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The reception of modern mathematics in Belgian technical education: Adhering or resisting?

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Belgium was one of the first European countries to be involved in the modern mathematics movement of the 1960s. The reform was led by a university professor (Georges Papy), supported by a number of enthusiastic teachers of general secondary education. The reformers showed almost no interest in technical education. In the mid-1960s, however, it became clear that also the mathematics programs of technical secondary education would be modernized. We examine the diverse reactions of stakeholders of technical education to the announced reform. Emile Ridiaux and like-minded teachers prepared and attempted to use modern mathematics for technical applications. Others, e.g. inspector Charles-François Becquet, resisted the upcoming reform, but his organization called MATEC, could not stand up to the well-oiled machine of Papy and his disciples. Consequently, from September 1, 1969, modern mathematics was generalized in all technical secondary schools in Belgium.

Keywords: Belgium, MATEC, modern mathematics, reform movement, technical education.

Introduction

Belgium was a pioneering country in the modern mathematics movement of the 1960s. A first experiment with modern mathematics began as early as 1958, one year before the landmark Royaumont Seminar. The experiment was carried out with prospective kindergarten teachers and was led by Frédérique Lenger and Madeleine Leprope (De Bock & Vanpaemel, 2018). For technical assistance with follow-up experiments, the experimenters enlisted the help of Georges Papy, a professor of algebra at the University of Brussels. However, Papy did not limit himself to consulting: From 1959 he started his own experiments and would completely dominate the movement. In May 1961, he founded the Belgian Centre for Mathematics Pedagogy that grouped the country's most prominent modern mathematics enthusiasts. The Centre coordinated all aspects of the reform movement: It edited new curricula, set up experiments, developed course materials, retrained teachers, established local working groups, etc. The interpretation of modern mathematics was quite radical. Sets, relations, and algebraic structures formed the basis; logic, deductive reasoning, and proof were central. With appropriate political support, Papy's modernization efforts would lead to a mandatory implementation of modern mathematics in the general sections of secondary schools from September 1968.

Papy and his team members, who typically had an academic or general education background, showed little interest in technical education. No experimental programs or experiments were anticipated for this type of education. From official directives of the mid-1960s, however, it became clear that technical schools would also be involved in the modernization of the mathematics programs, a reform that prioritized intellectual formation over practical utility. A circular letter issued by the *Nationaal Verbond van het Katholiek Technisch Onderwijs* [National Association for Catholic Technical Education] on November 15, 1966, stated that every mathematics teacher in

technical education should urgently inform himself about modern mathematics. To this end, these teachers were strongly advised to attend the classes given at the initiative of the Belgian Centre for Mathematics Pedagogy, and school boards were asked to give their teachers the opportunity to do so. (Holvoet, 1968). We find a similar recommendation in the 1966 mathematics program of the *Enseignement technique et professionnel féminin de l'État* [Technical and professional education for women in the state], as cited in Holvoet (1968): “All teachers are strongly advised to increase their knowledge by all means and in particular to attend regularly the courses organized by the Belgian Centre for Mathematics Pedagogy¹” (p. 101).

In this paper, we search for answers to the following research question: “How have teachers and other stakeholders in technical education responded to an announced reform that seemed diametrically opposed to the goals of mathematics in technical education?” To answer this question, we have analyzed the available reform documents and all Belgian journals for mathematics teachers from that period: *Mathematica & Paedagogia*, *Nico*, and *Matmo* (see below). Moreover, we systematically searched *BelgicaPress*, a digital database of historical Belgian newspapers up to 1970². This study is part of a line of research on the history of the modern mathematics movement in Belgium that recently led to the book *Rods, sets and arrows: The rise and fall of modern mathematics in Belgium* (De Bock & Vanpaemel, 2019). However, the reform in technical schools and the role of key actors in it remained underexposed. The present study aims to fill this gap in the existing literature on the Belgian modern mathematics movement. The scope of this type of research is, however, not just “purely” historical: Researching mathematics education of the past can provide historical insights that support the future, or as Van Bendegem (2021) stated it:

This research is not merely historically interesting but is also relevant to understanding what present-day STEM (and I would add STEAM) initiatives are really about and what the potential pitfalls and dangers can be, and what the underlying educational aims and goals are (or should be) vis-à-vis society at large. (p. 604)

