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Mathematics at the Royal Danish Military Academy of 1830

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This paper takes its starting point in the question concerning why mathematics was chosen as the most important subject in the education of Denmark's new officers when the Royal Military Academy was founded in 1830. To answer this question, source material from the period is researched. From the source material, three educational aims in the mathematical education can be derived: mathematics as a goal in itself; mathematics as a tool; and the mathematical method. These educational goals can be seen as a desire to educate officers in three skills: theoretical knowledge; vocational knowledge; and general education. Together these two sequences of each of the three elements are connected in pairs, thereby creating a link between the officers to be educated and mathematics as a taught subject. It is concluded that mathematics was chosen as the most important subject, because it supported the needs an officer educated at the Academy was required to possess.

Keywords: Military schools; officer's mathematics education; societal elite.

The Royal Danish Military Academy

In 1830 a new military education was created in Denmark – an education that was very different compared to similar educations that existed in Denmark at the time and even very different compared to the modern officer's education in Denmark. This new education was called The Royal Military Academy, and it played a central role in the history of Denmark due to the establishment being an expression of the emerging nationalism that was forming in the country. It also marked the start of a professionalization of the military, which consequently formed a new social class: the educated officers. With this institutionalization of military training there was a desire to organize the knowledge believed necessary to become an officer. This created a need for both skilled teachers and teaching material of a certain quality that could support this new institution.

In particular a need for educated mathematicians arose, since mathematics was chosen as the main subject for the entire education regardless of which field of study, the students were subjected to. At the Royal Military Academy officers could study the following fields: general staff officer; engineer officer; artillery and rocket officer; and road officers. For all four fields of study, mathematics was the subject that had the highest number of modules throughout the 4-year education. The education was split into two classes – referred to as the youngest class and the oldest class – both having a duration of two years. Students in the youngest class followed courses classified as being “purely scientific”, which included mathematics, chemistry, physics and languages. In the oldest class the students had courses classified as the “applied“ subjects, which included war history, mine teachings, and field maneuvers.

The split mentioned above seems consistent with the general view of mathematics as a teaching subject at the time, i.e. in Denmark as well other countries in Europe mathematics was viewed as an entity made up by two parts: a pure and an applied (Kragh et al., 2005, pp. 297–298). Pure mathematics was perceived as the theoretical part, which was considered beneficial to the ability to think logically and connect structures in a certain way – important aspects of what was described as

the “general education”. The applied part of mathematics was perceived as a tool for solving various problems, often in a very practical context.

Out of all the subjects taught at the academy, mathematics made up half (49%) of the total number of lessons taught during the youngest class. In total during the four years, mathematics made up one fourth (25%) of the lessons taught making it by far the largest single subject taught during the entire education. Not only was mathematics the largest single subject, it was also taught at a very high level in particular in comparison to mathematical knowledge of the average population of Denmark at the time. The students at The Royal Danish Military Academy were taught descriptive geometry, mathematical analytics and rational mechanics, which consisted of both complicated proofs and assignments varying from very abstract situations to practical use. Even compared to the current officers’ education in Denmark at The Royal Danish Defense College, this prioritization of mathematics is notable. An article brought in a Danish military magazine present the fact that 40% of all permanent military employees have difficulties even with 9th grade level mathematics suggesting that the mathematical knowledge of today’s military education has been somehow downsized (Frovin, 2014, p. 16).

In a central source material book from 1855, which is concerns the creation and subsequent operation of the Royal Danish Military Academy, the following is stated:

The Danish academy is modelled on the French educational institutions. [...] the organization, the teaching methods (first theory taught by a teacher and then repetition), the exams, which are supervised by other officials than the teachers – these main points with minor details are directly copied from the French educational institutions, only with smaller modifications which are caused by the economic situation and the smaller scale of the Danish educational system. (Caroc, Bjerring, Reich, & Købke, 1855, p. 31, my translation)

This strong inspiration was most likely due to the fact that several of the officers in the planning commission of the Royal Military Academy in Denmark had themselves studied at the Ecole Polytechnique. A key difference between the Ecole Polytechnique, created in 1794, and the Royal Military Academy was however that the Royal Military Academy did not train civil engineers, which was the case at the Ecole Polytechnique.

The prioritization of mathematics in a military context, as in the case of the establishment of the Royal Danish Military Academy is not only a Danish phenomenon, it is closely linked to similar trends which started years before in central Europe with France as a starting point (Bradley, 1976, p. 165). The French Revolution and the European wars throughout the 1700s led to developments in both weapon technology and construction work. This again increased the need for better educated mathematicians and hence teaching in more advanced mathematics.

