CALKINS' *PRIMARY OBJECT LESSONS*: PRACTICES FOR DRAWING AND MEASURING

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ABSTRACT

This article analyzes the handbook *Primary Object Lessons*, emblematic article on the process of pedagogical innovation at the end of the nineteenth century in Brazil. The proposed lessons developed by Calkins assume a deeply *practical* education, according to Pestalozzi. The purpose of the study is to analyze how the practices are revealed in the teaching proposal of geometric knowledge and, to this end, it investigates how they are mobilized on the lessons of shapes, numbers and drawings, i.e. what the practices are and in what ways they participate in the schooling process of geometric knowledge inserted into sustained methodological proposal by the assumptions of Pestalozzi. The aim is, based on Chervel (1990), to understand geometric knowledge in the early years as a product historically built by Brazilian primary schools. It seems clear that what is at stake is the development of practices to estimate measures with the naked eye, a skill that requires school learning and systematic exercise. As for drawing, Calkins' handbook ratifies practices already initiated in previous manuals, the practice of freehand drawing of geometric figures. In summary, it appears that drawing and measuring are supporting practices when teaching practical geometry and deserve further investigation.

Keywords: Calkins; Geometric knowledge; Practice; Measuring; Drawing.

RESUMO

O artigo analisa o manual Primeiras Lições de Coisas, obra emblemática no processo de inovação pedagógica no final do século XIX no Brasil. A proposta de lições desenvolvida por Calkins pressupõe uma educação profundamente prática, de acordo com Pestalozzi. O objetivo do estudo é analisar como as práticas se revelam na proposta de ensino de saberes geométricos, e para tanto, investiga-se como elas são mobilizadas nas lições de formas, de número e de desenho, ou seja, quais são as práticas e de que maneiras elas participam do processo de escolarização de saberes geométricos inserido na proposta metodológica sustentada pelos pressupostos de Pestalozzi. Busca-se, pautado em Chervel (1990), compreender os saberes geométricos dos anos iniciais como um produto historicamente construído pela escola primária brasileira. Parece claro que está em jogo o desenvolvimento de práticas de estimar medidas com o olho, uma habilidade que requer um aprendizado escolar e exercício sistemático. Quanto ao desenhar, o manual de Calkins ratifica práticas já iniciadas em manuais anteriores, a prática do desenho à mão livre de figuras

geométricas. Em síntese, tudo indica que desenhar e medir são práticas de sustentação ao ensino de uma geometria prática e merecem investigações mais aprofundadas.

Palavras-chave: Calkins, saberes geométricos, prática, medir, desenhar.

1. Primary Considerations

Primary Object Lessons is the title of flagship didactic work in the pedagogical innovation process in the late nineteenth century in Brazil. It was written by Norman Allison Calkins[1] in 1861, translated and adapted to Portuguese by Rui Barbosa[2], and published in 1886, by the National Press. Targeted at education in elementary schools, it is structured in order to clarify the fundamental principles of the object lessons, both in the household and at school.

The manual is very important in the evolution of the Brazilian pedagogical thinking circulating[3] the state of São Paulo in the late nineteenth and early twentieth century, and is widely recommended as a guide for preparing lessons for master-students from São Paulo Normal Schools in order to disseminate the intuitive method, also known as object lessons. Lourenço Filho[4], in the foreword to the work reissued in 1945, highlights its value as a document of a new pedagogical direction, implemented in developed countries and widely influential in the school practices of Brazilian masters, attested in numerous writings and adaptations.

In the appreciation of the intuitive method, Rui Barbosa defends object lessons as a methodology that should cover the entire program, since it is the case of a general process to which all disciplines of elementary education are subjected (BARBOSA, 1946). He also emphasizes the need for reform and participation of the master in the realization of teaching from this methodology:

[1]It can be said that, in this clash and in the consolidation of intuitive teaching in the United States, Calkins' work has come to play a decisive role. A primary master for some years, and then school principal in the inner State of New York, he moved to this city in 1846, to then devote himself to the advocacy of education renewal. Noting the difficulty felt by teachers to adapt on their own, Pestalozzi's ideas on the current teaching practice make up, then, a form of lessons which he publishes. (LOURENÇO FILHO, 1950, apud CALKINS, 1950, p. XV)

[2]Rui Barbosa (1849-1923) was a legal consultant, a lawyer, a statesman, an orator, a journalist, a tireless educated man of the Portuguese language, and a literary man. The writings of Rui Barbosa on education comprise a limited period of his political career as a social reformer and among them, in the 1881 to 1886 period, is the translation of the book of didactic guidelines by N.A. Calkins *Lessons of Things*, translated in 1881 and only published in 1886. (BASTOS, 2000, p. 84). The innovative proposals for elementary schools supported by Rui Barbosa and its production are ratified in the period called Brazil's First Republic or Old Republic, comprising 1890-1930.