Ridiaux’s actions to welcome modern mathematics

Emile Ridiaux (1924–2006), trained as an engineer, was a mathematics teacher in the secondary technical section of the *Université du Travail* [University of Labor] in Charleroi, an important industrial center in the French-speaking part of Belgium. With a view to preparing mathematics teachers in technical schools for the arrival of modern mathematics in their classrooms, Ridiaux founded a new teachers’ journal, titled *Matmo*, a reference to “modern mathematics”, and subtitled *Revue des ensemblistes du secondaire* [Journal for enthusiasts of sets in secondary schools]. *Matmo* was published between 1964 and 1968. A total of thirty issues appeared: Ten in the first volume (1964–1965), ten in 1966, five in 1967, and five in 1968. Layout and style of the journal were very

¹ All translations were made by the author.

² Collections of the Royal Library of Belgium (<https://www.belgicapress.be/>). Keywords used: “Becquet”, “Matec”, “Matmo”, “Papy”, “Ridiaux”.

basic and each issue had only 16 stapled pages. The journal did not question the upcoming reform as such, on the contrary. In the first *Editorial* (September 1964), we read:

We do not claim to be scholars! We know the scholars, because they have come down to us, to our teaching! At the secondary level, even at the primary level, we want to apply their advice, because we have confidence, and, with them, we have hope in a much better mathematical future.

Browsing through the different issues of *Matmo*, one notices that most of the contributions were written by Ridiaux himself and some of his colleagues. Mainly lesson ideas for lower (technical) secondary education are presented, on “modern” topics such as sets, relations, and structures (inspired by Papy’s proposals), but also “classical” topics from algebra, higher arithmetic, and geometry are considered from a modern point of view. Sometimes student reactions are included in the lesson plans, showing that the lessons had already been trialed. Attention is also paid to applications of mathematics, especially from physics (e.g., electrical circuits), but also from chemistry and biology. *Matmo* regularly informs its readers of new developments related to mathematics education, both in Belgium and abroad (e.g., with echoes from France and the USA). Specific Belgian reform initiatives, in particular the in-service courses of Papy’s Centre, receive ample attention. The emergence of an opposition movement in 1966 (see the next section) is also reported and limitedly documented, but already in the first issue of 1967, Ridiaux writes that although he welcomes remarks and criticisms, “We would like to avoid a quarrel between the ancients and the moderns, especially among teachers...” (in capitals, no pagination). After that, *Matmo* will not include any news about the opposition movement...

It is worth mentioning that in 1969 Ridiaux published a textbook on a remarkable method in which arrow graphs, one of the favorite representational tools of Papy and his collaborators, were used to transform algebraic formulas (Ridiaux, 1969). This technical skill was not considered important by modern mathematics reformers, but it was fundamental to (technical) applications of mathematics. In Ridiaux’s method, a path of arrows, representing operations, is drawn from a variable to be found to a given variable. By tracing the inverse arrows, which represent the inverse operations, the requested variable can be calculated (see Figure 1). Sometimes, Ridiaux also visualized the different steps in this process via film strips, a didactic tool known from Papy’s *Mathématique Moderne* (De Bock & Vanpaemel, 2019). In Ridiaux (1970), the author explained how this method can also be used to solve (systems of) linear equations. Ridiaux’s method is no longer used in Belgian schools today, but it is still recommended, albeit in a modified form, by some mathematics educators of the 21st century (see, e.g., Noël, 2003). The case illustrates how Ridiaux tried to didactically modernize mathematics for technical education, his way of conforming to reformers’ expectations.

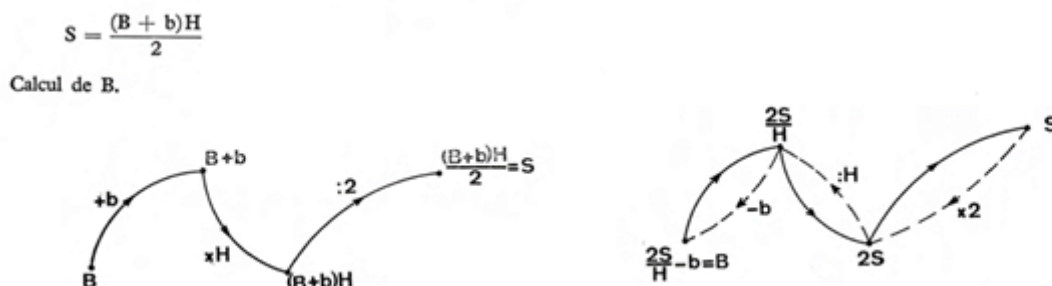


Figure 1: Example of Ridiaux’s method for the transformation of formulas using arrow graphs; the variable B has to be calculated from the given formula (Ridiaux, 1969, p. 18)

