'Mebahis-i İlmiye' as the first periodical on mathematical sciences in the Ottoman Turkey

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Mebahis-i İlmiye (1867–1869) was the first periodical on mathematical sciences published in 19th century Ottoman Turkey. The authors primarily attempted to introduce the mathematics required for the financial, societal, educational and military development of the country. This paper analyzes the periodical in order to understand (i) the fundamental reasons for its publication, and (ii) transmission of contemporary mathematics from Europe to Ottoman Turkey. Findings unveiled that the periodical had various reasons for mathematics education in the Ottoman society of the time. Moreover, it served the transmission issue to a certain extent.

Keywords: Mebahis-i İlmiye, Ottoman Turkey, history of mathematics education, reasons for mathematics education, transmission of mathematical knowledge.

INTRODUCTION

During the 18th and 19th centuries, the Ottomans transmitted mathematical knowledge from Europe on the grounds that it was the leading region of the time in terms of mathematical sciences. The mathematical knowledge was chiefly conveyed by translating European textbooks. Periodicals were salient in this process too, because editors could compile various kinds of sources, such as excerpts from journal articles, in accordance with the needs of the society. According to Günergun (2007), the earliest Turkish periodical introducing mathematical sciences was *Mebahis-i İlmiye* (Scientific Themes), issued between 1867 and 1869 in Istanbul, capital of Ottoman Turkey. It was published in Ottoman Turkish, which included Arabic and Persian words and was written in Arabic alphabet. The authors aimed to contribute to the teaching of pure and applied mathematics (other disciplines such as astronomy and physics). *Mebahis-i İlmiye* was a monthly publication of *Cemiyet-i Tedrisiye-i İslamiye* (Educational Society for Muslims) which was founded in 1865 by enlightened Ottoman state officials Yusuf Ziya Bey (1826–1882), 'Vidinli' Hüseyin Tevfik Bey (1832–1901) and Ahmet Muhtar Bey (1839–1919) with the goal of enlightening Muslim society by promoting mathematics and science education.

The idea of publishing the periodical belonged to Yusuf Ziya Bey, who was teaching basic arithmetic to apprentices in Grand Bazaar as an accountant in *Daire-i Askeriye* (Military Office) (Zeki, 1924). However, Hüseyin Tevfik Bey, a graduate of Mühendishane (School of Engineering) (Schubring, 2007), committed himself to the publication from the very beginning (Günergun, 2007). He was a remarkable mathematician and had a deep background in education: military attaché and vice-principal in *Mekteb-i Osmani* (Ottoman School) in Paris. During the time of *Mebahis-i İlmiye*, he gave courses on mathematics and mechanics in *Mekteb-i Harbiye* (Military Academy), and he taught mathematics to apprentices as a member of *Cemiyet-i Tedrisiye-i İslamiye*. He was well-known for his book originally titled "Linear Algebra" (first edition in 1882), in which he introduced the general notion of linear algebra independent of the terms 'associative' or 'non-associative' (Schubring, 2007). Given Tevfik Bey's education in the context of traditional Islamic mathematics and his later formation in European mathematics, he was the appropriate person for transmitting European mathematics into the Ottoman context of mathematics. Lastly, Ahmet Muhtar Bey, who was a graduate of *Mekteb-i Harbiye*, was teaching science in the time of *Mebahis-i İlmiye* in this school.

In her historical research, Günergun (2007) asserted that the periodical served the purpose of teaching mathematical sciences for different groups of individuals in the Ottoman society, which was considered as indispensable for the growth of national prosperity. Yet, there may be further reasons for publishing this periodical, which can be unfolded through mathematics education literature. In accordance with Niss' (1996) reasons for mathematics education in a society, this study intends to analyze *Mebahis-i İlmiye* with respect to the motives leading to its publication. Moreover, it aims to clarify the mathematical traditions that the authors relied on in the publication, which will also reveal the transmission of mathematical knowledge from European powers as the 'metropolis' to the Ottoman Turkey as the 'periphery' (Schubring, 2000). Hence, the following research questions are asked:

1) For what reasons did *Mebahis-i İlmiye* provide the 19th century Ottoman Turkey society with mathematics education? How were the reasons addressed in its content?