[3]Lourenço Filho forewords the handbook *Primary Object Lessons* in 1949 and points out that this was referenced in several prints such as: the Pedagogical Magazine of Rio de Janeiro (1890-91), which features an extensive overview of Calkins' ideas, the magazine Public School of São Paulo (1894), and the collection of the Teaching Magazine of São Paulo (1910-1915).

[4]Manoel Bergström Lourenço Filho (1897-1970) graduated from the Pirassununga Normal School in 1914. In 1930, he took over the General Board of the Public Institution of the State of São Paulo, boosting education reform that would bring the principles of the New School in the state education. He was considered one of the main representatives of the New School movement in Brazil (SOUZA, 2009).

> *'The teaching method matters most*, says a well-known English educator, *but much more important is the quality of the master'.* No matter how rational, in effect, a method may be, no matter how effective the educational properties may be, they cannot build either a complex of algebra formulas, which are resolved in precise and foolproof solutions to every difficulty, or an apparatus that fatally obeys certain mechanical combinations of force and motion. The method, in pedagogy, is but the system indicated by nature, to cultivate physical, moral, and intellectual life, in the initial and decisive period of its human development; and life can be forwarded only by life. In this sense, therefore, the master's price is not smaller than the method's, because without the master the method would be an ideal conception; because the method is inseparable from the master; because the master is the animated method, the method in action, the method alive (BARBOSA, 1947, p. 119, *emphasis added*).

Primary Object Lessons: for training the senses and developing the faculties of children: a manual of elementary instruction for parents and teachers is the full title of Calkins' work, as it is a handbook intended for masters, containing textbook guidelines. To Rui Barbosa, the teacher's role is essential to the successful implementation of the intuitive method, which supports the translation into Portuguese of the *Primary Object Lessons* manual by Rui Barbosa.

The Primary Object Lessons method advertises itself as a disruption to the formal, traditional, nineteenth-century education model, marked by verbal and call-to-memory processes. It means "teaching by the appearance, by reality, by intuition, by the reflective exercise of the senses, by the complex culture of the observation faculties" (BARBOSA, 1886 apud CALKINS, 1950, p.09).

The proposed lessons developed by Calkins assume that education should arise from the curiosity of children, the desire to know, establish observation habits, awake to the knowledge, cultivate drawing faculties, and compare, think, reason and establish judgment in a deeply *practical* education (CALKINS, 1950, p.37, *emphasis added*)

This study examines how the practices[5] are revealed in the teaching proposal of geometric knowledge[6], investigating how they are mobilized on the lessons of shapes, numbers and drawings; in other words, what the practices are and in what ways they participate in the schooling process of geometric knowledge inserted into the sustained methodological proposal by the assumptions of Pestalozzi[7], according to whom:

> 1. Activity is a law of childhood. Allow the children to become used to doing; educate the hand.

[5]The study makes up the partial results of the Post Doctorate Project "*The practical dimension and the elementarization process of geometric knowledge*" inserted in an International Cooperation Project "*The teaching of mathematics in primary school in the nineteenth and twentieth centuries: comparative studies between Brazil and France"* (CAPES/COFECUB) and in a Research Project (FAPESP).

[6]We chose to use the term "geometrical knowledge" understanding it as all concepts, definitions, themes, pedagogical properties and practices related to geometry, which are present in the elementary school culture, in different educational programs in primary education textbooks, in educational magazines and other vestiges of elementary school (LEME DA SILVA, 2015, p. 42).

[7]Johann Heinrich Pestalozzi (1746-1827), Swiss educator, was born in Zurich. As a student, he took part in political and social reform movements. Known for its action as a teacher, director and founder of schools, his ideas delimit the Intuitive Pedagogy, whose basic feature is to provide, to the extent possible, data sensitive to the perception and observation of students (ZANATTA, 2012).