Becquet and the action of MATEC

From Charles-François Becquet (1915–1987), a totally different sound was heard. Becquet was a master of mathematics (University of Liège, 1940), a teacher and later an inspector of technical secondary education organized by the state. In addition, though less relevant here, Becquet was a political author and militant in the Walloon Movement during and after World War II. In July 1963, Becquet had published an article entitled *Réformons les mathématiques* [Let’s reform mathematics], in which he argued for a reform but one different from that proposed by Papy and his Centre (Schwilden, 1968). More specifically, Becquet advocated an approach that “makes better use of intuition, repetition, and new methods, such as those used in programmed courses”. Becquet did acknowledge, however, that it would be desirable “to integrate the useful parts of new theories, taking into account the various levels and objectives of education” (Schwilden, 1968, p. 7). He also insisted that the reform be carried out slowly and gradually, and that the old not be swept away at once:

Basically, the first phase would be focused on setting the traditional in order and the second phase on implementing the new theories. In this way, there would never be a deep conflict in the continuity of the curriculum, but a slow and secure evolution. The teachers themselves would not feel like pawns, like toys in the hands of curriculum developers. (Becquet in Schwilden, 1968, p. 7)

As early as September 1963, Becquet and some like-minded mathematics teachers at schools for technical education launched their own experiment to modernize the mathematics curricula for 12- to 18-year-old students in these types of school (Gadeyne, 1968). Eventually, 35 schools would follow Becquet’s experimental method (Vermeulen, 1968). Becquet considered his experiment successful: A survey of participating teachers revealed that the method better established basic knowledge and facilitated understanding of mathematics. As a result, fewer students failed mathematics than before (*Le Soir*, April 24, 1968). In support of his actions, Becquet had founded a new teachers’ association, *Mathématique et Technique* (MATEC) [Mathematics and Technique], in the first half of 1966. *Matmo 04/66* recorded a short press release about the initiative:

About 30 school principals and teachers belonging to the various networks of technical education met, under the presidency of Mr. Inspector Becquet, at the *Institut d’Enseignement Technique de l’État*, in Namur, to constitute an association Mathematics and Technique, whose aim is the

defense of technical education and its illustration in the framework of mathematics. (no pagination)

A Board of Directors was elected consisting of Becquet (president), J. Loomans (general secretary), and G. Benoit (administrative secretary), the latter two being principals of a technical school of, respectively, the official and Catholic network. Nine working groups were also established, each to address a specific problem related to the mathematics programs, and the relationships between technical education, on the one hand, and other forms of education and industry, on the other (*Matmo* 04/66, 05/66). At a session on October 12, 1966, MATEC's Board of Directors adopted the following resolution:

The Board of Directors of the teachers' association Mathematics and Technique expresses its strongest reservations regarding the consequences for the future of students in technical education resulting from the introduction of systematic teaching of set theory in the lower grades of technical and vocational secondary education. (*Matmo* 10/66, no pagination)

MATEC thus explicitly opposed the systematic introduction into the lower grades of technical secondary education of set theory, "a gateway to philosophy and logic but not to technical calculation", as Becquet had declared in an interview in *Le Soir*, a leading newspaper in the French-speaking part of Belgium (*Le Soir*, April 24, 1968, p. 6). But what did the technical schools fear would be lost, and what specifically did they propose as an alternative? The main concern, perhaps, was that in Papy's curriculum proposals mathematics would not be helpful to and would even isolate itself from other courses in technical education. In a letter dated November 1966 from Becquet addressed to the principals of the technical schools we read:

The technicians insist on the practice of calculation. A solid knowledge of the fundamental operations involving integers, decimal numbers, and fractions is essential. The study of the metric system and its elementary applications, initiated in elementary school, must be continued. [...] Vocational training, the practice of technical drawing, and the technology course require real aptitudes in the above-mentioned subjects. [...] In technical schools, the first-year drawing program includes geometric drawing and, already, an introduction to industrial drawing through the representation of simple parts. Teaching recipes alone would have no educational value. [...] The drawing activity must therefore, in principle, be based on a prior knowledge of geometric notions acquired by experimental or intuitive means in the course of mathematics. It should be noted that the first-year geometry course should, more than in general education, introduce students to the knowledge of the common plane forms and solids and train them to see in space, because these notions and this skill are indispensable for the drawing of parts in the wood and iron workshop. It follows that the preservation of an elementary practical teaching of geometry, but always with a formative character, is essential. (*Matmo* 10/66, no pagination)

