The History of Public Education in Mathematics in Iceland and its Relations to Secondary Education

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In this paper several official decisions of severe consequences for public mathematics education in Iceland and its relations to secondary education are considered and analyzed by the historical method; examining legislation, official documents and arithmetic textbooks.

Introduction

Icelandic society has a well recorded history since the country was settled by the Vikings around the year 900. It became a part of the Danish realm in the late 14th century. The Icelanders nurtured their medieval literature through the centuries while keeping up with European habits and trends as possible, being one of the poorest countries in Europe. From the mid-18th century, public education in reading and Christendom was monitored by parish priests and provided by the families. Adherents of the Enlightenment in the late 18th century made an attempt to modernize the society, while catastrophic events such as volcanic eruptions and earthquakes reduced the effects of their efforts. However, a considerable amount of educating material was produced, among them arithmetic textbooks, written in a European style, aimed at business.

Lower secondary schools and several primary schools were established in the largest towns from the 1860s onwards. However, the main rule was that children were to be educated within the families, who were to realize legislation on public education in writing and arithmetic, passed in 1880. It soon emerged that the task was beyond the capacities of the families. No goals were explicitly stated in the 1880 legislation and the European commercial arithmetic was tacitly adopted, adjusted to Icelandic context. Its justification was training young people to cope with the growing trade in Iceland's late start of industrialisation by the turn of the 20th century. The legislation released initiative and creativity of the non-mathematical educated class. A number of arithmetic textbooks were composed for primary education, and geometry textbooks as well for the growing secondary education.

The growth continued after Iceland acquired Home Rule in 1904 and the subsequent 1907 Education Act, when education for 10–14 years old children became free of charge on the responsibility of the local communities. Itinerant schools were run in the remotest rural areas and were first completely superseded by boarding schools in the 1970s. Iceland declared independence and a republic was established in 1944. In 1946 the parliament passed new school legislation, shortening the former six-year secondary schools to four-year schools and creating a route from the lower secondary level into them by a national entrance examination. High expectations, which were only later realized, were attached to that legislation.

Several official decisions in the period 1920s to 1940s hindered natural development of public mathematics education. They made it dependent on upper school levels and caused stagnation for decades. The impact of these decisions remained into the 1960s and 1970s when ideas on admission to further and higher education were rapidly changing. As changes were long overdue by then, Iceland fell prey to the international 'New Math' reform wave to drop into a difficult turmoil for one more decade before a real domestic reform could take place.

The Period 1780–1880

Literacy was widespread in Iceland from the mid-18th century, due to efforts on behalf of the adherents of the Lutheran pietism movement. Religious education of Icelandic youth would have been hard to achieve without the use of printed textbooks. As a result, almost every boy and girl in the country was able to read by 1800. Yet there were no primary schools and no professional teachers, only parish clergy who monitored the education provided in the home.

During 1784–1930 only one secondary school with an upper secondary division existed, the Reykjavík School (situated in Bessastaðir, a nearby farm, in 1805–1846). Mathematician B. Gunnlaugsson served there for 40 years from 1822. His presence changed mathematics education in the country from next to nil to fulfil the requirements of the Royal Directorate of the University and the Learned Schools in Denmark. Gunnlaugsson retired in 1862. A decade later the Danish system of upper secondary schools was revised to be divided into a mathematics-science stream and a language-history stream.

At that time the Reykjavík School was too small to be divided into two streams. A school affairs board proposed a combined stream as previously but through political lobbyism at the highest level the language-history stream was chosen by regulations in 1877. Those behind that decision were the headmaster and his colleagues who taught modern and ancient languages lobbying for their own subjects, while evidence exists that the mathematics teaching at the school at that time did not appeal to its pupils. This proved to be a fateful decision, to delay preparations for engineering studies, for a small nation on the edge of breaking out of a stagnated agricultural society; still without durable buildings, roads, and bridges in a large country.

The Period 1880–1920s

Concurrently with the reduction of mathematics teaching at the Reykjavík School, there was a progress in public education which then did not have to adjust to requirements from the upper school level. Legislation on public education in writing and arithmetic was passed in 1880 and two lower secondary schools were established in the early 1880s, one in the Northern-Iceland, and the other in the vicinity of Reykjavík in the south with teacher training soon as an affiliate, and Iceland Teacher Training College was established in 1908. In the early 20th century, several privately run lower secondary schools for the general public were established, called people's schools.

From the last quarter of the 19th century a number of arithmetic textbooks were published in order to meet the requirements of the 1880 legislation and to aid the general public in an environment of growing commerce and industrialization. The textbooks were written in the classical style of arithmetic textbooks, introduction to the number concept, numeration and basic instruction in the four operations, basically with utilitarian aims. The majority of these textbooks were written by the largest professional class, theologians and priests, while several of them were written by members of the growing class of primary teachers.

In spite of the common model of the textbooks, they offered considerable variety in approaches and some discussion on didactics among primary teachers took place. The variety concerned algorithms and mental arithmetic, presentation of proportional calculations, divisibility and effects of the place-value notation on its visibility.