2) On which mathematical traditions did the authors of *Mebahis-i İlmiye* rely?

According to Niss (1996), the reason why a society is educated in mathematics is "a driving force, typically of a general nature, which in actual fact has motivated and given rise to the existence (i.e. the origination or the continuation) of mathematics teaching within that segment, as determined by the bodies which make the decisions (including non-decisions) in the system at issue" (p. 12). Niss makes a distinction between the reasons addressing *formative ends* serving the individuals' development, and those referring to *practical ends* resulting in practical outputs for the society.

Niss (1996) sets three categories of fundamental reasons for mathematics education: (i) *technological and socio-economic development of society*, (ii) *political, ideological and cultural maintenance and development of society*, and (iii) *providing individuals with prerequisites which may help them to cope with life*. The reasons may be driven by the desire for the societies' own welfare or their effort for competing against the other groups of societies of the time. Related to *technological and socio-economic development of society*, mathematics education aims to train individuals who would serve their country as labor force of high quality. Such an education attempts to develop individuals with high abilities, knowledge and dispositions for performing their role in the society. In other words, it requires individuals to have "knowledge, skills, flexibility, and attitudes so as to allow them to obtain, manage, and develop jobs in the present and in the future" (Niss, 1996, p. 25). This requirement connotes the indispensable relationship between science and commerce, manufacture and industry. Individuals should possess certain general qualifications (i.e., some applicable side of mathematics and geometry such as mensuration) as well as those specifically related to their vocation. The reasons of this first category are expected to produce practical ends. The global mathematics education in the 19th century substantially served this kind of reasons.

The initial needs for a mathematics education have virtually sprung from the reasons under *society's political, ideological and cultural maintenance and development*, for example, to meet the administrative requirements of the society. More precisely, this type of reasons indicate that mathematics education can assist individuals to become nationalist, collaborative, hardworking and dedicated to work for their society. Moreover, it enriches the individuals' mental capability and skills, especially those related to reasoning.

Providing individuals with prerequisites which may help them to cope with life refers to making individuals to acquire the required knowledge and skills for different aspects of their daily lives such as business life, education, personal development and so on. This kind of reasons are valid for addressing practical ends, to exemplify, an individual may confront with a task in his work which requires the application of basic mathematics.

Schubring (2000) defines the notion of 'transmission' of mathematical knowledge as the dissemination process of mathematical ideas from scientifically established 'metropolis' countries of the time to not yet scientifically productive countries in the 'periphery'. In this process, contrary to a received view where by 'transmission', it is understood to hand over concepts remaining identical, traditional and new mathematical knowledge becomes transformed according to the particular national, cultural and societal context of the peripheral country through an active role played by innovative individuals. Thus, in this conception, reception transforms the received. Herein, the reasons behind such transmission are important as well. In order to examine such a transmission process, selecting a country, which was not colonized in the imperialism period, is a good choice because this situation could enable the country to be independent in receiving the new mathematical knowledge.

THE 18TH AND 19TH CENTURY CONTEXT OF THE OTTOMAN TURKEY

Decay strongly felt in the economic, educational, social and military fields was the main cause of the decrease in the political authority that existed in the 18th and 19th century Ottoman Empire. There were wars with neighboring countries and nationalistic upheavals in various communities under the Ottoman rule (Günergun, 2008). The Ottomans fought mostly against European and Russian armies, and most of the wars were lost. The defeats drew the Ottoman administrators' attention to the superiority of the opposing military forces which developed new military organizations (Günergun, 2006). The losses were also linked to complete regression including the abuses in the administrational and financial areas (Somel, 2001).

