GEOMETRY AND PROFESSIONALITY OF PRIMARY EDUCATION TEACHERS AFTER EDUCATION PROGRAM – 1959 TO 1971

Maria Cristina Araujo de Oliveira
mcrisoliveira6@gmail.com

Universidade Federal de Juiz de Fora

ABSTRACT

This study develops a characterization of professionality used to analyze proposals for geometry courses linked with primary education and teacher training programs in Brazil and France. Official prescriptions were published between 1959 and 1971. In this period, the concepts of Modern Mathematics were disseminated at international level. Professionalities strongly influenced by the proposals of Modern Mathematics were identified, which consider that the main function of teaching this discipline is the development of logical thinking and generalization as the goal of learning process. Regarding geometry, priority is placed on the study of properties of both plane and spatial geometry using methodologies that mix old systems and innovative methods especially based on cognitive psychology. In both Brazil and France, based on the documents analyzed, the teaching trajectory moves from space to plane full of comings and goings.

Keywords: Geometry; Professionality; Professionalization; Primary education teacher; Education programs.

RESUMO

No artigo desenvolve-se uma caracterização de profissionalidade que é utilizada para analisar as propostas para o ensino de geometria veiculadas em programas de ensino primário e normal no Brasil e na França. As prescrições oficiais foram publicadas entre 1959 e 1971. Nesse período ocorreu a disseminação do ideário da matemática moderna em nível internacional. Identificam-se profissionalidades marcadamente influenciadas pelas propostas da matemática moderna que consideram a função principal para o ensino dessa disciplina o desenvolvimento do raciocínio lógico e a generalização como meta para o processo de aprendizagem. Em relação à geometria, destaca-se a priorização do estudo das propriedades das figuras geométricas tanto plana quanto espaciais a partir de metodologias que mesclam heranças anteriores e inovações advindas sobretudo da psicologia cognitiva. Tanto no Brasil quanto na França, a partir dos documentos examinados, percebe-se uma trajetória de ensino do espaço para o plano num movimento de idas e vindas.

Palavras-chave: geometria, profissionalidade, profissionalização, professor primário, programas de ensino.

1. Introduction

This study analyzes professionality, identified and characterized in official prescriptions that parameterize the teaching practice in primary education. At first, it attempts to understand the concept of professionality based on broader perspectives, involving it in geometry teaching knowledge. The selected documents are for the primary education and teacher training, from 1959 to 1971.

At international levels, this period encompasses the dissemination of the Modern Mathematics Movement, considered the second international movement of mathematics modernization. It intended to redirect school curricula based on theoretical developments in Mathematics, especially in Algebra, and using the set theory as Math unifier. In methodological terms, the proposals were based on Jean Piaget's cognitive psychology.

Most programs analyzed are from Brazil, but one French program is considered, because it is by observing the other, the stranger, the unfamiliar, that we are led to review our own analysis in a Brazilian perspective.

2. Professionality as a category of analysis in geometry teaching

To explain how professionality is understood in this study, it is necessary to distinguish from and characterize its relation with other concepts related to the teaching profession. We will not discuss whether the teaching activity is a profession (BOURDONCLE, 1991, 1993), we will state it as such. A first important distinction is to consider professionality as a dimension of professionalization.

Historically, the teaching profession originated in different congregations of the church – in Brazil, particularly in Jesuitical groups. In these institutions, "a body of knowledge and techniques and a group of standards and specific values of the teaching profession" is developed. (NÓVOA, 2014, p. 16).

The 18th century held important discussions regarding the definition of a profession. The debate around the profile of a teacher involves laity, the need to be linked to a professional category or not – group of professors, selection processes for the function, responsibility for payment, institutional association. (JULIA 1981 *apud* NÓVOA 2014, p. 15)

Also in that century, a license for teaching is created, which becomes a requirement to practice this profession, and one of the important instruments in the teacher professionalization process.

In the 19th century, the state control on the teaching profession started by replacing religious with non-religious teachers. However, according to Nóvoa (2014), there was no "significant change in motivation, standards and *original* values of the teaching profession: the teacher model remains very close to the priest model (Julia, 1981a)." (NÓVOA, 2014, p.15)

For Bourdoncle (1991), professionality reminds of a more or less elevated and rationalized nature of knowledge and capability developed among teachers based on actions and official prescriptions or of specialized institutions (educational and research centers, universities) and continued education. For the researcher, this term may be understood as professional development, improvements of the individual.

Educational institutes are created and developed as a specific place of socialization destined to learning.

> Learning is a really important activity for the humanity that invented institutions dedicated to its own development: schools, understanding the term in its broader sense, that is, every institution whose purpose is to favor constructive activity in a certain domain. (PASTRE, VERGNAUD et MAYEN 2006, *apud* HOFSTETTER & SCHNEUWLY, 2009, p. 9. *Our translation.*)

According to the authors, constructive activity precisely consists in intentional learning, whose main purpose is to transform individuals.