> 2. Cultivate the faculties in their natural order, first form the spirit, instruct it after.
> 3. Start with the senses and never teach a child what he or she may find out on his own.
> 4. Reduce each subject to its elements. One difficulty at a time is enough for a child.
> 5. Go forward step by step. Be thorough. The measurement of one piece of information is not what the teacher is able to pass on, but what the child is able to absorb.
> 6. For every lesson there must be a thread, either immediate or remote.
> 7. Develop the idea, then give the word. Cultivate the language.
> 8. Proceed from the known to the unknown, from the particular to the general, from the concrete to the abstract, from the simpler to the more complicated.
> 9. First the synthesis, then the analysis. Not the order of the subject, but the order of nature (A ESCHOLA PUBLICA, 1895, pp. 357-358).

The nine items listed as "Pestalozzi's alfhorhimes", according to the conclusion of the book published in the journal *A Eschola Publica*, in São Paulo, demonstrate the practical dimension of the proposed methodology: the activity as the center of education; the activity, educating the hand; to start by the concrete, by the experience to get to the abstract, the theory. However, the purpose of the investigation presented herein is to deepen the analysis of a practical pedagogy in the particularity of elementary knowledge, and in particular geometrical knowledge.

It is clear that research refuses to accept the conception of teaching content as vulgarizations or adaptations of the science of reference or as the image of a "lubricant-pedagogy". Chervel exemplifies this by stating that the "grammar theory" taught in French schools is not the expression of reference sciences, but a school grammar that was historically created by the school itself, at the school and for the school. Similarly, we seek to understand the "geometry" and "practical geometry" taught in the early years as a product historically built by Brazilian elementary schools in the period in question and for that, it is necessary to consider teaching as a constituent element of the mechanism that turns teaching into learning in the production of school knowledge, "to delete the pedagogy of the study of the contents is to condemn oneself to understand nothing of the actual operation of the teachings" (CHERVEL, 1990, p. 182).

The intention in this study is not to conduct a comprehensive analysis on Calkins' work since many researchers have done so[8] in the history of education, and initial studies on the teaching of mathematics (Gomes, 2011)[9], but to focus on the overlapping of the practice considered central to the method in question and the geometric knowledge in construction.

2. It all starts with the Shapes

[8]Souza, 1998; Bastos 2000; Valdemarin, 2004; and Saviani, 2011 are quoted.
[9]Gomes analyzes the presentation of mathematical contents, especially what the author calls "geometry lessons", and highlights five aspects of the book's approach: the presence of plane before spatial geometry, the various materials essential to the teaching of geometry, the association between design and teaching and the sequencing of the geometric contents (GOMES, 2011).

> Since the shape is the most suitable quality to the first lessons, of which the child is to become used to observing with scrupulous attention and fairness the distinguishing properties of things. The ideas of shape are likely to be represented by flat descriptions. They are the most capable, therefore, of adapting to the first rudiments of teaching and the first discipline of rigorous observation habits (CALKINS, 1950, p. 71-72).

The shapes are chosen as the first notions to be taught to the child, being the most intuitive to be observed and the gateway to school. Geometric shapes can be considered as the most elementary knowledge in the educational process in the new teaching model, the Primary Object Lessons method, which gained ground in official guidelines in Brazil from the late nineteenth century onward. Therefore, the geometric knowledge gains significant emphasis in Calkins' proposal before numbers and words. According to Pestalozzi:

> The elements (shapes, things, numerical relationships, words) are essential because they correspond to the true nature of sentient, rational and speaking beings: they thus constitute the true elements. In fact, our knowledge of things operates naturally by the recognition of shapes, by calculating the measures and their translation into words[10] (TROUVÉ, 2008, p. 252).

The observation of things is the starting point in the Pestalozzian method and the most basic thing to note is more precisely geometric shapes, that is, from the outset geometric knowledge take part, integrate and constitute the elementary school knowledge. This finding seems to still have significant room in studies of school processes in the early years, whether in the field of History of Education, Literacy[11] and even in the History of Mathematics Education, in which they are very early studies[12]. Indeed, the gap in surveys helps to reinforce common sense and wrong representations that "geometry was never in primary education" or "the teaching of geometry was abandoned".

In addition to being the gateway to school knowledge, the lessons of shapes take special place in Calkins' work and correspond to the largest number of pages in his work, which are characterized for associating the different ways to their respective objects:

> In the realm of education, it is the seeing, the comparing, the grouping, not the bare repetition of words, which determines the exact knowledge of things. Do not omit any of these applications: Ask the child to see, teach them to compare, train them to execute, or to produce, demanding, after all, that they describe what they have perceived (CALKINS, 1950, p. 74).

