

HISTORICAL REVIEW OF TEACHING GEOMETRY IN HIGHER EDUCATION IN SERBIA (1838-1914)

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Abstract

Since the establishment of the first higher education institutions in Serbia in the 19th century, geometry and technical drawing have been an integral part of curricula. In order to fill the gap in the systematic review of teaching in the education system of that time in Serbia, the paper researches the presence of geometry in the curriculum of the first institutions of higher education in Serbia, at the Lyceum (1838-1863), in the Great School of Belgrade (1863-1905) and Belgrade University (1905-1914). The contribution of professors to the foundation and development of the subject of geometry and technical drawing as the basic language of graphic communication of engineering and technical knowledge is also presented.

Keywords: teaching of geometry, history of education, higher education in Serbia

1 INTRODUCTION

The first higher education institutions in Serbia were established in 19th century, after the period of Ottoman rule. From the beginning, technical sciences were introduced in these higher education institutions, as carriers of economic development in architecture, construction and engineering in general, following the example of the contemporary teaching models at prestigious European universities, and the growing need for qualified engineers and specialists in the technical profession.

In order to fill the gap in the systematic review of teaching in the education system of that time in Serbia, the paper researches the presence of geometry in the curriculum of the first institutions of higher education in Serbia, at the Lyceum (1838-1863), in the Great School or Great Academy of Belgrade (1863-1905) and later Belgrade University, from its foundation (1905), until the beginning of the First World War (1914). The research aims to find out how education in the field of technical sciences was approached in relation to the growing need for qualified engineers and specialists in the technical profession, evaluates the importance of geometry and technical drawing within the curriculum of the mentioned institutions, and highlights the prominent professors in this field.

2 TECHNICAL SCIENCES IN THE FIRST HIGHER EDUCATION INSTITUTIONS IN SERBIA (1808-1914)

The beginnings of higher education in Serbia date back to the period of the First Serbian Uprising (1804-1813) and the foundation of the Great School of Uprising Serbia (1808-1813) [1] [2]. In 1838 the Lyceum was founded in Kragujevac [2] [3]. After it was moved to Belgrade in 1841, the *natural and technical department* was established in 1853 [4] [5]. Prior to this, technical professionals were educated at the First Engineering School in Belgrade (1846-1849) [5] [6]. Following the growing need for technical professionals in the fields of land surveying, planning regulation and infrastructure and public facilities building, which, in the absence of domestic experts, were performed by foreign engineers [5], the Great

School was founded in 1863. It consisted of three faculties: Law, Philosophy and Technical Faculty [7]. In 1880 new subjects were introduced in the Department of Natural Sciences and Mathematics of the Faculty of Philosophy, among which was descriptive geometry [3]. Its curricula development continued at the Technical Faculty, where new departments were formed following the legislative regulations of 1896 and 1897: Civil Engineering, Architectural and Mechanical Engineering [7] [3]. The Technical Faculty owned five collections, including the Collection of Design Geometry and the Collection of Preparatory and Technical Drawing [3]. The number of students increased over the years, and the conditions were met for the Great School to become the University of Belgrade in 1905 [3] [7].

3 DESCRIPTIVE GEOMETRY IN THE CURRICULUM OF HIGHER EDUCATION

The curriculum of the Great School of Uprising Serbia included 'croquer' in the first grade, i.e. topographic or hydrographic measuring based on the method of popular geometry [2].

The art of drawing was the most popular subject in the Lyceum's study program for the school year of 1839/40, with 5 classes a week taught in the first, and 4 classes in the second year. As part of the mathematics curriculum, geometry was taught twice a week [8]. These subjects own their popularity to Atanasije Nikolić (1803-1882), the first rector of the Lyceum, who opened a (private) drawing school there in 1839 [8]. At Nikolić's suggestion, from 1839 *the art of drawing* should be taught daily in the Gymnasium and Lyceum. In the same year, he initiate the collection of funds and tools for the drawing school (drawing boards, rulers, frames for drawings, pencils) [8]. The introduction of the subjects of geodesy and art of drawing into the Lyceum curriculum contributed to the development of the first regulatory plans and projects for the regulation of watercourses, road layouts, parceling and topographic measuring [2], which included: surveying of land holdings, regulating settlements, making maps, etc. [5].

At the first Engineering School, geography, mechanics, and architecture were studied consecutively over three years, and drawing was a mandatory subject. Atanasije Nikolić taught practical geometry, the theoretical part during winter and the practical part during summer, when the engineering school cadets participated together with the engineers in the surveying of land holdings and construction of buildings and roads [5]. The content of practical geometry subjects (land surveying, geodesy) of this school is unknown due to the lack of historical or direct sources [9].