In a traditional conception, which addresses learning by itself, schools are intended to general training, transmission of general culture, synthesized by the concept of Bildung (BENNER; BRUGGEN, 2004, *apud* HOFSTETTER and SCHNEUWLY, 2009, p. 10)

The content taught is the result of a complex process of knowledge development and transformation, theoretically analyzed by the theory of didactic transposition of Chevalard (1985) or school culture of Goodson (1993). Disciplines or subjects constitute a particular organization of knowledge according to school purposes. (CHERVEL, 1998)

This historically addressed process is reconsidered, according to the concept of "school form" of Vincent, Lahire and Thin (1994). (*Apud* HOFSTETTER and SCHNEUWLY, 2009, p. 10)

This school form, which assumes a distinction between learning and doing and involves specific periods and places for learning, can be characterized according to five relatively invariant aspects of specific social relations:

> 1. School as a specific place, separate from other social practices (the practice of specialty in particular), linked with the existence of objective (or objectified) knowledge;
> 2. "Pedagogization" of social relations of learning, linked with registration-codification of knowledge and practices;
> 3. Education systematization, producing long-lasting effects of socialization (social reproduction);
> 4. School is a place to learn the ways of power exercise, thanks to the objective rules teachers and students are submitted to;
> 5. The creation of a structural-school relation in the language and in the world (VICENT; LAHIRE; THIN, 1994, *apud* HOFSTETTER; SCHNEUWLY, 2009, p. 11. *Our translation.*)

This view, although generic, can support considerations around the school, professionalization and professionality. Regarding professional curriculum and

knowledge, Rey (2006, *apud* HOFSTETTER; SCHNEUWLY, 2009) states that building professional knowledge to be transmitted in a curriculum implies decomposition, objectivation, theorization, distance in relation to practice. On the other hand, the professional knowledge of a curriculum is not sufficient to effective teaching practice.

The researcher considers that the historical movement that led to the insertion of professional knowledge in the curriculum was the result of a double mutation: social practices were inserted in speech and their transmission was then through speech. Regarding knowledge, as an object and as a teaching tool, there is much literature in the USA in the 1980s, and more frequently in Europe.

Hofstetter and Schneuwly (2009) define two constitutive types of knowledge related to the teaching profession: knowledge to teach, that is, the subject of the teaching activity; and knowledge for teaching, which are the tools supporting the teaching activity.

Knowledge for the teaching activity, based on the field of professionality, involves knowledge about the subject to be taught, the student (at different levels, including adults) and prior knowledge, its development, the learning mechanisms, teaching practices (methods, devices, decomposition of knowledge to teach, types of organization and management etc.).

A perspective of professionality can be then thought as the construction of knowledge for teaching based on knowledge to teach. In the teaching professionalization process, a group of knowledge will constitute professionality, own or shared knowledge that comprise the professional identity "according to the audience and education degree, according to the education content and discipline, according to the institutional connection and professional status." (HOFSTETTER; SCHNEUWLY, 2009, p. 17) Such professionality involves great effort of pedagogical and didactic theorization, which implies a broader formalization of practice itself. (HOFSTETTER; SCHNEUWLY, 2009, p. 17)

In the beginning, professionality was more linked with technique than with a group of theoretical teaching knowledge, built in general by experts not belonging to the universe of teachers.

The creation of teacher training schools in the 19th century had an important role in the process of teaching professionalization, and professionality as well. In this context, the debates addressed the requirements to perform the profession, the curriculum extension, the improvement of academic level, among other questions.

According to Nóvoa (2014),

> Training institutions have a central place in the production and reproduction of the group of knowledge and system of standards for the teaching profession, performing a critical role in the development of pedagogical knowledge and a common ideology. More than training teachers (at an individual level), teacher training schools produce the teaching profession (at a collective level), contributing to the socialization of its members and the generation of a professional culture. (NÓVOA, 2014, p.18)

The analysis below presents a practice of search, identification and characterization of professionality elements related to teaching geometry to the primary education, considering the prescriptions for this level of education and the teacher training, since that, in the latter, the purpose is the professional training of the primary education teacher. The documents analyzed are from 1959 to 1971, when the proposals of Modern Mathematics were gradually disseminated.

3. When should the professionality in official Brazilian prescriptions be analyzed – like geometry –, and how to teach it?

The Law of National Education Guidelines and Bases (LDB – *Lei de Diretrizes e Bases*), enacted in 1961, kept the structure of the Organic Law for Teacher Training of 1946, through which the training to primary education teachers was provided in two cycles. In the first cycle, the high school lasted 4 years. During the third year the disciplines had pedagogical basis, such as Education Psychology, Education Sociology, and Education Philosophy, followed by one year of pedagogical preparation. In the second cycle, the teacher training would last 3 years, after the high-school period.

