libraries in the interior of France. Moreover, every Monday, at night, at the city hall, popular courses were offered for the practical use of the method. These classes were taught by a teacher of the engineer Lagout's trust.

For the cities of the interior, there was a teacher available to give three public initiation lectures, charging only the amounts corresponding to the expenses.

TAKITECHNIE

ENCYCLOPÉDIE DES MATHÉMATIQUES ÉLÉMENTAIRES

Conseil supérieur

Dans un rapport au Ministre, sur la Réforme des méthodes à l'étude au Conseil supérieur, M. Lagout établit que la *takitechnie* (1) assimile en 3 conférences et 20 leçons tout programme officiel d'une année scolaire.

Avis aux Etudiants

Le Ministre de l'Instruction publique vient de distribuer, par don gratuit de l'auteur, M. Lagout, la *takitechnie*, (*tachus* prompt, *techné*, sciences) aux grandes bibliothèques de Paris et à celles des 184 principales villes de France.

Cours populaires à Paris et en province

A Paris, des cours publics de *takimétrie* et de *takim-algèbre* ont lieu tous les lundis soirs de 9 heures à 10 h. 1/2 à la mairie du quatrième arrondissement (hôtel de ville) par un délégué de M. Lagout, ingénieur en chef, auteur de la nouvelle méthode.

Pour la province, un professeur est disposé à aller faire 3 conférences publiques d'initiation moyennant le simple remboursement des frais : 50 fr. fixe, et un permis de 2e classe.

Figure 1. Newspaper *La Croix*, of Paris, edition of December 5, 1884.

In the mid-1870s, Édouard Lagout was embedded in a well-articulated network of French institutions, with the support of which he produced the material, edited the manuals and disseminated the method, promising a quick way of accessing the practical knowledge of elementary geometry and other subjects of school mathematics. In this sense, one of the strategies for disseminating the material was to give public lectures in schools and other places, inviting parents, teachers and authorities to listen to the conference and watch the material being shown. Announcements of these lectures given by Lagout can

be found in Brazilian newspapers, as is the case of a note published in *Diário do Janeiro*, edition of June 15, 1877.

This conference was given in the auditorium of the School of Bridges and Sidewalks in Paris, in which Lagout made a detailed presentation before a ministerial committee in charge of the French patent service. In this way, it is possible to perceive that, in the context of the last decade of the imperial regime, the first signs of dissemination in Brazil of the teaching method through the tachymetry begin to appear. The central theme of the conference was the application of the method in the teaching of geometry. Sometime later, the commission published an evaluation report, concluding that the method created by the illustrious engineer could produce "a true pedagogical revolution" in the teaching of the exact sciences. The institutional evaluation of didactic material functions as a channel of strategic propagation, primarily when production is intended to penetrate the vast national education systems.

Without being attached to the usual rigours valued in the classical aspect of mathematics teaching, the tachymetric method evaluators record that the author was able to "physically demonstrate" that the square of the hypotenuse of a right triangle is equal to the sum of the squares of the legs. In this way, the inventor of the material appropriates a series of classic graphic illustrations, which are used as support for the development of deductive mathematical reasoning, typical of Euclidean thought. Nowadays, as can be verified in textbooks, the presence of these material resources persists, whose use presupposes the articulation between numerical, graphical and algebraic representations, in the same sense of diversifying the language used in teaching.

In the tachymetric method, published over a century ago, the triangles and squares that appear in Figure 2 were constructed of concrete material, causing the student to manipulate the pieces to prove that the area of the square whose side is the hypotenuse is equal to the sum of the areas of the two smaller squares. In algebraic language $(a + b)^2 = a^2 + b^2 + 4\,(ab)/2$, from which the classical algebraic expression $(a + b)^2 = a^2 + 2ab + b^2$.

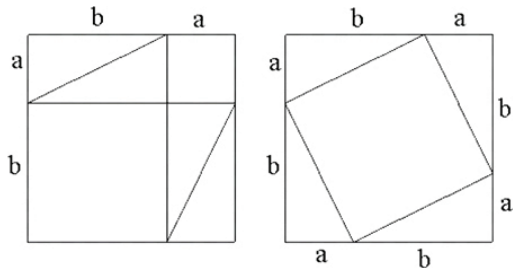

Figure 2. Classical illustration used to demonstrate Pythagoras' Theorem.