Still, the question remains, how mathematics was considered to help cadets become better soldiers? According to Karp and Schubring (2014) not much research has been carried out on mathematical education in a military context. In fact, they describe how this field is only just beginning to take shape alongside the methodology. Nevertheless this relatively new research field can contribute to our historical knowledge about the development of a society, because mathematical education have often been prioritized in historical periods, where society was in need of engineers, technical and scientific personal (Karp & Schubring, 2014, pp. 9-10). Hence, an understanding of how the mathematical education was constructed at military academies can provide us with an indication of

what kind of work tasks the military personal was meant to fulfil, thereby also explaining the general perception of mathematics at the given time. This sums up the focus of this paper, which may be condensed into the following research question: *Why was mathematics chosen as the most important subject, when the Royal Danish Military Academy was founded in 1830 as the new national officer's education program?*

Methodical approach

The answer to the above question shall be based on a carefully selected sample of source material from that period alongside a variety of secondary literature, which will form the historical background for the source material. The historical source material falls in two categories: books concerning administrative aspects; and teaching materials.

In the first category, two very central works from the period are used. The first book is *Plan to the Royal Military Academy* (my translation) and was written by a committee in 1830. The committee consisted of eight officers from the Danish army. Lieutenant general Franz Christopher Bülow oversaw this committee, and he was also the official author of the work. This book formed the official establishment of the Royal Military Academy and described all relevant matters for the creation and operation of the academy. The content covered everything from the overall structure and economic frame to detailed descriptions of the teaching subjects and lesson tables for all fields of study spanning over all four years. This book makes up the main source, since it contains several descriptions about why mathematics is important and what role mathematics was to play in various connections. The second central book is *Overview over the education in the special corps before 1930 and the Royal Military Academy's operation from its creation to 1855* (my translation), written by three officers and a professor from the University of Copenhagen: F. C. V. Caroc, V. J. Bjerring, C. E. Reich and J. P. Købke. This book was released on the occasion of the Academies 25-year anniversary. The book makes up an important piece of source material, because it is one of the only available books from the period that describes the development of military education and does so in a critical manner.

In the second category, the teaching materials, there are seven books in total. All seven are teaching materials in mathematics: three of these are textbooks in mathematical analysis; two are textbooks in descriptive geometry; and the last two are figure books in descriptive geometry the purpose of which were to serve as support for the textbooks. One textbook by Bendz (1831) was in particular used to support the conclusions about the role of mathematics at the Royal Military Academy. The book is in mathematical analysis describing differential and integral calculations, and an analysis shows that it contains practically no tasks related to extra-mathematical circumstances, which supports the interpretation of the text by Bülow (1830).

To set the historical frame for the Royal Military Academy, several books have been used, of which *Danish history of Natural science, Volume II* edited by Helge Kragh, and *Private Schools through 200 years, volume I* edited by Christian Larsen, are some of the more important books. These works provide an overall understanding of the educational level of young men from the higher levels of society in Denmark, who would be the students at the Royal Military Academy.

In order to set the European historical frame, both regarding military education in general and mathematics as a teaching subject and as a research profession in particular, several articles and books have been used. Here it is important to mention: Boyer (1968); Barnett (2015); and Bradley (1975). These works provide the study presented in this paper with background knowledge on how the

development of the Royal Military Academy might have been influenced by similar institutions in other European countries, in particular France.

Mathematics as the cornerstone

In the main source (Bülow, 1830) there are several descriptions and explanations about the various teaching subjects which were taught at the Royal Military Academy. The description of mathematics is rather interesting in this context. The following quote from the introduction became the starting point for the research described in this paper:

Mathematics, especially its analytical part, including rational mechanics, is considered the cornerstone in education as a whole. Thus it should give the students the means to understand a series of other important subjects. (Bülow, 1830, p. 38, my translation)

Through careful readings of this material several other interesting quotes were found and eventually they came to form the analysis. Through this archival based analysis I found evidence to suggest that the commission, who planned and designed the Royal Military Academy, were subject to three central educational aims, all having mathematics as the cornerstone: mathematics as a goal in itself; mathematics as a tool; and mathematics as a method. These aims were never explicitly uttered in the source material and could therefore make up a separate question for discussion. In the present analysis, however, they came to structure the reading of the source material. In the following I present carefully chosen excerpts from the source material in order to support the finding of the three underlying educational aims of the commission.