As a result of the decay, Ottoman Muslim administrators led a variety of necessary reforms in the above-mentioned fields to preserve the borders and to increase the prosperity of the Empire. In this sense, teaching of mathematics was initially modernized through the foundation of modern engineering and military schools in the late-18th and 19th century (İhsanoğlu, Şeşen, & İzgi, 1999). Günergun (2008) states that learning and application of the European scientific, mathematical and technical knowledge behind the military reforms were studied in these military schools which were systematized and tutored by both Ottoman and European (e.g., French, English and German) professors, technicians and experts. The schools focused on reaching contemporary European mathematics and science (Günergun, 2008). Correspondingly, there was a need for new books in which western methods were utilized (İhsanoğlu et al., 1999). The Ottoman administrators and military officers translated and edited European mathematical texts (mostly French) including applied mathematics, geodesy, mechanics, ballistics, and so on (Günergun, 2008). Mathematical studies according to the traditional eastern methods had seriously decreased after 1850. It was clear that these attempts by Ottoman scholars contributed greatly to the formation of the Ottoman mathematical and scientific nomenclature which was formed of words in Turkish, Arabic, Persian and European languages in the 18th and 19th centuries (Günergun, 2006). Therefore, the Ottoman Turkey became a meeting point for the Eastern and the Western cultures of science (Günergun, 2008).

Mathematics education in the modern trend was initiated in 1775 with *Hendesehane* (School of Geometry) (Günergun, 2006). Technical training was first given here for military officers of artillery, fortification and navy. Various branches of mathematics were taught by French and Ottoman experts in the leadership of the French military expert François Baron de Tott. Some mathematical tools were imitated in parallel with the west. The sources for mathematics education were mostly European texts at the beginning. The school was named as *Mühendishane* after 1781. Günergun (2008) states that teachers of this school in the 19th century translated and composed some European mathematics textbooks for teaching, for example, Ibrahim Edhem Pasha's (1818–1893) translation of the geometry book by Adrien-Marie Legendre (1752–1833). Indeed, this was the time for replacing the medieval Islamic sources of mathematics by the modern European ones. *Mühendishane-i Bahri-i Hümayun* (Imperial School of Naval Engineering) was established in 1784. Çınari İsmail Efendi (died, probably 1790) and Gelenbevi İsmail (died 1790), who were teachers in this school, wrote translations and compilations regarding algebra and logarithms considering the European sources in addition to the traditional books on algebra. For instance, Çinari İsmail Efendi translated Cassini and Clairaut's tables (Günergun, 2006). In order to train cadets in military officership and engineering that was necessary for the modern army *Nizam-ı Cedid* (New Order), *Mühendishane-i Berri-i Humayun* (Imperial School of Military Engineering) was founded in 1795. Hüseyin Rıfkı Tamani (died 1818) was a prominent teacher in this school through his translated and edited geometry and engineering textbooks from French and English. For instance, he and Selim Efendi translated John Bonnycastle's (1750–1821) "Euclid's Elements" from English as *Usul-i Hendese* (1797). Another teacher of *Mühendishane-i Berri-i Humayun* was Hoca İshak Efendi (died 1836) who wrote books on arithmetic, algebra, geometry and mechanical drawings based on the recent European mathematics. To illustrate, he used French Etienne Bézout's (1730–1783) works in the first volume of his *Mecmua-i Ulum-i Riyaziye* (Compendium of Mathematical Sciences) (İhsanoğlu et al., 1999). In 1834, *Mekteb-i Harbiye* was founded to train the cadets for the new army. This time a number of Ottoman administrators and teachers were trained in Europe (Günergun, 2006). To illustrate, Hüseyin Rıfkı Tamani's son was Emin Pasha (died 1851), who graduated from University of Cambridge with his doctoral thesis "Calcul de Variation", was assigned as director of *Mekteb-i Harbiye* in 1841.

The modernization process addressed above was not easy to accomplish. There were uproars mainly from *Yeniçeriler* (Janissaries) and *Ulema* (the learned of Islam). The janissaries were opposed to any military reforms because they probably regarded new developments in the military as a threat for their existence. They had further become extremely influential in politics with their conservative character. They created telling crises of modernization, for instance, destroying the institutions of *Nizam-ı Cedid* (e.g., printing house and schools) after the military defeats in Balkans and Arabian geography, and deposing Sultan Selim III in 1807 (Abdeljouad, 2012). In 1826, the reformist Sultan Mahmud II (1808–1839) abolished the *Yeniçeri Ocağı* (Corps of Janissaries) on the grounds that the janissaries had become inefficient as warriors. He established a modern army titled *Asakir-i Mansure-i Muhammediye* (Muhammed's Victorious Army) which completely replaced the rebellious Janissaries in 1826.