[10]*Selon Pestalozzi, ces éléments (les "formes" des choses, les "rapports numériques", les "mots"), sont essentiels car ils correspondent à notre veritable naturale d'être sensibles, rationnels et parlants: ce sont donc les véritables "éléments". En effet, notre connaissance des choses s'opère naturellement par la reconnaissance des "formes", le calcul des "mesures" et leur traduction par des "mots"* (TROUVÉ, 2008, p. 252).

[11]Mortatti, 2000; Morttatti, Frade, 2014a, 2014b are quoted.

[12]The inventory of surveys of stories of mathematics education produced about the early schooling years referenced in papers published in the Annals of the I *ENAPHEM* – National Meeting for the Research in the History of Mathematical Education, held in Vitória da Conquista, Bahia (2012), indicates that studies gain interest from the first decade of this century and have been growing in recent years (VALENTE, 2014).

Observation habits, faculties of conceptions, of drawing, comparing, imagining, reasoning and judgment make up, according to Calkins the foundations of a practical education. It is through the senses that comes the knowledge of the real world of things, the perception of similarities and differences in objects.

Thus, Calkins points out the need to equip the classroom with teaching materials that support the lessons, designated as a toolbox. It should contain figures such as triangles, squares, polygons and solids such as spheres, spheroids, cones, tapered, ovoid, cylinders, cubes, etc. and a goniometer, an instrument similar to a carpenter's folding ruler, with which it is possible to form geometric figures with lines and angles. In addition to objects, a chart or table representations of the different shapes and solid plane figures studied is considered equally important.

Rui Barbosa's position on the true purpose of the primary object lessons stands out, pointing them as a subject separate from the program:

> the *primary object lessons* is no *special subject* in the syllabus: it is a study *method*; it is not limited to a section of the program: *It covers the entire program*; it does not take up, in the classroom, a separate place such as reading, geography, calculus, or natural sciences: it is the *general process*, to which all professed subjects in elementary education should be subjected (BARBOSA, 1946, p. 215-216, *emphasis added*).

In this context, the manual is organized into specific lessons involving: shape, color, number, adding, subtracting, multiplying, size, drawing, writing, time, sound, elementary reading, quality of things, qualities, things, human body and moral education, all of them developed according to the intuitive method.

The lessons on shapes are presented in simulated questions and answers between teacher and students. The teacher's role as a conductor of the student in the observation, comparison and description of shapes becomes evident.

That being said, we may ask: Which practices support the development of the lessons on shapes? How do they articulate with the teaching of geometric knowledge?

3. Lessons on Shapes

Before starting the lessons on shapes, Calkins provides a table with the distribution of content in series and steps. The author emphasizes the importance of establishing what is important to study first and what should follow the natural order, "*in no case should the order in which the step-by-steps of each subject find themselves scaled be altered. However, one is allowed to study the first step of various subjects, before entering the second step of either one*" (CALKINS, 1950, p. 79). The same content is organized in two or three steps, which are often distributed in different series, as shown in the table below:

Table 1 – Order of Calkins' lessons on shapes

GRADE	Content	Steps
First grade	"Similarities and differences in shapes"	First and second
Second grade	"Linear shapes", "corners", "solids – spherical shape"	First
Third grade	"Linear shapes"	Second
	"Position of lines", "flat figures"	First and second
	"Cylinder"	First
Fourth grade	"Figure of lines", "position of lines"	Third
	"Angles"	Second
	"Flat shapes"	Third
	"Triangles", "quadrilateral shapes", "circular shapes", "flat and curved surfaces"	First
	"Solid figures", "cylinder and cone"	Second
	"Cube and cube shapes"	First and second
	"Prisms"	First
Fifth grade	"Angles"	Third
	"Triangles", "quadrilateral shapes", "circular shapes", "surfaces and faces"	Second
	"Solid figures", "cylinder and cone"	Third
	"Prisms"	Second
	"Pyramids"	First
Sixth grade	"Multilateral figures"	First and second
	"Round figures", "surfaces and faces"	Third
	"Pyramids"	Second
	"Quadrilateral shapes", "Triangles"	Third
	"Circle radius; quadrant; sector"	Fourth

Source: own work.