Of special interests are textbooks in the late 19th century by two brothers, the Reverends E. and H. Briem (1869, 1880, 1889, 1892). Both of them declared in their forewords that they would avoid scientific proofs and concentrate on what they considered important for the 'working life' of the country. The authors' avoidance of reasoning seems to be a reaction to

what they saw as excessive formalism in the foreign textbooks, merely an intellectual luxury in the Icelandic context.

In 1906, Iceland's first doctor in mathematics, Dr. Ó. Daníelsson, published an arithmetic textbook, *Arithmetic*. It was quite elementary with straightforward explanations of common algorithms on the four operations in whole numbers and fractions, but containing a number of worth-while problems for solving. Daníelsson became the first mathematics teacher at the new Teacher Training College where he built up mathematics training of primary teachers. Daníelsson published a second, more advanced edition, in 1914, to suit the student teachers, of whom most had only short schooling, such as itinerant primary school of several weeks a year, and possibly a year or two in one of the people's schools.

In 1920, Dr. Daníelsson became employed as the main mathematics teacher at the six-year Reykjavík School when a mathematics stream was established there after 42 years of absence of higher mathematics. This was the highest post available for a mathematician, as the University of Iceland, established in 1911, was mainly a professional school in theology, law and medicine, with a small department of humanities. In 1920, Daníelsson published a new edition of his book, suitable for beginners in the lowest classes of the Reykjavík School. By that edition Daníelsson had omitted all reasoning to support procedures such as to the Euclidian Algorithm, which had been contained in his first edition. Presumably his experience contributed to Dr. Daníelsson's opinion that explanations of theoretic topics were futile so he decided to lay his main emphasis on problem solving.

Daníelsson's *Arithmetic* aimed at the lower secondary level but was considered rather difficult. In 1927–1929, one of his former teacher students, E. Bjarnason, published an arithmetic textbook for the primary level, where he claimed that he had avoided inconsistencies with the textbook of Dr. Daníelsson, who had most graciously read Bjarnason's book and offered good advice. Bjarnason favoured emphasizing exactness and speed by training of one algorithm only for each operation without any alternatives as Dr. Daníelsson seems to have done too.

In the late 1920s the government established a number of public lower secondary schools, both in rural and in small scattered urban areas, under the leadership of Minister J. Jónsson, a former teacher trainer. The aims of these schools were utilitarian, to prepare young people for working life, and theoretical considerations were not on the agenda. Arithmetic should for example mainly concern bookkeeping. At the same time Minister Jónsson restricted the admission to Reykjavík School in order to lead pupils to his practical schools. Furthermore he elevated the northern lower secondary school to upper secondary level, not the least to counterbalance the Reykjavík School and its emphasis on ancient studies.

By the 1930s Dr. Daníelsson had acquired a superior position on the secondary school level. No mathematics teacher was his equal in education and status. His position was still further strengthened by the restricted admission to the Reykjavík School. That action created a fierce competition for the few seats in the school producing future officials. Gradually Daníelsson's textbooks, the *Arithmetic* in particular, were taken up in the practical lower secondary schools, presumably in case the pupils would make attempts to enter the upper secondary level.

In the early 1940s, the then Ex-Minister Jónsson paradoxically brought up complaints in the parliament about the retrogression in the practical lower secondary schools, established by him, to use Dr. Daníelsson's textbooks, aimed at the future professional class, being controversial to his ideas of the schools' utilitarian aims.

The Period 1930s–1960s

The 1930s were a difficult period in many countries. The Great Depression caused poverty among the general public. As a result of that situation in Iceland, a State Textbook Publishing House was established by a political decision of parliament in order to distribute textbooks free of charge to children at compulsory school level up to the age of 14, thus reducing the burden on families of paying educational expenses. An editorial board, composed of three representatives, one of them Ex-Minister Jónsson, was to have the role of dealing with contracts with the authors. The publications were to be funded by a special textbook levy for each family with children (*Alþingistíðindi* 1936 A).

The former diversity in choice of textbooks was reduced by this act. Bjarnason's *Arithmetic* was chosen for free distribution, thus ruling out other primary level arithmetic textbooks.

A number of titles were published, most of them developed on the initiative of the State Textbook Publishing House. The majority of these new titles were, however, published in the period 1937–1941 (Sigurgeirsson, 1987: 15, 76). From that time until 1957 there were serious difficulties in funding the project due to heavy inflation. The parliament was reluctant to increase the textbook levy, so the amount of available money declined in value, which explains poor quality of the textbooks and rarity of new publications.

The decision to establish a state publishing company was to have an impact on the general conception of school mathematics, choice of mathematics topics, presentation of topics, the relation between the social settings presented in textbooks and the reality of the times of the users, teacher training, and teachers' preparation for new topics and different presentation, when at last the syllabus began to change in the late 1960s.