The new guidelines ensured autonomy for the states to propose programs. However, they defined up to five mandatory disciplines, including Mathematics, which should be concluded at state level. Regarding programs for Mathematics, with the Modern Mathematics, a rupture with the national reference tradition rule occurred in this period with Colégio Pedro II[1]. (OLIVEIRA *et al*, 2010, p. 37-38)

The proposals for the introduction of Modern Mathematics, or the principles identified with the international movement of Mathematics teaching modernization, known as Modern Mathematics Movement (MMM), started to be discussed in National Congresses of Mathematics Teaching, in 1957 and 1959, but not deeply. In 1962, the program "Minimum Subjects for a Modern Mathematics Program for Middle and High School" was approved, which was discussed also in teacher training[2] courses.

The book *O Movimento da Matemática Moderna – história de uma revolução curricular* (Modern Mathematics Movement – history of a curricular revolution, in a free translation), which summarizes the result of a research project that investigated the dynamics of this movement in Brazil and Portugal, shows that primary education reflects the changes proposed in methodological terms from Jean Piaget's genetic psychology and materials, publications and courses provided in several Brazilians states by Zoltan Dienes.

> In this segment, based on the studies analyzed, there is a clear concern of the instructors that worked with the primary school teachers about innovation of teaching methodologies, adapting them to the cognitive age of children. Also involving these age characteristics, printed materials were produced to attract children's attention, such as the insertion of pictorial representations, colors and graphical resources, which went beyond the technology limits of that time. (OLIVEIRA *et al*, 2010, p. 110)

---

[1] School created in the Empire period, in 1837; it was the benchmark and it supervised the Brazilian education until the creation of the Ministry of Education in 1930.
[2] Training was used to refer to continued education.

A balance of these materials produced as a result of the investigation shows that the MMM in the primary education in Brazil was more directed to experimenting new methodologies that placed students in constant activity, through learning situations that prioritized discovery. Starting the training intuitively, the path should lead to gradually treated situations of systematization and formalization. In this context, the role of a teacher was to direct the student's path. (OLIVEIRA *et al*, 2010, p. 109)

3.1 The Experimental Mathematics Program for Primary Education, RS, 1959

In 1959, the Educational Guidance and Research Center linked with the Secretariat of Education and Culture of the State of Rio Grande do Sul published an experimental Mathematics program for the primary education level. This program, although from the late 1950s, already shows signs of the movement that would be consolidated in the 1960s.

Some initial paragraphs discuss the importance of Mathematics in practical life, exploring its utilization from simple activities – like counting – to professions that require specialized training, like astronomers and physicians. The text concludes that, with Mathematics, it is possible "to solve extremely important problems and enable the critical acquisition of mental processes to thought evolution, such as induction, abstraction, generalization, reversibility of thought." (RIO GRANDE DO SUL, 1959, p. 5)

As for the general purpose of a subject, the following is noted: developing and organizing the logical thinking of individuals, presented in the first place, followed by other three of more generic nature, as "promoting the social integration of the individual, becoming familiar with the economic possibilities of the community." (RIO GRANDE DO SUL, 1959, p. 5)

The function of Mathematics in children training starts with changing the emphasis to the development of logical thinking, no longer focusing solutions for daily problems, but on fulfilling immediate needs of life.

In this program, geometry teaching starts with solids (sphere, cube and cylinder), with the recognition of these shapes in usual objects; then lines (straight and curved); followed by angles (right, acute and obtuse – without degree reference), with the recognition of square, rectangle and triangle, definition of perimeter in practical situation, recognition of circle, curved and flat surfaces by observing and comparing them. In the following phase, the definition of quadrilateral and triangle, recognition of quadrilaterals, study on triangle sides, perimeter (practical determination of perimeter of regular and irregular surfaces), area of square, rectangle and isosceles triangle area, recognition of pyramid and cone; later, study on circle, circumference, radius and diameter, circle area (practical demonstration), prism (quadrangular, rectangular and triangular), side faces, bases, edges and vortices.

Some elements of professionality may be identified in this program regarding the development of the geometric content. A similarity is observed to proposals influenced

by the new school, in the recommendation to start teaching geometry from solids, in particular sphere and cube. However, a different practice is identified, moving from space to plane full of comings and goings, with the introduction of new figures and new geometric elements. After studying straight and curved lines and angles, then comes the study on quadrilaterals, triangles and circles that will lead to pyramid and cone.

This program recommends that the teacher should analyze the readiness of students to new content and, as needed, create situations that allow them to enrich the required experiences. This recommendation highlights the needs to evaluate prior knowledge of students to guide the practice.

Self-discovery is encouraged as a teaching strategy, as well as the use of varied and significant didactic material. But there is no recommendation of specific materials or suggestions of activities that can lead to self-discovery. However, for the concrete materials, a sequence is presented of phases to be observed by the teacher to achieve the goals defined. The sequence assumes a course that starts with the real contact and object handling – called the concrete phase –; then going to the semi-concrete phase, with the utilization of pictures, drawings, signals; and, finally, the symbolic phase, where numerals, for instance, are inserted.