Along the same lines, Lagout's method included other material resources for the teaching of geometry formulas, such as intuitively approaching the area of a circle of radius r by a series of triangles. In other words, with regard to the aforementioned "physical demonstration" of geometrical theorems and properties, admitting the precedence of the

material aspect over deductive logic, it should be noted that, after almost a century and a half, material resources for teaching geometry and its articulation with numbers and algebraic expressions, principles that we consider to be associated with the notion of diversification of languages.

The teaching of the logical-deductive method was not a priority in this area in which tachymetry followed the impulse of the popularisation movement of school education at the end of the Nineteenth Century. The material used in the tachymetric method allowed validating expressions of the type: $(a + b)^2 = a^2 + 2ab + b^2$ ou $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$. These and other features of this method are still present in current mathematical textbooks.

In general, it is clear that the purpose of the material was to increase the intellectual and productive value of teaching and to remove the false rules in use, referring to the hitherto predominant teaching style of copying and repeating, devoid of meaning and significance for the student. The French author, interpreted by Professor João Antonio Coqueiro, also said that the *doctrine* of his method consisted of *from the simple to the compound, from the cube to the polyhedron, from the particular to the general, from the known to the unknown, from the particular to the general, and finally from the concrete to the abstract.*

In considering the relationship between the teacher's formation and the legacy left by the historical past, as described by Cláudia Alves (2012) and also how she considered, in the specific field of History of Mathematics Education, Maria Maura Magalhães Gomes (2018) delivered at the closing session of the IV ENAPHEM, held in Campo Grande (MS). In other words, in the broad sense of teacher education, the survivals of educational materials of the past in the present, even when preserved with new languages and consortium with other current information technology resources, must be considered.

A didactic material related to the principle of visualization adopted in the tachymeter method and which can still be found in contemporary textbooks and in the teaching practices of mathematics teachers consists of using cardboard cut-outs and illustrations on a sheet of paper to show the student, in a visual way, that the sum of the internal angles of any triangle is equal to two right angles. Figure 3 illustrates the presence of this type of material at present, although in an articulated way with the deductive reasoning of geometric properties.

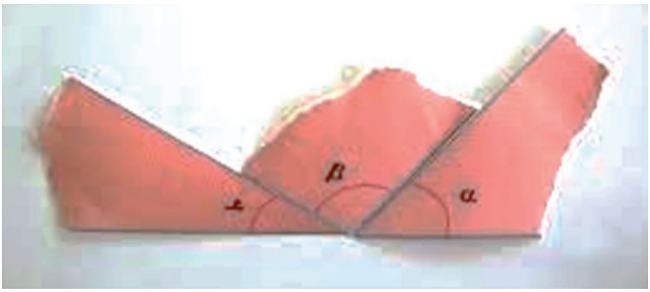

Figure 3. Material used to demonstrate that the sum of the internal angles of any triangle is equal to two right angles (www.laboratoriosustentaveldematematica.com).

To strengthen the basis of his appropriation of the intuitive method, whose principles are almost the same as those we have just described, Édouard Lagout uses *Rules for the Direction of the Spirit*, of René Descartes, in the sense of fighting what he calls *false methods built inside out of the human brain*, referring to the classical mathematical teaching procedures that support the beginning of learning from abstract bases to arrive at a concrete reference or from a generic statement to arrive at the particular case.

However, the success of a production depends on a convergence of factors, among which institutional strategies, and it is almost impossible to spread a great invention in the solitude of an isolated initiative. Keeping in mind this, the French author who wrote several books on tachymetry in the teaching of mathematics resorts to the speech of the Minister Jules Ferry, delivered to the French primary teachers, on April 2, 1880, in the sense of not supporting what he called inversion of their teaching methods, prioritizing abstractions to the detriment of concrete and utilitarian aspects. It was based on these ideas and in this context that the Lagout method prioritized the use of diagrams, demonstrative images gathered in tables, so that one could "*learn by just one glance"* the first elements of the discipline, but exaggerates in considering this type of knowledge as "*principles and truths*", although the product had a precise function to attend to the genesis of a discipline destined for popular instruction (Chervel, 1990).