By education legislation in 1946, compulsory schooling was extended to the age of 15, the last two years at the lower secondary school level. The formerly six-year secondary school became a four-year school on upper secondary school level. An entrance examination into it was to be arranged all around the country, as a measure towards providing equal opportunities for education. The syllabus of what had been the second year of the Reykjavík School was adopted as a syllabus for the entrance examination, presumably as a concession to the two upper secondary schools. The mathematics textbooks to be used were Daníelsson's *Arithmetic* and *Algebra*. This syllabus remained in place for 30 years, until 1976, with alternative options of 'New Math' oriented topics from 1967. By accepting Daníelsson's textbooks as the prescribed curriculum of a national entrance examination in 1946, which remained unaltered for two decades, together with Bjarnason's monopoly at the primary level, the total authority of Daníelsson's early 20th century ideas of arithmetic teaching remained into the 1960s, when a release was found in the 'New Math' reform wave, which broke rather harshly on Iceland (Bjarnadóttir, 2006).

Introduction of 'New Math' in the Period 1960s–1970s

By 1966 the State Textbook Publishing House had not taken any initiative in updating the primary school arithmetic syllabus and it only offered a simplified alternative to Daníelsson's *Arithmetic* for the lower secondary level. At that time the 'New Math' reform movement reached the Icelandic mathematical community. The four Nordic countries: Denmark, Finland, Norway and Sweden, established a cooperation to produce teaching material for schools. In Iceland, extremely theoretical material by Bundgaard, a Danish author, was translated for the primary school level.

By 1972 the new syllabus had reached half the population on the primary level. Algebraic concepts such as the commutative, associative and distributive laws, place-value notation to the base five, prime numbers, permutation of three digits, the transverse sum and its relation

to the nine times table were all introduced before the close of the third grade. In the following years set theory was introduced, with pairing, subsets, intersection and union, various place-value systems, linear functions and geometry of points, lines and planes in a set-theoretical framework (Bjarnadóttir, 2006: 293-297).

Most primary-level teachers had little acquaintance with the above concepts, not to speak of changing conventional teaching into conducting discussions. As practically all primary level teachers had studied only at the Teacher Training College, where mathematics education was minimal after Dr. Daníelsson left the school in 1920, they had to work hard to cope with this new material. The initiative for creating new learning material was transferred from the State Textbook Publishing House to the Ministry of Education. A new department of School Research and Development was established at the Ministry to conduct the developmental work in mathematics, physics and other subjects.

The 'New Math' soon had a reaction. The experience of a completely different material from what they had grown up with and taught drove a group of teachers into a new wave of initiative in creation of teaching material. The department of School Research and Development enjoyed the favour of the Minister of Education and a number of young and creative teachers were recruited there. A new series of mathematics textbooks were created, and carefully brought into life by experimental publications and test-teaching.

Summary and Conclusions

This account is an attempt to summarize the process of developing public education in mathematics for a nation heading towards independence and self-support since the second half of the 19th century. Explicit goals were not stated and the real goals have to be read between the lines in the textbooks and the authors' statements in forewords. The goals were primarily utilitarian, to aid the general public in coping with life in a context of growing commerce and rising industrialization. The teaching material was true to the European tradition of commercial arithmetic but originally it offered some variety in presentation. At the beginning, teachers had a choice of a variety of textbooks, while their distribution depended partly on the position, status and sphere of authority of the textbook authors. The little emphasis on mathematics at the Reykjavík School ensured an independence of influences and pressure from the upper school level.

Gradually the choice reduced. Three political decisions of social-democratic origin, intended to ease the working class's access to education, had serious consequences. The decision to restrict the admission to the sole upper secondary school ensured the superiority of its employees to govern the syllabus of the primary and lower secondary education. The establishment of the State Textbook Publishing house resulted in a limited choice of learning material, especially arithmetic textbooks. Finally, the decision to choose the syllabus of the former lower secondary division of the Reykjavík School as that of a national entrance examination kept the syllabus of the whole lower secondary education rigid for more than two decades, resulting in a total stagnation.

Dr. Daníelsson was a unique entrepreneur in textbook writing and restoring upper secondary mathematics education after four decades of its absence. However, he was also a doorkeeper to the highly attractive gate to higher professional education. In the power of his superiority, arithmetic textbooks written or approved by him became the permitted and feasible syllabus in Icelandic primary and lower secondary education far into the second half of the 20th century. The textbooks in concern were faultless in themselves but by their monopoly position, teachers and pupils were refrained from becoming acquainted with any other presentation than approved by Dr. Daníelsson. Emphasis on certain 'correct' algorithms

prevailed, and basic ideas, such as prime numbers or prime factoring, were unknown to teachers and pupils, not because Dr. Daníelsson did not know them, but because he did not consider it timely to introduce them at the primary and lower secondary school levels.

Dr. Daníelsson's influence remained into the 1970s when people's ideas on admission to further and higher education were rapidly changing. As this influence was long overdue by then, the international 'New Math' reform, became a catalyst to a real domestic reform of public mathematics education.

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