FINDINGS

Mebahis-i İlmiye had two volumes formed of issues corresponding to 1867 and 1868. During the publication period, there were main topics serializing a mathematical subject or mathematics problems for the public. In Table 1, main topics in the periodical are illustrated with corresponding author(s) and brief contents.

Table 1 indicates that the topics in *Mebahis-i İlmiye* consisted of collections from both pure and applied mathematics. No primary research existed, hence *Mebahis-i İlmiye* can be characterized as a periodical rather than a journal. The authors apparently reflect-

Main Topics	Author(s)	Contents
Hesab-ı Müsenna (Dual Arithmetic)	Hüseyin Tevfik Bey	Oliver Byrne's dual arithmetic with explanations
Fenn-i Basite (Science of Sundial)	Ahmet Muhtar Bey	Construction and usage of Islamic sundials
Fenn-i Makine (Mechanical Sciences)	Hüseyin Tevfik Bey	The concepts of mechanical operation of machines
Mahsusat ve Gayrimahsusat (Perceptible and Imperceptible Matters)	Hüseyin Tevfik Bey	Physics: motion, movements of the earth, Newton's law of gravitation... Metaphysics: logic, philosophy of knowledge...
Arsa Taksimi (Partition of Lands)	Hüseyin Tevfik Bey	Division of lands with various geometrical shapes
Emsile (Examples)	Anonymous	17 problems asked to the reader and their solutions sent to the periodical
From Public to the Reader*	Anonymous	Problems sent by newspapers and their solutions by the periodical
Vocational Mathematics*	Hüseyin Tevfik Bey & Yusuf Ziya Bey	Mathematical knowledge and skills needed for industry or craft segments to increase effectiveness
Topics from European Science*	Hüseyin Tevfik Bey	Contemporary topics from European mathematics journals
Islamic Contributions to Science*	Hüseyin Tevfik Bey & Yusuf Ziya Bey	Topics from Islamic mathematicians' textbooks (e.g., al-Karaji's proof for $1^3+2^3+3^3+...+n^3 = [1+2+3+...+n]^2$)
Topics from Greek Mathematics*	Hüseyin Tevfik Bey	Diophantus's problem on five equations with five unknowns
Main topics with a '*' mark are categorized by the authors of this study considering the aim and content of shorter papers.		

Table 1: Main topics in *Mebahis-i İlmiye* by the authors and contents

ed their educational background and their lectures in *Mekteb-i Harbiye* when selecting and ordering the main topics such as *Fenn-i Basite* (Günergun, 2007). The periodical included recent European mathematics, ancient Greek mathematics and medieval Islamic mathematics.

Technological and socio-economic development of the society

Some of the articles under Vocational Mathematics* seem to stress the relationship between industry and science. It was stated in Hüseyin Tevfik Bey's *Sanayiinin Muhtac Olduğu Ulum* (Knowledge Needed by Industry) that blacksmiths should master mechanics, drawing, geometry and the relevant computation underlying metal working. Goldsmiths had to know basic chemistry, drawing and geometry. It was also noted that theoretical knowledge provided by science was a must for improving crafts and industrial professions. It is not solely dependent upon practical knowledge. In another article by Hüseyin Tevfik Bey, *Bakırcılık ve Demirciliğe Mütealik Bir Mesele* (An Issue in Copperworking and Ironworking), the optimum ratio between the radius (of the base) and height of a container was given to produce the container with the smallest possible surface area and the least raw material. *Kavaid-i İlm-i Hisab* (Rules of Arithmetic) was the serial of an arithmetic book written by Yusuf Ziya Bey for educating the students of the *Cemiyet-i Tedrisiye-i İslamiye*'s school. The content mainly consisted of numbers (integers, rational numbers, prime numbers, irrational numbers), the arithmetical operations, checking the results of the operations, extraction, ratio and proportion, and equations. This could be for training "'human calculators' for business and commerce" (Niss, 1996, p. 25).