In the period 1842/43-1853/54, descriptive geometry and practical geometry did not exist as independent subjects. In 1854/55 practical geometry was introduced into the Lyceum curriculum, until the founding of the Great School (1863). From 1853 to 1864 practical geometry at the Lyceum was taught by professors Filip Hristović, Emilijan Josimović and Dimitrije Nešić who taught geometric drawing [2].

At the Technical Faculty of the Great School there were 12 vocational and 6 basic subjects, including descriptive and practical geometry [3]. In 1873 the number of vocational subjects increased, and the natural science subjects were mostly transferred to the Department of Natural Sciences and Mathematics of the Faculty of Philosophy. New subjects, preparatory drawing and machine science, were introduced at the Technical Faculty following the intention of the state to educate engineers who would participate in the construction of *iron roads* [3]. Among the vocational subjects, practical geometry with topographic drawing and descriptive geometry with geometric drawing, which was represented in curriculum of all departments of the Technical Faculty, were introduced [3]. In 1903/04 descriptive geometry program included: Orthogonal design, Projection transformations, Dimension lines design, and Axonometric orthogonal design. Perspective was taught as well [10].

Professors who taught descriptive geometry were the authors of textbooks. The most important textbook was *Elementary Geometry* (A. Nikolić, 1841), including planimetry, trigonometry and stereometry [5], where the geometric and mathematical terms were introduced in the Serbian language. Emilijan Josimović published *Fundamentals of Draft Geometry and Perspective* (1874), Dimitrije Stojanović *Perspective* (1871) and *Methodology of Descriptive Geometry* (1899) [11]. There were also *Geometry for Higher Schools of the Principality of Serbia* (F. Močnik, 1857), and *Draft Geometry* (P. Bajalović).

4 TEXTBOOKS AND TEACHING MATERIALS

Books, necessary instruments, original plans and teaching aids taken from the military school (Požarevac, 1836 - 1837) were provided for the teaching of mathematical and geographical sciences at the Lyceum [4] [8].

Professors who taught descriptive geometry were the authors of textbooks. The most important textbook was "Elementarna geometrija" (*Elementary Geometry*) (A. Nikolić, 1841), including planimetry, trigonometry and stereometry [5], where the geometric and mathematical terms were introduced in the Serbian language. Atanasije Nikolić wrote the first textbook for the teaching of mathematics, „Algebra ustrojena za upotrebljenje slišatelja Filosofije u Liceumu Knjažestva Srbije" (*Algebra Arranged for the Use of Students of Philosophy in the Lyceum of the Principality of Serbia*), (1840, Belgrade), and the second textbook was "Elementarna geometrija – ustrojena za upotrebu slušatelja filozofije u Liceumu Kneževine Srbije" (*Elementary Geometry - Arranged for the Use of Students of Philosophy in the Lyceum of the Principality of Serbia*), (1841, Belgrade). The textbook had a volume of 215 pages and 5 sheets with drawings, and consisted of three parts: planimetry (ten chapters), trigonometry (with numerous completed tasks) and stereometry (two chapters) [5]. As an author, Nikolić solved the problem of forming geometric concepts and creating mathematical terms in the Serbian language. The textbook was used for 17 years in teaching, and after this period the textbook "Геометрія за више школе Княжества Србіє" (*Geometry for Higher Schools of the Principality of Serbia*) by Dr. Franz Močnik (1857, translated by Vuk Marinković) was used. Močnik's textbook had 357 pages, and it consisted of four chapters: Planimetry, Stereometry, Trigonometry, and Application of algebra to geometry [5].

Professor Emilijan Josimović wrote *Fundamentals of Draft Geometry and Perspective*, a handbook for students of our highest schools (Belgrade, 1874).

Professor Dimitrije Stojanović (1841-1905) wrote the textbook *Perspective* (1871), and published the textbook on draft geometry "Metodika nacrtne geometrije-slike" (*Methodology of Descriptive Geometry*) in two parts (text and pictures) (Belgrade, 1899), which consisted of five chapters: Orthogonal design, Central design, Theory of designed forms, Conical trains, and Central collineation in space [11].

Professor Petar Bajalović wrote down his lectures on 192 pages in the textbook "Nacrtna geometrija" (*Draft Geometry*).