For a good result in teaching, other recommendations are provided, such as: take students' experience into account; foresee learning situations that fulfill students' interests; diversify learning situations; classify the difficulties in increasing order; propose repetition exercises of the same type for every difficulty degree; periodically check the knowledge acquired by the students; redirect teaching techniques and processes based on diagnostic tests.

All these recommendations have a professionality character, as they refer to the way a teacher should manage the teaching process. But, in this document, they do not present further details or references to support teachers.

3.2 Elementary Primary Education Programs, MG, 1961

When analyzing the elementary primary education programs of Minas Gerais from 1961, they present an introduction signed by Secretary of Education Odilon Behrens, of March 27, 1953, which shows the significant increase in the number of students through data in tables, requesting teachers for the "meditated" study of the programs, for the discussion with colleagues and their application to students. The development commission includes professors Alda Lodi (Arithmetic and Geometry); Jeanne Louise Milde (Drawing and Manual Work).

Professor Alda Lodi was in U.S. on a trip funded by Minas Gerais state government when Secretary Francisco Campos was in charge, and she took a specialization course at the Teacher's College, of Columbia University, from 1927 to 1929. She worked at the Escola de Aperfeiçoamento (Improvement School) in Belo Horizonte, whose activities started in 1929, when she came back to Brazil, giving classes in the Arithmetic Methodology course. Until 1950, she worked at this institute and the School Administration Course, also in Belo Horizonte. The studies in the U.S. were related to

the governmental initiative to introduce progressive education proposals based on the ideas of John Dewey, William Kilpatrick and Edward Lee Thorndike.

The program of Arithmetic and Geometry starts with teaching considerations presented in 5 pages. The first paragraphs address the importance of Arithmetic in daily activities such as estimating, measuring, comparing, evaluating and calculating. The text emphasizes that school Arithmetic is not linked with life Arithmetic, urging the end of such dichotomy. Problems are presented as priorities for the development of the arithmetic work. Three out of the five pages of the introduction section address the problems, with examples of what can be proposed to students. This program is not distant from the progressive education proposals, especially when it emphasizes the importance to fulfill everyday needs.

Four paragraphs address geometry teaching, which recommend its development by observing the shapes present in the child's daily routine and that is related to the manual work and agricultural work, developing it as a ground measurement to study the areas.

Geometry problems should result from real circumstances. In general terms, the program development should consider a logical and psychological chain, with no gaps or interruptions or long intervals without applying the subject already learned.

To end the teaching considerations, a list is provided with 11 attitudes to obtain good results, including: fulfill the differences in the classroom, presenting more difficult questions to more developed students and qualitatively and quantitatively balancing work; make students create the habit to check their own work; develop mental calculation. However, the attitudes are described in items, not providing detailed data on how to fulfill such recommendations.

The recommendations for each grade describe the content to be used in an illustrative manner, with suggestions of activities and examples of problems. In the first grade, although there is no recommendation for geometry teaching, at the end of the list of the skills the students should develop, there is one item which mentions the recognition of a circle and a square, with applications. In the second grade, the recommendation is for the teacher to take students to recognize and apply the geometric shapes: circle, triangle, quadrilateral. There is no example or suggestion for the utilization of specific materials. In the third grade, the study of angles is recommended, firstly by identifying right angles in rectangles and squares, and further expanding the idea by observing other quadrilaterals and triangles. This grade also introduces straight and curved lines, with the recommendation that such lines should be observed in professional activities: gardeners, carpenters, painters. In the fourth grade, the knowledge required involves the calculation of areas and perimeters and the application of geometric shapes to the production of drawings and maps. It is curious that there is no reference in this document to spatial figures, not even the most basic and familiar to children, such as sphere and cube.

There are few elements of professionality for geometry teaching. One of them can be recognized in the reference to the utilization of familiar figures, such as rectangle and square, for the identification of straight angle. The expansion of the notion of angle would be by observing other quadrilaterals and triangles.

3.3 Decree n° 6.879, MG, 1963

In 1963, Decree n° 6.879 defined the curriculum for teacher training in Minas Gerais. Mathematics was mandatory in the four years of middle school and in the fifth year of pedagogical training. In the first two years, it would be taught in four classes a week and, in the following three years, in three classes a week. In the second cycle, Mathematics, comprised of Arithmetic and Geometry, was mandatory in the first two years out of total three years, in three and one classes a week, respectively. The document has no indication that can be interpreted as professionality, not even in general terms about Mathematics teaching, although it is a regulation for teacher training.

3.4 Primary Education Programs, MG, 1965

Two years later, in 1965, new primary education programs were published in Minas Gerais. In the list of objectives, their titles indicate their contents. For example, popular culture, social change, integration into social reality, education for life. The first pages of the content for the first grade also has information about the role of Mathematics in primary education: "Mathematics is understood in the relation it has with instruments of work required for the everyday life"; the examples provided are meter, scale or coin (MINAS GERAIS, 1965a, p. 13). This program follows the same direction as the other one, reminding of the applications in everyday life, with special emphasis on the measurement.