Mathematics as a goal in itself

There are several quotes that put emphasis on the importance of “mathematics as a goal in itself” without mentioning a specific purpose of the mathematical knowledge, which might lead one to think that there was another purpose besides the more direct usage of mathematics. A central quote on this is from the descriptions of the teaching subject of physics, where the proper way of learning is explained:

The dual way to realization; the experimental and the mathematical, which here make up the right teaching method, which also has an exceedingly significant influence on the entire development of the mind; because the mind gets used to neither neglecting the simplicity of the real world nor making us lose ourselves in these details, thereby forgetting the general principles. (Bülow, 1830, pp. 39–40, my translation)

Here mathematics is mentioned as one of the two ways to true realization, whereas an experimental or practical way is mentioned as the other. In fact we touch upon a very central aspect. As mentioned earlier, several publications state that mathematics in this historical period is seen as a unity consisting of two parts, namely pure and applied mathematics. The distinction between these two is noticeable in the way the mathematical subjects were structured during the education at the academy. For example, descriptive geometry was divided into a theoretical and an applied part, with a vast difference between what kind of theory and assignments the students were to do. The following quote is a description of what kinds of assignments the students should be able to accomplish during a lecture in the theoretical part of descriptive geometry.

For a given curve, draw a tangent, which has a horizontal projection that is parallel to a given line.
(Bülow, 1830, p. 76, my translation)

This assignment is purely mathematical without any trace of an extra-mathematical scenario, which was very important since the purely mathematical way was thought to be one of two parts in the learning process. This central point can be further validated by looking at the teaching material used in descriptive geometry, which are two textbooks both authored by L. S. Kellner. The first book (Kellner, 1830a) – which consisted of only one booklet – described a theoretical approach to geometry, whereas the second book – consisting of six booklets – described different ways to use the given theory in a wider range of subjects, spanning how to construct different buildings to how shadows fall on objects (Kellner, 1830b). From reading the source material it seems clear that students were believed to be able to understand the basic sciences to the fullest before they could apply them in other connections. Since mathematics was a subject that had its usage in other scientific disciplines and a large part of the applied disciplines, mathematics appears to be a subject that students should learn and master before applying it in extra-mathematical connections.

However, the mathematical curriculum exceeds the need in other subjects, which indicates that the students were meant to learn beyond the point of what they were actually going to use in these subjects. This suggests that mathematical knowledge was an educational goal in itself, because it was thought to be beneficial in various ways.

Mathematics as a tool

The second identified educational aim was that it was essential that the students learned how to apply mathematical equations and a logical approach to problems, because it was a required tool in both the purely scientific and applied subjects taught in the youngest and oldest class at the academy. Especially in the applied subjects mathematical knowledge was necessary, since these applied subjects were the ones to make a student capable of fulfilling his later duties in a specific position within the military.

For that reason it was important that the students knew how to use mathematics as a tool, which according to the source material forms the experimental way to realization. This practical use of mathematics can be seen in a description of an assignment from descriptive geometries in the applied part, which the following quote illustrates.

Explain the various timber connections in roof- and stair constructions. (Bülow, 1830, p. 79, my translation)

This example forms a clear contrast to the other assignments from descriptive geometry in the theoretical part, where there is no connection to the real world. In this short assignment, the student should be able to construct very specific structures according to a set of requirements.

This vast span from theoretical knowledge to the ability to use it practically is closely linked to the term “general education”, which is commonly referred to by Bülow (1830). Hence, this term is vital for this analysis, and needs to be explained in this paper as well. The term “general education” (in Danish “*almendannelse*” similar to the German “*Allgemeinbildung*” or “*Bildung*”) was a common term in the Danish society in the beginning of the 1800s, and the exact meaning of the term was greatly influenced by the first Danish professor in pedagogy, L. C. Sander. The “general education” term was also seen as a unity with two parts: the general part and the professional part. The

professional part was a person's ability to carry out a certain profession or job, which required some specific skills and knowledge. The general part was a person's ability to engage in and contribute to different levels of the society, which required overall knowledge about culture, history, behavior, science, manners and language (Slagstad, Korsgaard, & Løvlie, 2003, pp. 9, 245). Both of these rather different parts should be in place before the general education was complete. And this was one of the central goals at the Royal Military Academy. Hence, in order for the students to gain this general education, they should be educated to be good soldiers and loyal officers with insight in every relevant subject in their field.