Jules Dalsème emphasises aspects of the first geometry lessons for which the teacher should be attentive, noting that besides taking care of language and objects in geometric form, it was necessary to do a careful work with figures and drawings only to start calculations of interest geometric. Jules Dalsème emphasises aspects of the first geometry lessons for which the teacher should be attentive, noting that besides taking care of language and objects in geometric form, it was necessary to do a careful work with figures and drawings only to start calculations of interest geometric. He states that even though Mr Édouard Lagout pioneered the proposition of the so-called method of tachymetry, many active masters and zealots already knew how to explore the principles formalised in the texts dealing with method.

These masters knew how to use objects made of wood, cardboard, and other simple materials to assemble geometric figures. Cutouts and gluings are also features that many teachers often use. *All these simple materials can be called materials of the tachymetric method*, Dalsème ends, in order to value the effective production of the teacher, regardless of the name attributed to a method or educational resource. Thus, he observes that, in applying the method of tachymetry, it would be necessary to distinguish the word from the thing. The word was introduced by Édouard Lagout (Dalsème, 1889, p.22).

Two months after the end of the Pedagogical Exhibition of Rio de Janeiro, at the end of 1883, the *Lagout's tachymetry* was disclosed as a modern method practised in the primary education of the Menezes Vieira College, directed by Professor Joaquim José de Menezes Vieira. A private educational institution that offered primary, secondary and vocational courses. Even though it was a private institution, this college was inserted in the social and political context of the expansion of instruction for the popular classes.

However, the strategy of disseminating the methods adopted at the college continued to be the conferences announced in the local press.

One of these lectures was delivered by Professor Ulisses Cabral, a member of the faculty of Menezes Vieira College, according to an announcement published in the Rio de Janeiro newspaper *Gazeta de Notícias*, October 7, 1883 (Figure 4), using the term *taquitécnica* as an efficient method for teaching different contents of mathematics. As the lecturer argued, the primary basis of the method, also called the integral method by other authors, is the articulated *pictures, objects, and demonstrative diagrams*. Still according to the said professor, "*the proper combination of these materials, duly mastered by the master, enables the purpose of the method which consists in the art of teaching in a pleasant and quick manner*".

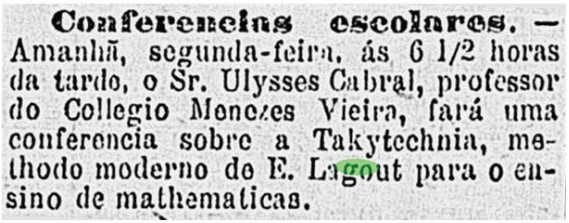
Conferencias escolares. — Amanhã, segunda-feira, ás 6 1/2 horas da tarde, o Sr. Ulysses Cabral, professor do Collegio Menezes Vieira, fará uma conferencia sobre a Takytechnia, methodo moderno do E. Lagout para o ensino de mathematicas.

Figure 4. Divulgation of Lagout's Method in Rio de Janeiro (*Gazeta de Notícias*, October 7, 1883).

In the framework of the Pedagogical Exposition of Rio de Janeiro in 1883, tachymetry was inserted in a broader set of materials suitable for teaching mathematics, including abacuses, arithmometers, geometric solids built in wood, among many others. The teaching of mental calculation was conceived as a support for the efficient use of the arithmometer and the first elements of geometry, with the figures and objects developed by Lagout.

Another record on the circulation of said material in Rio de Janeiro is in the announcement of the Colégio Alberto Brandão, a private primary and secondary school, published in the newspaper *O Programma Guiador*, on March 19, 1887. This notice detailed to the interested parties the operation of the primary and secondary courses, with due study plans, class schedules, faculty and what they called "*modern tools used in teaching*". Primary education was divided into three annual courses: elementary, middle and higher.

The primary course was taught by Professor Christina Moerbeck, who was in charge of preparing students to continue at the other two levels of primary education. In elementary school, the *First Lessons of Things*, also called *Calkins method*, based on the version made by the adviser Rui Barbosa, published in Brazil in 1886. Still in elementary school, classes on a particular day of the week were reserved for mental calculation, conducted in a way associated with the exercises done in the arithmometer. According to the announcement, the use of this instrument was carried out according to

the pedagogical guidelines of Dr Alambary Luz, director of the Normal School of the Province of Rio de Janeiro.