5 PROFESSORS

Atanasije Nikolić (1803-1882) was the first rector of the Lyceum, elected in 1839/40. As an engineer, he made a great contribution to the urban planning of Belgrade, in the field of surveying and land parceling. He participated, as well, in the urban planning of towns around Serbia, the layout of roads, and the arrangement of watercourses. He founded the first drawing school at the Lyceum, where he taught courses Earth Sciences, Drawing (1839/40-1841/42), Mathematics - Algebra and Elementary Geometry (1839/40-1841/42 and 1845/46) and Architecture (1840/41-1841/42, 1845/46) [2].

Mihailo Petrović was an assistant to Atanasije Nikolić on the course Art of engraving in 1839/40 [2].

Filip Hristović (? - 1857) taught Practical Geometry (1854/55-1856/57), as well as courses: Mathematics (1852/53-1853/54), Higher Mathematics, Mechanics, and Architecture (1854/55-1856/57) [2].

Emilijan Josimović (1823-1897) was an engineer, and he taught practical geometry at the Lyceum (1857/58-1858/59, 1860/61-1861/62), and later at the Great School (1869/70-1873/74) geodesy (Practical Geometry with Topographic Drawing (1874/75-1877/78), and *Draft Geometry* (1869/70-1873/74). In addition to the above courses, he taught Mathematics (1845/46-1853/54), Higher Mathematics (1857/58-1861/62), Mechanics (1850/51-1853/54, 1857/58-1861/62), and Architecture (1857/58-1858/59, 1860/61-1861/62). He is considered the first Serbian urban planner. He was, as well, rector of the Lyceum (1849/50) and of the Great School (1874/75 and 1876/77) [2].

Dimitrije Nešić (1836-1904) was a mathematician. As a substitute teacher, he taught Practical Geometry (1862/63), and then, as a professor, geometric drawing as part of the Elementary and Advanced Mathematics course at the Great School (1863/64). He taught courses Elementary and Higher Mathematics (1864/65-1865/66), and later Lower and Higher Mathematics (1866/67-1873/74), Mathematics (1874/75-1881/82), and Higher Mathematics (1882/83-1893/94) [2].

Konstantin - Kosta Alković (1834-1909) was a mathematician and physicist. He taught the course Descriptive Geometry at the Great School (1863/64) [2].

Mihailo Petković (1833-1917) was an engineer, and he taught draft and practical geometry and geometric drawing (1864/65-1868/69) at the Great School, as well as the courses Science of construction on land and water (1869/70-1880/81), and Science of construction of ordinary and iron roads (1881/82-1886/87) [2].

Dimitrije Stojanović (1841-1905) was a civil engineer, and the professor of Draft Geometry with geometric drawing (1874/75-1886/87) at the Great School [2].

Petar Vukićević (1862-Belgrade, 1941) was a mathematician. He was an intern (assistant) on the course of Draft Geometry at the Great School (1887/88-188/89) (in 1887/88 the professor's position was vacant) [2].

Milan Kapetanović (1859-1934) was an architect. He taught Draft geometry at the Great School and Belgrade University (1888/89-1905/06, 1908/09), as well as the course Perspective (1902/03-1903/04) and Design of Public Buildings (1902/03) [2].

Petar Bajalović (1876-1947) was an architect. He taught Draft Geometry and Perspective (1906/07-1913/14) at the Technical Faculty of the University of Belgrade [2].

Jovan Gašić was an assistant in the Draft Geometry course at the Technical Faculty of the University of Belgrade (1908/09-1913/14) [2].

6 CONCLUSION

This paper contributes to the history of higher education in Serbia in the chronological period 1838-1914, in the segment related to the subjects of geometry and technical drawing, as well as to the history of science. The contribution of professors, mostly engineers and architects, to the establishment of the subjects of geometry and technical drawing, and the advancement of technical sciences and engineering, has been presented, as well.

Geometry and technical drawing were an integral part of the curriculum for degrees in philosophy, civil and mechanical engineering, architecture in Serbia (1838-1914), either as an independent subject or as part of other subjects, necessary for the education of specialists in the technical profession, mainly with the aim of educating future civil servants who, in addition to general, also needed specialist knowledge in technical areas important for land surveying, urban regulation, drawing up plans for construction roads, bridges and high-rise buildings.

Thanks to esteemed professors, such as Nikolić, Josimović, Simonoviću, Stojanoviću, and Kapetanoviću, geometry and technical drawing were represented to a large extent in all higher education institutions of this period, and the first trained technical staff in Serbia in the 19th century acquired practically applicable knowledge in the field of design and construction, contributing to the overall economic development.

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