Resolution n° 1/64, addressing the program approval, states that it was based on studies held before its publications and inquiries involving the participation of about seventy technicians, when "more than two hundred and forty professors" were interviewed" (MINAS GERAIS, 1965a, p.13).

The central commission in charge of developing the document was constituted of two professors of Didactics of Mathematics – Helena Lopes and Rizza Araujo Porto, one professor specialized in Psychology and thirteen people with administrative functions in the state education. The commission also had two other professors connected with Mathematics: Olga Barroca, specialized in Mathematics, and Jacy Stella Vieira de Vasconcellos, teacher of Methodology of Mathematics. Other three teachers with administrative functions were in the commission.

Professor Rizza Araujo Porto was in the University of Bloomington, in U.S., in 1956, with 13 other professors from Minas Gerais who received scholarships from PABAEE[3] to take courses there. The topic of this program was methodological modernization based on American experiences that should be adapted to our reality. Professor Porto wrote books like *Ver, Sentir, Descobrir a Aritmética* and *Frações na Escola Elementar*; and published articles in *Revista do Ensino* of several Brazilian states – in Rio Grande do Sul, she also had articles published in 1961 and 1962. (PAIVA; PAIXÃO, 2008)

---

[3] Programa de Assistência Brasileiro-Americana ao Ensino Elementar (Brazil-U.S. Support Program to Elementary Education).

In the introduction, in the part dedicated to Mathematics, the document presents a number of recommendations to teachers, highlighting that it is necessary to consider children's individual differences, learn about their prior knowledge before starting to teach, use familiar situations for children, promote mathematical experiences that allow to acquire significant concepts, guide the children through the discovery of generalization that unifies knowledge and prepares the basics of learning.

Three elements of professionality are particularly identified with traces of Modern Mathematics in the text: the acquisition of significant concepts rather than mechanization; a discovery learning proposal, which is largely disseminated; and the concern about generalization as qualitatively superior knowledge to be achieved through stages that would start with intuition and experimentation.

The recommendations also address the teacher's relation with the program and Mathematics, suggesting familiarity with the core ideas of the program, and knowledge on the sequential nature of Mathematics. The "mental computation" and problem resolution are highlighted, and the importance of both in child's learning is discussed.

It includes guidance about the importance of fixation exercises and the variety of situations when they should be proposed, using mental calculation and problem resolution as strategies. Lastly, the assessment is addressed as diagnosis to guide the teacher's work, without using this term explicitly, but suggesting that, after analyzing the result of a test, a new work would be planned to eliminate the challenges identified.

In terms of general objectives of the discipline, regarding geometry, it is expected to develop skills to represent site plans and spatial relations through drawings. By showing the aspects that characterize geometry in Modern Mathematics, the program indicates that a more systematized study is required in primary education. (MINAS GERAIS, 1965, p. 301)

Several suggestions of activities are presented. One of them relates Arithmetic with Geometry, proposing that students, by observing figures divided in the middle, see if the halves are equal: square, rectangle, circle and triangle. The emphasis in the first grade is on activities to differentiate plane figures from spatial figures: a cube from a square, a sphere from a circle. The introduction of spatial figures in the first grade is a strong difference between this program and the program published in 1961.

The use of everyday objects is suggested as an opportunity to analyze different shapes and study the capacity of objects: one liter can be in containers of different shapes: a straight parallelepiped, a cylinder, a cube.

Angles and straight line are addressed in the third grade, when the use of a ruler and a compass is proposed to produce geometric shapes. Angles are studied by observing objects like scissors, clock hands. The suggested activities include building bars and strips with polygons, and cubes and parallelepipeds with cardboard. The explanation of how to use objects to observe the concept of angle and the recommendations to build spatial figures with cardboard are instructions whose goal is the development of professionality, in this case, associated with geometry teaching.

In the 4th grade, the child should be able to understand what parallel, perpendicular and oblique lines are, as well as the difference between area and perimeter and how to calculate the volume of a cube and a parallelepiped. The activities suggested in the program are in general to measure the elements of plane figures, diameters, perimeters. The program suggests experimentation activities for perimeter calculation, with measurement made by using a string contouring the figure.

The bibliographical references include the two books of Rizza de Araújo Porto mentioned above, three books of Piaget, education programs of other states like Rio Grande do Sul and São Paulo, but the dates of these programs are not specified. The bibliographical recommendation is associated with professionality. However, letting teachers in charge of studies on professionality does not contribute to effectively supporting the practices.

3.5 Primary Education Programs, SP, 1969

In São Paulo, the primary education program of 1969 was published in a context of education system expansion and its purpose was to regulate and reorganize the primary education system, and integrate 5,000 new teachers recently hired to work in the state education system into the new primary education schools in São Paulo (MEDINA, 2007, p. 94). This program was the first to have Mathematics teachers in its development, with Professor Manhúcia Liberman representing GEEM[4].