In the upper primary course, taught by Professor Alberto Brandão, director of the establishment, the subject of Tuesdays was the mental calculation, with operations on the metric system and *Lagout's tachymetry*, based on the text of Dr. José Rodrigues Azevedo Pinheiro, author of the *Arithmetica for children,* whose 5th edition was published in 1880, by Nicolau Alves, according to the Catalogue of the Library of the National School Museum. The classes of *notions of linear geometry* were also taught by Professor Azevedo Pinheiro.

Professor I. Moerbeck, who taught primary school classes, taught *developed mental calculation*, whose operations with integers and decimals were done using the arithmometer. The same instrument was announced as a novelty for the study with the operations related to the metric system. It should be noted that in secondary school classes there is neither the use of Lagout's tachymetry nor the use of the arithmometer, and the same authors indicated by the Pedro II College were used in the courses of arithmetic, algebra and geometry so that the students were the preparatory examinations.

The secondary course of the Alberto Brandão College was constituted by the following disciplines: *German, English, French, Philosophy, Latin, Geography, History, Rhetoric, Portuguese, Arithmetic, Algebra and Geometry.* Professor Arthur Azevedo taught classes in Arithmetic, Algebra and Geometry, and the following books were adopted: Vianna's *Arithmetica*, Cunha's *Compêndio de Álgebra* and Ottoni's *Compêndio de Geometria*. As a press announcement: "The course of physical and natural sciences would be taught by the illustrious Luiz Carlos Duque Estrada as soon as there were students enrolled, as well as classes in Greek and Italian". These are information published in the newspaper *O Programma Guiador*, of Rio de Janeiro, on March 19, 1887.

The tachymetric method was also the object of discursive diffusion in the province of Maranhão, in the context of the last decade of the monarchic regime. Author of well-known late-Nineteenth Century math school textbooks, Professor João Antonio Coqueiro, a native of Maranhão, a few years after returning from France, where he defended a thesis in physical and mathematical sciences, wrote an article to express his convictions about what he understood to be the advantages of applying the tachymetric method in the teaching of school geometry. This article was published in the newspaper *O Paiz*, São Luiz, edition of March 7, 1883. In this article, it is stated: "*Taquitécnica is the modern art of promptly teaching the positive sciences and making them, in a short time, assimilable and transmissible"*. It explains the Greek roots of the word, noting that *tachus* means that which comes ready, fast and immediate, while *technia* means the art and the technique of doing or producing something with mastery.

It should be noted that, in the year of publication of the article, the Pedagogical Exhibition of Rio Janeiro was organised, with the participation of educators from various countries, to show what was most modern in terms of teaching using the intuitive method. In this Congress, Arens' arithmometer was exposed, for the teaching of elementary operations of arithmetic and decimal metric system (Pais, 2014).

The reading of the article raises a historical reflection regarding the traces of comparative elements between the diffusion of the method of France and the way in which it was appropriated and divulged in the Brazilian context from the 1880s. Everything indicates that the method of teaching geometry was conceived, in Professor Coqueiro's opinion, as an instrument to enable the teaching of the more traditional view of the positive sciences. A very different view of the pedagogical origins of creation and diffusion of the intuitive method, which intended only an experimental and visual initiation of the practical part of the geometric contents.

João Antônio Coqueiro points out that tachymetry was being recognized as the *new art of teaching quickly*. This expression expresses the sense of combating expository methods, of the scholastic type, based much more on discursive rhetoric than on experimentation or information arising from sensation. Faced with the expansion of the popular public education offer, teaching should prioritise practical, utilitarian aspects and without wasting much time. A proposal that had little proximity to the programs and methods provided for the preparatory studies, aiming to enter the higher courses.

The rapidity with which the new method was being propagated in the professional schools of Paris induced this understanding. Coqueiro exemplifies *in the Turgot Industrial School, one of the oldest in the French capital, tachymetry is taught with the support of the rigorous theory, that is, with complete geometry, in only twenty lessons.* The enthusiasm for the supposed results extrapolated the purpose of the discipline in the professional education, affirming that classes covered the *integral doctrine of the new program of the geometry of the elementary classes of the Lyceums, with a duration of five years.*

Coqueiro advocated that the provincial government of Maranhão should acquire the material to make it available to the primary teachers of the capital, understanding it to be the way to expand popular education. He praises the teachers, saying that they could, with rapid preparation, be enabled to master the new way of teaching, by changing the *monotony of teaching* which public education programs imposed on them. It also states in its article that the price of the equipment for teaching tachymeter, including a box with the demonstrative tables, for primary schools would cost 26 francs and for professional schools, the price would be 60 francs.