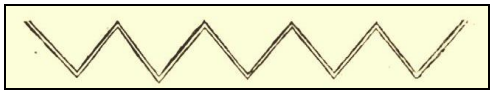
For the first grade, only one lesson is suggested, being called "Lessons to develop the ideas of similarities and differences in shapes". Faced with various objects, students are required to "*view the shape in its entirety, the whole of the object, without ever trying to analyze or describe the basic features that are added to the overall configuration*" (CALKINS, 1950, p. 86). From the second grade onwards, the lessons on specific topics are proposed.

And what practices are mobilized for the acquisition of shapes? How are they developed? Two examples are analyzed. The first – "Lessons to develop the ideas on linear shapes" – is organized in three steps:

1st step – straight, broken and curved lines (for second-graders)
2nd step – wavy and spiraling lines (for third-graders)
3rd step – defining and drawing lines (for fourth-graders)

In the first step, the suggestion is to resort to multiple objects, such as twines, pencils, rulers, pointers, flippers, wires, as well as to highlight edges of existing objects in the classroom. The terms "straight line", "broken line" or "curved line" should be used, without instilling the abstract meaning of the idea of line, as in geometry. This is exploration and observation guided by the teacher's questions, such as:

> Then, taking a goniometer or a folding ruler, so that all members stay at an angle, says the master: What shape is it?



"Bent". Then, extending into directness all members of the rule: What shape is it now? "Straight" (Ibid, p. 87).

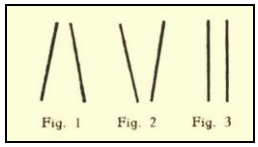
The second step follows a manner similar to the first, but with the presentation of corrugated and spiraling lines; and the third step, having developed two series after the start of the study of the lines, is to define and build the idea linearly in itself in which the student is asked to measure the distance between two points in situations of: straight, curved, and wavy lines, and to compare the results, and then describe the observed, such as:

> What would you say about the straight line? "It's the shortest line between two points." Very good; but you may express yourself saying that the straight line is the shortest distance between two points. What is a straight line?
> "A straight line is the shortest distance between two points" (Ibid, p. 93).

Finally, students are asked to draw different lines on the blackboard and on individual stones. The second example – "Lessons to develop the ideas of position of lines" – is proposed in a similar way:

1st step – sloping and vertical lines (for third-graders)
2nd step – horizontal and oblique lines (for third-graders)
3rd step – parallels to perpendiculars (for fourth-graders)

The first and second steps follow the same approach of the initial steps in the previous example, with the observation conducted by the master of real objects in the positions being addressed, as well as their representations. In the third step, in the following grade, to develop the idea of parallel, the examples of objects and representations are resumed, and finally the students should observe the ends of lines:



Pointing at the lines of Figure 1, the teacher inquires: In these two lines, the two extremes of one side are the same distance apart as the two sides across? Pointing at Figure 2, ask the same question. These two lines are at the same distance from each other at both ends? (CALKINS, 1950, p. 101).

The dialogue goes on to compare the different representations and, at the end, the teacher is instructed to say: "*Two lines side by side and at the same distance from each other like these (the point Figures 3) are called parallel lines. Does the word "parallel" mean extending next to each other?*" (Ibid, p. 101)

Both examples show the importance of drawings and representations of shapes, as a second stage of observation of real-world objects. The chart or map with the representations of the shapes is suggested in many lessons. Another hallmark is the comparison of measures for the definition of the shapes being addressed. The visual perception guided by the master, such as the case with the parallels, the fact that the

straight lines may or may not have the same distance apart supports the characterization of the position of parallel lines.

The practice of measuring by visual estimation is considered a hallmark of practical training as opposed to theoretical teaching. Calkins theoretically criticizes the concepts presented in textbooks, for example, mentioning the definition of parallel lines: "*Two parallels, however much they produce, never meet*." (Ibid, p. 103), for not considering the two characters essential and visible to children: they are side by side and being equidistant in all its extension. He also points out that "*properties such as 'being parallel on the same plane, and never being able to intersect, no matter how long either side may be' belongs to the teaching in high schools and has no place in the education of elementary schools*" (Ibid, p. 103-104).

Finally, it is worth considering that drawing the geometric shape and measuring it by estimation are practices that support the "Lessons to develop the ideas of flat figures"; however, in the "Lessons for developing the ideas of solid figures", the drawing and the visual measure no longer receive the same emphasis.