Another relevant main topic was *Fenn-i Makine* (Mechanical Sciences). Based on his lecture notes in *Mekteb-i Harbiye*, Hüseyin Tevfik Bey explained the basic concepts such as velocity, time, rotation, power, resistance, motion, work and efficiency needed for geometrical and mechanical study of machines. He intended to teach the characteristics and working principles of machines and how to construct them.

Arsa Taksimi (Partition of Lands) included common problems for dividing lands of various geometrical shapes and their solutions according to the recent scientific methods of the time. Partition of triangular areas into two or three equal parts and curvilinear areas through integral calculus such as the trapezoidal rule, Thomas Simpson's (1710–1761) rule and Jean-Victor Poncelet's (1788–1867) rule. Exploiting such new European sources in the periodical illustrates the notion of transmitting mathematical knowledge. Moreover, some widely consulted measurement information about surfaces and solid matters was provided for workers.

In *Emsile* (Examples), there were questions which would familiarize the audience with the working principles of some technological tools of the time such as pendulum (#14), lenses (#15) and barometers (#17). These questions were selected for those asked to students of a French lycée, and they indicate an attempt to knowledge transformation.

Political, ideological and cultural maintenance and development of the society

From political and ideological perspectives, the authors emphasize Islamic Contributions to Science* through several articles. For example, *Hasan bin Ali bin Ömer el-Marakeşi'nin "Cami el-mebadi ve'l gayat fi amel el felekiyat" Nam Kitabından Tercüme Olunmuş Bir Meseledir* (A Problem Translated from Hasan ibn Ali ibn Omar al-Marrakechi's Book Titled "Cami el-mebadi ve'l gayat fi amel el felekiyat") by Yusuf Ziya Bey was the translation of a problem on latitude and declination from a book by al-Marrakechi, a Moroccan astronomer of the 13th century. The geometrical method in this problem based on length of shadow and geometrical path did not require observational tools or logarithmic scales. *Bir Zaman Ulema-yı Arabın Malumları Olan Havas-Adaddan Bir Mesele* (A Problem Known by Arab Scholars in Former Times) gave place to geometric justification of the sum of the cubes problem, $1^3+2^3+3^3+...+n^3=(1+2+3+...+n)^2$, which referred to al-Karajī's (953–1023) famous book titled al-Fakhri fi'l-jabr wa'l-muqabala (The Glorious Book of Algebra).

The periodical presented cultural perspectives by means of displaying the interdisciplinary characteristics of mathematics and multi-cultural face of mathematics. To illustrate, mathematics was linked to other disciplines such as astronomy and physics. Real life problems like al-Marrakechi's calculation of latitude and declination can be shown as an example of the link between mathematics and astronomy. As for mathematics and physics, *Fenn-i Muvazene-i Miyah Usulü ile Bir Dairenin Mesaha-yı Sathiyesini Tayin* (Finding the Area of a Circle with Fluid Mechanics Method) under Topics from Greek Mathematics* discussed a law by Archimedes and the related proof. It was about finding the area of a circle which served as a basis for a cylinder whose height was equal to the diameter of the circle. In order to find the area of this circle, the cylinder was filled with water. Then the water was transferred into a cube that had a length of the diameter of the circle. The area of the circle was equal to the product of the length of the cube and the height of the water in the cube. Mathematics in physics could also be distinguished in *Emsile* through some problems regarding the concepts of heat and temperature (*#3*), mass and density (*#5*), velocity (*#4*), and so on.

Mahsusat ve Gayrimahsusat (Perceptible and Imperceptible Matters) contained issues of physics and philosophy. Newton's law of gravitation, which could be considered as relatively new mathematics-related knowledge, was utilized to distinguish between perceptible and imperceptible matters which were explained as that could be observed (e.g., free fall of objects) and could not be directly observed (e.g., gravitational force). Herein, the necessity of asking the possible reasons behind the perceptible matters in daily life was stressed as well, for instance, why balloons fly rather than fall to the ground. Force, absolute and relative motion, the Earth's daily and yearly rotation were also explained in the same manner.