The main intention is to express a way of conceiving tachymetry as a methodological approach to the teaching of school mathematics and other disciplines. The broader context of this idea involves the movement of expansion of the supply of popular primary education and professional education, occurred at the end of the Nineteenth Century. The technological and scientific development resulting from previous centuries foreshadowed new capitalist times. It was necessary to modernise old teaching practices, clearly differentiating the education for the preparatory courses destined to the elites of that destined to the primary education seen as necessary for the popular classes and the professional formation of workers.

The tachymetric method was not restricted to the teaching of geometry or the science of forms. To reach a more expressive comprehension of the method, involving other disciplines. In this sense, Professor João Antonio Coqueiro observes what he

understood to be the great advantage of studying the application of the same principles of tachymetry to the teaching of Arithmetic or Algebra, being understood as the science of generalisation of numbers. Following the same line of reasoning, it observes that the said principles could give excellent results if they were applied to the study of the mechanics that corresponded to the case of the sciences of the forces.

In describing ample praise, Coqueiro observes that he had not acquired the complete collection of the books of Lagout by a simple carelessness of his bookseller since it had ordered some time. He states that he had in his hands two books of tachymetry by Jules Dalsème, who studied at the Polytechnic School of Paris and was a professor of mathematics at the Senna Normal School. In the words of the author from Maranhão: "*were two little books admirable for lucidity, with which are explained the most difficult theories of geometry".* One of them was titled: *First elements of Tachymetry or Natural geometry for use in primary schools,* and the other *Elements of Tachymetry or natural geometry for use by professional schools of public works agents.*

The professor from Maranhão notes in his article that the last title mentioned was composed of only 59 pages, confirming our understanding that it is a publication destined for popular teaching. The content of the treatise was well divided into seven lessons, containing 82 figures, which served to expose the complete geometry and its most critical applications. The price of the book was one franc and fifty cents. The content of the first booklet was the same, with the seven lessons, the same number of pages and figures, but the subject was treated more elementally, and its cost was half the price.

CONCLUSIONS

Although the historical period focused on the last decades of the Nineteenth Century, the diffusion of the method in Brazil reached the first decades of the following century. In this sense, in the decade of 1910, the tachymetry appears in the legislation of the public instruction of the State of São Paulo, to designate the teaching of "practical geometry". This expression was used to emphasise the precedence of the importance of teaching utilitarian aspects of geometry; on the contrary, the classical approach conceived as a result of the logical-deductive method and axiomatic construction. More precisely, the tachymetry is contained in article 41 of Decree No. 2225, April 16, 1912, signed by President Manuel Albuquerque Lins of the State of São Paulo. This article describes all of the following subjects for the four-year primary course: *Reading and deduction of grammar principles.*

> Writing and calligraphy. Arithmetic calculation on integers and fractions. Practical Geometry (tachymetry), with the notions necessary for its applications to the measurement of surfaces and volumes. Metric decimal system. Free-hand drawing. Moral and civic education. Notions of general geography. Cosmography. Geography of Brazil, especially that of the State of São Paulo. Notions of physical, chemical

and natural sciences, in their most diverse applications, mainly to hygiene. History of Brazil and reading about the life of the great men of history. Reading music and singing. Gymnastic, manual and military exercises appropriate to age and sex.

The second paragraph of article 41 predicted that in the primary courses at night for adults, the teaching of manual work was excluded and the students were exempt from the practice of gymnastics. However, in these courses, the teacher should "expand the teaching of geometry by explaining the design processes that are empirically employed in the various trades".

The presupposition adopted in the conception and dissemination of the method and resources foreseen in its use consisted of valuing the precedence of materiality as a support to understand geometrical theorems and properties. Instead of persisting in the classical approach of the deductive-logic method, derived from the Euclidean tradition, this type of material was intended to make learning faster, thus justifying the prefix of Greek tacit origin, which means fast, which works quickly and on a regular basis such as the *Tic Tac* of old mechanical watches or tachycardia, when the heart accelerates beyond normal rhythm. Moreover, when this resource was created and disseminated at the end of the nineteenth century, a much broader movement was underway, consisting of the diffusion of the *intuitive method* and its slightly different version, more focused on the study of sciences, *Lessons of Things*.

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