4. Lessons on Numbers

The set of lessons on numbers of the work is extensive and organized by topics. The lessons fall into four blocks: Of numbers, Of adding, Of subtracting and Of multiplying, each with subdivisions. It is worth reaffirming that the methodological guidelines of a practical teaching permeate all the lessons of the work, as reiterated Calkins:

> The success of elementary teaching in this matter depends on the actual display of objects. There is no theory of numbers, or memorizing and reproducing abstract rules, which will never infuse for a childhood fair number of ideas, and preparing them through secure foundations for the practical knowledge of arithmetic. (CALKINS, 1950, p. 245)

Among the subdivisions is the set of "Lessons to develop ideas of equal parts or fractions" and inside the subtopic of size, which in turn presents the "Lessons to develop ideas of length and dimension"[13], structured in:

1st step – length
2nd step – measure of length
decimal measure of length

And how is the teaching of the measures proposed? Are there similarities with the practical measures identified in the Object Lessons?

The first step addresses the observation and comparison of measuring in books, sticks, strings, hair, and real-world objects, asking which is longer. It also lists a set of words that mean length, such as: long, longer, elongated, extensive, stretched, short, and

[13] Unlike the Lessons on Shapes, there is no table specifying the series in which each step must be taught.

brief, among others. In the second step, which develops measuring in specific, the teacher shows inch measures. The children are given slips of paper to be folded in inches, then they learn to measure two, three inches in different objects. Once familiarized, they proceed to the training of visual measuring by estimate:

> Raising a three-inch long wand, the teacher asks: How long is this wand? After the eye-measuring by the children, check their calculation. Therefore, the vision will get used to assessing the length, training in order to satisfactorily determine the approximate length of one, two, three, six inches.
> The teacher shows objects, having the children assess and then measure their length; draw features in stone, and do likewise; finally, he orders them to draw in their stones, or on the blackboard, various lengths of these lines, which he shall indicate. Hence, *pari passu* with the eye, the hand will be educated (Ibid, p. 333).

The measures with precise instruments are proposed in the last step of the lessons. In short, the practice of measuring by estimate, to develop and accustom the eye to make measures is further worked without a specific link with geometric shapes, but combined with the representation of length measures in lines and thus the practice of drawing, to educate the hand.

5. Lessons on Drawing

Drawing lessons, unlike the lessons on shapes and on numbers, are reduced, as the author points out, other than the intent to develop a series of drawing lessons, and simply suggest to teachers the first introductory steps. Altogether, 10 steps are proposed, the first three being:

> 1st step – to manipulate stone and pencil
> 2nd step – vertical, horizontal and oblique lines; drawing lines of equal length, splitting in half, in four parts
> 3rd step – to draw certain extension lines to accustom the eye to assess the dimensions; right, acute, obtuse, and parallel angles [14]

It can be said that the introduction of drawing lessons are very close to the lessons of shapes, since in the ten steps the figures drawn are all geometric. The first sketches are lines and their positions, just as the first steps of the shapes, but from the beginning the teaching of tracings is linked to the visual measurement; from the second step, drawing lines with particular measure are required for further confirmation, as well as dividing lines into equal parts, which also requires training in assessing equal measures.

6. Final considerations

[14] 4th step – drawing squares and oblongs; 5th step – splitting squares into four equal parts, drawing diagonals; 6th step – drawing rhombuses, rhomboids and concentric squares; 7th step – square in oblique direction; 8th step – pentagon and hexagon; 9th step – drawing the Greek cross and the Maltese cross; and 10th step – quadrants, semicircles, circles and diameters.

This study aimed to review Calkins' work *Primary Object Lessons*, translated by Rui Barbosa, to analyze and understand the relationship between the practice and the teaching proposal of geometric knowledge, conveyed in a work that is considered benchmark in the late nineteenth century and early twentieth century, a moment of organization and consolidation of the Brazilian primary education.

The initial analysis of the Lessons on Shapes, a privileged *locus* for the teaching of geometric knowledge revealed the significant presence of practices of design and measures, which were also present in the Lessons on Numbers and Design. Once again, the presence of geometric knowledge in different lessons reinforces the idea that primary education is characterized by a non-disciplinary school culture, distinguished from high school. The early school years, mathematically speaking, refer to a primary, basic, the most elementary math; the teacher of the early years is a versatile professional, being responsible for addressing a variety of knowledges that were not organized in the form of disciplines (Valente, 2014a).