The mathematical method

This brings us to the last identified educational aim, namely the mathematical method. The mathematical method is mentioned several times in *The Plan to the Royal Military Academy* and was described as something that benefitted the general ability to think and to conclude logically, not only in a mathematical context but also in other circumstances. Actually, it was believed that once a student had acquired the mathematical method, this student would be able to transfer this knowledge and approach to other fields of study and everyday scenarios (which we of course know from mathematics education research often is not the case).

This idea becomes clear through the following quote, which is taken from a paragraph that describes the Danish language as a subject, taught at the Royal Military Academy.

The incessant desire for clarity and definitiveness of expression leads to clarity and definitiveness in concepts of the person, whose thinking has become sharpened by the mathematical study of the natural sciences. Thought and language are in close contact with each other; they constantly excite and control one another. (Bülow, 1830, p. 41, my translation)

Not only is the mathematical study seen as something that sharpens the minds of the students, which makes them more precise in their choice of words, it is actually seen as something that makes the students more likely to draw the right conclusion based on logical assumptions. This is further supported by the following quote.

The verdict is always most correct, when it can be constructed with numbers, or, and even more perfect, with specific algebraic symbols that simultaneously provide idea and form, the common and the special, the abstract and the concrete. (Bülow, 1830, p. 38, my translation)

The above suggests that the mathematical method played several important roles in the education at the Royal Military Academy. Not only was mathematics a central subject in order to acquire the other subjects taught at the academy, it was also believed to develop the mind and the communication of those who mastered the mathematical method to its fullest extent.

The officer: Gentleman and soldier

In the following, I compare the above described three educational aims, which were condensed from the source material, and connect them with the three levels of knowledge that might make up some of the main reason why mathematics was chosen in the first place. These three levels of knowledge could be described as: theoretical knowledge; practical knowledge; and general education.

Theoretical knowledge: It is the idea that an officer must be trained in the basic sciences that are used in various parts of his work as a soldier. Courses in this type of knowledge are taught at the youngest

class, which is certainly not a coincidence, but part of a basic philosophy that these basic sciences must be mastered in full, before the student will be able to apply the knowledge in other contexts. This explains why several of the mathematical topics were not connected to any applications. The point was to learn the theoretical basis without any applied context.

Practical knowledge: This type of knowledge is gained through the courses taught at the oldest class, because these subjects are related to the different fields of study, i.e. the “applied” subjects. For example, it was in the oldest class that artillery and rocket students had training in artillery, mine teaching and statistics, as well as practical exercises in artillery shooting and marching. This tendency is present in all fields of study. Many of the courses for students in the youngest class served as basis knowledge for the applied subjects in the oldest class.

General education: Here the underlying idea is that an officer in addition to knowing his profession to his fingertips also should be a well-educated gentleman. That meant that an officer trained at the Royal Military Academy should be a person with a broad insight into the culture, history and language of Denmark as well as other European countries. The students should also have a wide knowledge of the natural sciences and their mutual connections, but also with sensible ethics, a good appearance, attitude and solid behavior.

It may seem odd that an officer was taught about Danish literature, since this does not immediately suggest itself as a useful subject for an officer. But at the time an officer was also a person who should be able to be part of Denmark's highest layer of society. In fact, officer was one of the best educated professions in all of Denmark at the time. Therefore, it was indeed expected that the officers were well-educated in many subjects and trained in the spirit of the time.

Conclusion

My starting point was a question about why mathematics was chosen as the cornerstone subject, when the new officer training institution in Denmark, the Royal Military Academy, was founded.

In this paper the reasons for choosing mathematics as the main subject are examined through source materials and mathematical teaching materials from the academy and the given period. The analysis of these contemporary sources was structured around three educational aims, which were supported by a close reading of the source material linked to other similar institutions of the time, e.g. the Ecole Polytechnique. These educational aims could be thought to show three distinct levels of knowledge, which were desirable for a recent graduate student to possess from the Royal Military Academy, i.e. theoretical knowledge, practical knowledge, and general education.

Besides these two sequences being findings in their own right of the present study, yet a finding is that they belong together in pairs. That is to say, the aim of mathematics as a goal in itself was to support students' development of theoretical knowledge; the aim of mathematics as a tool that of practical knowledge; and the aim of acquiring the mathematical method served a purpose of general education. Hence, it seems fair to say that mathematics was chosen as the cornerstone for the education at the Royal Danish Military Academy, because it supported the objective – namely to educate good officers.

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