This program shows a democratic character, which is a special fact considering the military dictatorship of the country in that moment, and it does not suggest any specific methodology, making schools free to choose it after the publication of the results from studies on different methodologies. (MEDINA, 2007, p. 104)

Regarding geometry, the analysis of Medina (2007) is that the proposal was an axiomatic treatment, in an abstract manner with the study of properties, "aiming the recognition and study of relations." (MEDINA, 2007, p. 117)

In general, according to the analyses of Medina (2007), the primary education program of 1969, regarding Mathematics, is based on teaching through mathematical facts, emphasizing the structural properties of the operations. Although it is concerned about the children's psychological development in content distribution, the content is not exactly suitable to the age. The program does not present suggestions of activities.

3.6 Teacher training programs, RN, 1971

The teacher training programs of 1971 published in the State of Rio Grande do Norte, according to the document itself, are the result of an evaluation of other existing programs and the application of the proposals of a course held on January 4-26, 1971, for state teachers. The proposal viability can be analyzed by experience.

---

[4] Grupo de Estudos do Ensino da Matemática (Mathematics Teaching Study Group).

The course, supported by SUDENE[5] and USAID[6], had teachers from the Federal University of Rio Grande do Norte and Centro Regional de Pesquisas Educacionais João Pinheiro (Regional Center of Educational Research) of Belo Horizonte, a body of INEP. Two programs are analyzed here: the Mathematics program and the Mathematics didactic program.

The Mathematics program development commission was coordinated by Marcondes Mundim Guimarães and its members were: José de Araújo Ferreira; José Amilton Pereira; Maria Fausta Fernandes; and Osvalita Rodrigues Pinheiro.

The program is organized in items: one-page introduction; a chart with the units and subunits; bibliographical references; bibliographical recommendations for knowledge enrichment; a list of didactic procedures and two observations.

In the introduction, the text highlights the importance of a teacher in a teacher training course paying attention to the professional and vocational character of the teacher training schools, placing Mathematics in the context of primary education schools, as well as the essential concepts related to Mathematics, qualifying students in this course for practical life situations, with knowledge they would use in their practices as teachers, being sure to "prepare their students to rigor of logical thinking, and clear and precise language to express thoughts". (RIO GRANDE DO NORTE, 1971, p. 122)

The program points out two aspects to teachers: the importance of rigor in terminology and conceptualization, according to more modern theories; and whenever possible, combine theoretical knowledge with practical application.

The chart with units and subunits shows the contents are practically the same for primary education, although the bibliographical references for each subunit are mostly of middle school, with authors like Osvaldo Sangiorgi, Scipione de Pierro Neto, Alésio de Caroli; Zoltan Dienes is also included in the bibliographical references.

Geometry and decimal systems and measurements are in the sixth unit of a total of seven, comprised of 12 subunits. The subunits cover plane geometry, and the first item is sets of points, and then, triangles, quadrilaterals and circumferences, perimeter, area; in spatial geometry – study of main geometric solids, measurement of volume, measurement of capacity, measurement of mass.

The bibliographical references for knowledge enrichment include two books of philosophy of Mathematics (one of Bertrand Russel); *Aprendizado Moderno de Matemática* of Zoltan Dienes; a book on logic; and two books on the theory of sets (one of Benedito Castrucci and one of Edgar de Alencar Filho).

There is a list of 11 didactic procedures, starting with a presentation, including an independent study, a seminar, a team work, audiovisual resources, excursions, interviews and conferences, among others.

---

[5] Superintendência para o Desenvolvimento para o Nordeste (the Superintendency for the Development of the Northeast).
[6] United States Agency for International Development.

The Mathematics didactic program was coordinated by Wanda Knupfer de Paiva, and its development had the participation of professors: Ivoneide Ramos da Silva, Joselita de Oliveira, Margarida Câmara Bezerra, Maria Cacho Belchior, Maria Edmar Fernandes, Maria Isabel Sarmento Rodrigues, Maria Salonilde Ferreira, and Marlena Soares de Araújo.

Highlighting recent achievements like the trip to the Moon and deep sea studies, the professors associated the importance of Mathematics and a well-trained teacher to teach it in primary education schools. The proposal organization considers, according to them, understanding Mathematics as a hierarchy of structures and relations and its application to primary education classes.

The geometry concepts comprise the seventh unit of total nine. The following units address (Mathematical) problems and evaluation. The development of program content follows the order from space to plane. The solid figures will be studied in this sequence: concept, characterization and classification. The plane figures will be studied starting with making solid figures plane and following the same sequence: concept, characterization and classification. Lines as part of plane figures and finally point and space. This order is similar, in general, to the proposed program of primary education.

For the development of program content, some suggestions of didactic procedures are provided, regarding the study of solid and plane figures that involve presentations about the origin of geometry and the concept of geometric axioms; organization of activities for the recognition of figures and association of names with both spatial and plane figures; making solid figures plane on cardboard for the recognition of plane figures.

The bibliographical references repeats some Mathematics books recommended in the Mathematics program, but also include others on Mathematics methodology, didactics based on Piaget's psychology, two books of Zoltan Dienes, as well as Mathematics programs of 1965 of the State of Minas Gerais.