It seems clear that what is at stake is the development of practical measurements to estimate with the eye, a skill that requires school learning and systematic exercise. Identifying distances of equal measure, knowing how to estimate lengths, in addition to allowing the differentiation and definition of geometric shapes, practices with school purposes aiming at a subsequent geometry teaching, also meet a demand of social order in a predominantly rural society, changing due to the industrial development.

It can be said that the exercise of measuring with the eyes is a school practice characterized by the Primary Object Lessons method in response to needs of social order and schooling of geometric knowledge.

The practice of measuring with the eyes is strongly present in the first draft of the manual and practical geometry adapted in Brazil, "*Linear Design Principles including that of Practice Geometry, by the mutual teaching method*".[15] It is an adaptation and translation by A. F. of P. and Iollanda Cavalvanti d'Albuquerque[16] of the French manual "*Le dessin linéaire d'après la méthode de l'enseignement mutuel*" produced[17] by the mathematician Louis-Benjamin Francoeur. Considered a "simplified" formula of the Pestalozzi method,[18] it aims to exercise the vision and hands and became a model for many other book authors in France.

[15]For a more detailed study of the adapted work, see LEME DA SILVA, M.C.; VALENTE, W.R., 2014.

[16]Antônio Francisco de Paula de Holanda Cavalcanti de Albuquerque, the Viscount of Albuquerque (1797-1863) was elected congressman by his province in the 1st legislature 1826-1829.

[17]Minister Decazes requested in 1818 to the SEI – Society for Elementary Instruction – a drawing method that enables students to copy or even to draw by memory or imagination, figures and ornaments that are used in the mechanical arts, architecture, and constructions (D'ENFERT, 2007, p.37).

[18]According to the Swiss pedagogue, knowledge is useful in the sensitive perception of nature, and, more particularly, in the visual sensations. It rests on an ABC of perception that an 'art of measuring' leads to the observation of shapes and its comparison with the elementary geometric figures, and then to their representation through drawing (D'ENFERT, 2007, p. 44).

The difference lies in the teacher's role in teaching. In Albuquerque's adaptation there is no guidance from the master to the students, they repeat again and again until obtaining a true copy of the original drawing, with identical measures, and the teacher evaluates the drawings only with instruments. In Calkins' handbook, in turn, the student is guided by the teacher at all times.

The drawing, specifically the ability to perform strokes, constitutes a second practice, also featured in Calkins' lessons hereby analyzed and recognized as important in the intuitive method. Calkins highlights Pestalozzi's consideration on drawing: "There is no writing without drawing" (CALKINS, 1950, p. 359).

Drawing becomes a school practice that stands out in primary schools with the Primary Object Lessons method, extensively advocated by Rui Barbosa in 1882.[19] Proposals for the teaching of drawing receive special attention in the report prepared by Rui Barbosa: there are almost a hundred pages solely for his defense. It is clear that the introduction of drawing as a subject to compose primary education is a movement internationally discussed and with many consensuses which are listed in the document, among which we highlight two points: in the pedagogical order, drawing should precede writing and, in the social order, its inclusion as a popular school subject is one of the most powerful forces for fertilization of the work and expansion of wealth in the states (BARBOSA, 1947).

In this sense, Calkins' manual meets Barbosa's claims and ratifies practices already initiated in previous manuals, the practice of freehand drawing of geometric figures. The practice of drawing, in Brazil, has a longstanding, close dependence on the teaching of geometric knowledge, from the Empire to the late nineteenth century.[20] Only in the early twentieth century, with the introduction of the method called natural, characterized by enhancing the daily lives of children and directing activities to objects and beings that surround them, does the relationship between drawing and geometric knowledge change.

In summary, the present study reaffirms the importance of increasing the investigative field in surveys on how the elementary geometric knowledge is made up, modified and consolidated in the elementary school culture. Everything indicates that drawing and measuring are supporting practices when teaching practical geometry and deserve further investigation. To paraphrase Pestalozzi, we risk saying that "There is no geometric knowledge without drawing and measuring".

7. References

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[19]Rui Barbosa presented to the Brazilian parliament two reports in 1882: one on the reform of primary education, and another on secondary and higher education, but the publication of the volume including the annexes was completed in 1883, effective date of appearance of this document (Souza, 2009, p. 75).

[20] See LEME DA SILVA, 2014.

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