Mebahis-i İlmiye also took up interesting contemporary topics in order to develop curiosity for mathematics revealing the mystery of the universe. Hüseyin Tevfik Bey's *Arıların Peteklerinin Müseddes El-Şekl Olmasının Sebep ve Hikmetine Dairdir* explained why bees made hexagonal wax cells in their nests together with the related mathematical proof. This subject and all the others under Topics from European Science* seemed to contribute to the transmissions from the 'metropolis'.

In order to make the society more intellectual, *Mebahis-i İlmiye* allowed exchange of ideas (Günergun, 2007). The periodical published the answer of *Emsile #3* by Saadet Efendi, a teacher in *Mekteb-i Harbiye*; and the answer of *Emsile #7* by Zeki Efendi as a second grader in the same academy. In the latter, it was notable that Hüseyin Tevfik Bey stated that there might be alternative solutions. The authors of the periodical also published the answer to an interest payment problem by *İstanbul Gazetesi* (Istanbul Newspaper) in From Public to the Reader*. In *Mahsusat ve Gayrimahsusat*, Hüseyin Tevfik Bey criticized Resul Mesti Efendi's essay in a newspaper claiming that the earth does not move. This was in line with the periodical's modern view of science.

Providing individuals with prerequisites of life

Mebahis-i İlmiye included some basic mathematics required for individuals' day to day working life. Under Vocational Mathematics*, *Mesele: Acaba Ayakları Ne Vecihe Vaz Etmekte Ziyade Faide Vardır* (Issue: What is the Effective Position of Legs to Firmly Stand Up) by Hüseyin Tevfik Bey accounted for the ideal geometrical standing position for a soldier when on guard. In *Fenn-i Basite* (Science of Sundial), how to design, construct and use the Islamic sundial was displayed in order to help local timekeepers determine the five prayer times in a day and also the Mecca direction for prayers. Another topic here was *Fenn-i Makineden Dülgerliğe Dair Bazı Mebahis* (Some Issues about Woodworking, A Branch of Mechanical Sciences) in which matters of physics such as force (e.g., direction, magnitude) and resultant force for the construction of poles underlying the construction of wooden buildings were explained. The content of *Mebahis-i İlmiye* was also composed of mathematics serving the individuals' educational life and personal development. *Emsile #14*, *#15*, *#16* and *#17* were mathematical problems taken from French periodicals for lycée students published a decade earlier. Lastly, mathematical problems that would be encountered in everyday private lives were presented, for example, the interest problem in *İstanbul Gazetesine Cevap* (Answer to Istanbul Newspaper).

CONCLUDING REMARKS

Findings indicate that *Mebahis-i İlmiye* addressed all the three kinds of reasons for mathematics education (Niss, 1996) to a certain degree. The authors utilized transformation of the recent knowledge of both pure and applied mathematics from Europe, mainly from France, as the 'metropolis' of the time (Schubring, 2000). Reception occurred in the difficult social setting of conflicts between modernizers and traditionalists, and within the already existing culture of Islamic mathematics. An important aspect of this transmission was the development of a terminology for the modern mathematics in Ottoman Turkish language, since the traditional mathematics did not provide terms for the new developments in the field.

The development of an own terminology is essential for an eventual take-off.

Future research will, on the one hand, focus on identifying the public reading of this periodical and its reception in the 19th century Ottoman Turkey and, on the other hand, introducing an international comparative dimension on the transmission of mathematical knowledge to the other 19th century non-colonized countries (e.g., China) which have original mathematical cultures (e.g., the development of 19th century publications in mathematics). The further comparative studies may assess results of the project, begun in France in 2013, on *Circulations des mathématiques dans et par les journaux: histoire, territoires et publics*. The transmissions of mathematical knowledge from Europe to the Ottomans by *Mebahis-i İlmiye*, which is investigated in this paper, can shed light on a broad systematic investigation of the above-mentioned future research. Moreover, *Mebahis-i İlmiye*'s promotion of mathematics education can enable such a further study to reveal national, cultural and societal motives behind the transmission in a clear way.

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