Mendes & Assis (2014), when analyzing these programs, identified that the most significant change in this document is perhaps related to the suggestions for didactic procedures. (MENDES; ASSIS, 2014, p. 26)

These programs are also analyzed by Brito & Gutierre (2007) as part of the actions supported by SUDENE–USAID association, aiming to provide the "support required to technological development, which would allow industrialization of society, in agreement with the ideals from the creation of SUDENE." (BRITO; GUTIERRE, 2007, p. 8)

Specifically regarding professionality for geometry teaching, a movement of alternation from spatial geometry to solids and plane geometry, initially analyzed in the experimental program for the primary education in Rio Grande do Sul, in 1959, will also be seen in Minas Gerais in the program for primary education of 1965 and in the program for teacher training of Rio Grande do Norte of 1971 in the discipline of didactics of Mathematics. The geometry approach proposed by this program to students in teacher training under the discipline of Mathematics follows a classic course of the viewpoint of Euclid's *Elements*, which starts with studying geometric axioms from plane to spatial geometry.

In a broader perspective of professionality prescribed in regulations previously analyzed and identified with the modern proposals for Mathematics teaching based on the MMM, the main characteristic is in the bibliographical references that support such documents. Books of Piaget and Dienes are the basis of these programs and are recommended to teachers either during or after training. Specifically about Mathematics, Osvaldo Sangiorgi[7] and Scipione de Pierro Neto are modern references. The emphasis on axiomatic treatment can be seen only in the program of 1969 in São Paulo.

4. Professionality for Modern Mathematics teaching in France

In France, the introduction of Modern Mathematics in elementary primary education programs started in 1970. French reformers emphasized Modern Mathematics, evaluating Mathematics as "essential for the culture of modern men due to the role it has in learning about the contemporaneous world" (D'ENFERT, 2015, p. 58). The introduction of Modern Mathematics in primary education was justified by Piaget's genetic psychology that related the development of children's mental structures with the development of mathematical structures. However, the program developed in 1970 was basically the program of 1945 with a simplified and more rational text. (D'ENFERT, 2015, p. 60)

The main changes refer to the content approach. For example, for geometry, the study on properties of figures is highlighted. Professionalities in official texts in that period pointed out active pedagogy under the ability of invention and abstraction of children through team work, discovery of mathematical concepts and their related techniques.

The study conducted by D'Enfert (2015) about official texts for primary education and teacher training in France shows the proposed professionality based on Modern Mathematics is especially founded on deeper knowledge of Mathematics not only required for teaching.

The text of June 1969 addressing Mathematics in professional training to future teachers discusses that Mathematics teaching in primary education has its value as it allows everyone to be aware of the possibilities of creation to handle with the proposed situations and understand that apparently distinct situations may represent the same model or structure. However, to achieve such goals, methodological changes are also required: incite the initiative of students, develop their abilities of invention, accept different solutions (even if they are not simple for adults), work individually and progress at one's own rhythm. In this sense, it is required to deepen mathematical knowledge:

> Today, this change in method (incite discovery, not transmitting knowledge in a pre-organized manner) requires that the teachers actually master the discipline: it is not possible to use a suggestion from a student if the consequences of this suggestion are not immediately seen. Then, the teacher should not receive a training that provides mathematical basis to make his students acquire basic notions, but a training where the teacher masters the extensions of these notions [...]. (D'ENFERT, 2015, p. 530. *Our translation*).

---

[7] Professor Osvaldo Sangiorgi was the main author of didactic books of Modern Mathematics, precursor and president of GEEM during the whole period this group existed.

For this work with Mathematics, the higher education level participation was inserted through partnerships with teacher training schools.

For geometry teaching, the recommendations are: presenting open situations through handling objects, games, drawings, constructions, folding and planes. The development starts from space to plane. Suggestions of activities are provided that can be made with children for geometry learning. One very different suggestion proposed was to take pictures of some objects from different angles, and the students had to find the place where the pictures were taken from.

5. Final considerations

This analysis of education programs searching for professionality elements in these official prescriptions allowed identifying that such elements are more frequent in instructions related to knowledge for teaching than in knowledge to teach. Regarding what would be taught to children or their teachers in 1959 to 1961, it is practically the same geometric knowledge of plane or spatial geometry. However, the way to develop such knowledge is what allows us to better characterize the professionality for geometry teaching.

The geometry teaching trajectory starting from geometric solids to plane figures (space → plane), in an alternating movement, is observed in the Brazilian and French programs. The activities suggested for such programs have some parts in common: observation and comparison of objects, plane of objects and construction of figures with materials, among others.

When comparing all programs analyzed, even in the French program, the prescriptions for geometry are considerably less extensive. Arithmetic is prioritized, receiving a primary role. Even in the suggested activities involving Arithmetic and geometry, geometry appears illustratively.

For Perrenoud (2009), *nothing is quite so practical as a good theory*, and he explains this suggestive statement in agreement with Lewin (1951 *apud* Perrenoud, 2009) that a good theory is not necessarily a scientific theory. It is a theory that ensures "power over the world that allows foreseeing and suggests how to leverage the action. [...] It is above all the anthropology of knowledge: the actors need good theories to act" (PERRENOUD, 2009, p. 266. *Our translation*.)

The lack of professionality elements for geometry teaching allows concluding one of the reasons of the challenges and resistance to geometry teaching and learning, especially in primary education. The Mathematical Education has to formulate, develop and guide new professionalities for Mathematics teaching, in particular geometry.

6. References

Bourdoncle, R. (1991). La professionnalisation des enseignants: analyses sociologiques anglaises et américaines. *Revue Française de Pédagogie*, Paris, n. 94, jan./mar.

Brito, A. de J.; Gutierre, L. dos S. (2007). A formação de professores que ensinavam matemática no Rio Grande do Norte entre 1960 e 1979: o convênio Sudene/Usaid. *ANAIS do IX ENEM*. Belo Horizonte, UFMG.

Chervel, A. (1998). L'histoire des disciplines scolaires. In: A. Chervel, *La culture scolaire. Une approche historique* (pp. 9-57). Paris: Belin.

Chevallard, Y. (1985). *La transposition didactique*. Greboble: La Pensée sauvage.

D'Enfert (2015). *L'enseignement Mathématique à L'école Primaire de la Révolution à nos jours.* Tome 2: 1915-2000. (avec la collaboration de Josiane Hélayel). Limoges: Presses universitaires de Limoges.

Goodson, I. F. (1993). *School subjects and curriculum change*. London: Falmer Press.

Hofstetter, R. & Schneuwly, B. (2009). *Savoirs en (trans)formation: Au coeur des professions de l'enseignement et de la formation.* Bruxelas: De Boeck.

Medina, D. (2007). *A produção oficial do MMM para o ensino primário do Estado de São Paulo (1960-1980).* Dissertação (Mestrado em Matemática). Departamento de Matemática, PUC-SP.

Mendes, I. A. & Assis, M. M. A. (2014). A matemática do ensino primário na Escola Normal de Natal (Brasil): alguns fragmentos de história. *Revista da Rede Amazônica de Educação em Ciências e Matemática*, v. 01, p. 15-35.

Minas Gerais (1961). Secretaria de Estado da Educação. *Programa do ensino primário elementar*. Belo Horizonte: Imprensa Oficial. Disponível em: https://repositorio.ufsc.br/handle/123456789/104807 . Consultado em 02/jun/2015.

Minas Gerais (1963). Secretaria de Estado da Educação. *Decreto n° 6.879*. Belo Horizonte: Imprensa Oficial.

Minas Gerais (1965a). Secretaria de Estado da Educação. *Programa do ensino primário elementar. Primeira Série*. Belo Horizonte: Imprensa Oficial. Disponível em: https://repositorio.ufsc.br/handle/123456789/104802 . Consultado em 02/jun/2015.

Minas Gerais (1965b). Secretaria de Estado da Educação. *Programa do ensino primário elementar. Segunda Série*. Belo Horizonte: Imprensa Oficial. Disponível em: https://repositorio.ufsc.br/handle/123456789/104803 . Consultado em 02/jun/2015.

Minas Gerais (1965c). Secretaria de Estado da Educação. *Programa do ensino primário elementar. Terceira Série.* Belo Horizonte: Imprensa Oficial. Disponível em: https://repositorio.ufsc.br/handle/123456789/104804 . Consultado em 02/jun/2015.

Minas Gerais (1965d). Secretaria de Estado da Educação. *Programa do ensino primário elementar. Quarta Série.* Belo Horizonte: Imprensa Oficial. Disponível em: https://repositorio.ufsc.br/handle/123456789/104805 . Consultado em 02/jun/2015.

Nóvoa, A. (2014). *Profissão Professor*. Porto: Porto Editora, 192 p..

Oliveira, M. C. A. (Org.) ; Silva, M. C. L. (Org.) ; Valente, W. R. (Org.) (2011). *O Movimento da Matemática Moderna: história de uma revolução curricular.* 1. ed. Juiz de Fora: Editora UFJF, v. 01. 190p.

Perrenoud, P. (2009). Rien n'est aussi pratique qu'une bonne théorie! In: Hofstetter, R. & Schneuwly, B. *Savoirs en (trans)formation: Au coeur des professions de l'enseignement et de la formation* (pp. 265-288). Bruxelas: De Boeck.

Rio Grande do Norte (1971). Secretaria de Estado da Educação e Cultura. *Programas do Ensino Normal.* Natal: Imprensa Oficial. Disponível em: https://repositorio.ufsc.br/handle/123456789/116356 . Consultado em 02/jun/2015.

Rio Grande do Sul (1959). Secretaria da Educação e Cultura. CPOE. *Programa Experimental de Matemática.* Curso Primário. Porto Alegre. Disponível em: https://repositorio.ufsc.br/handle/123456789/122106 . Consultado em 02/jun/2015.