As an alternative, MATEC proposed that the lower grades of (technical) secondary education would study arithmetic, both calculation techniques and problem solving, the metric system, the basics of algebra (first degree algebra and the roots of a quadratic equation), plane geometry, trigonometry with right triangles (perhaps extended to non-right-angled triangles), and the first elements of solid geometry. Becquet did not oppose, at some later stage, the integration of some elements of vector

and matrix algebra in schools for technical education. As stated by Noël (1993) and evident from the above listing, MATEC considered mathematics primarily as a technical tool and not as gymnastics of the mind. In the textbooks for Becquet's experiments, developed under his supervision by a group of teachers from technical schools involved in these experiments, the difficult chapters were split into two parts to separate the meaning of operations from the practice of calculation. Needless to say, the work of MATEC was strongly criticized and even ridiculed by Papy ("Mr. Becquet, the courses of Belgian Centre for Mathematics Pedagogy are open to you. Learn! You will be forgiven a lot", Papy, 1968, p. 34).

Vain hopes and math wars in the late 1960s...

The political decision to mandatorily introduce modern mathematics in the first years of secondary education from September 1, 1968, was made by Henri Janne, Minister of Education in an outgoing government, and announced in a circular of May 14, 1965 (Janne, 1965). Janne was a former rector of the University of Brussels, a socialist and political friend of Papy. On April 11, 1968, Janne's decision was confirmed by Frans Grootjans and Michel Toussaint, the Ministers of Education at the time, but their decision only concerned the general sections of secondary education (Grootjans & Toussaint, 1968). Thus, no formal decision was yet made about modern mathematics in technical secondary education. Moreover, on June 17, 1968, a new government was formed with two new Ministers of Education: Piet Vermeylen and Abel Dubois. The newly appointed Ministers soon allowed some schools of general secondary education "not yet ready to implement the new curricula" to postpone the introduction of modern mathematics by one year (Noël, 1993). Could the decision of Grootjans and Toussaint be reversed? A time of uncertainty followed for Papy's partisans, a time of hope for his opponents. This uncertainty led to a fierce math war in 1968–1969, especially in French-speaking Belgium (De Bock & Vanpaemel, 2019).

During that war, MATEC, which in the meantime had grown to a grouping of more than 400 school principals and teachers (*Le Soir*, April 24, 1968), further developed into a more or less structured opposition movement against Papy and the Belgian Centre for Mathematics Pedagogy. Already in 1966, it united forces with the *Association des Docteurs et Licenciés en Sciences Mathématiques sortis de l'Université de Liège* [Association of Doctors and PhDs in Mathematical Sciences from the University of Liège] (*Matmo* 10/66). Toward the end of the 1960s, an umbrella organization of mathematics teachers opposed to Papy's reform was established—the *Association des Professeurs de Mathématique de l'Enseignement Secondaire* [Association of Teachers of Mathematics of Secondary Education] (Derwidué, 1969). In reaction to this opposition, a group of teachers who supported Papy's reform project for the secondary level was created—the *Comité pour la Promotion de l'Enseignement Mathématique* [Committee for the Reform of Mathematical Education] (Genaert, 1969). In 1968–1969, both organizations mobilized all those involved in the reform, including parents, for large-scale information meetings, hearings, and colloquia held in major Belgian cities (Figure 2).

**Le pénible spectacle offert
par la « guerre des math »...**



SUR LE FRONT DES MATHS

DES PROFESSEURS DE MATHS
repondent aux parents inquiets pour leurs enfants

QU'EN EST-IL DONC DE CETTE REFORME? VOIR SUITE EN P. 2

**A Waremme, 1.400 parents et professeurs
opposés aux “mathématiques de Papy”**

DES COBAYES POUR LES PAPYSTES

**A
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Vous
serez présents avec nous à la grande réunion des
Parents de la Province de Liège

**lundi 23 juin
à 20 heures**

au
PALAIS DES CONGRES
(Jardin d'acclimatation)
Salle de l'Europe
à
LIEGE

pour
affirmer la thèse des Parents
dans le problème de la réforme
de l'enseignement des mathématiques.

Association Provinciale Liégeoise des Parents d'Élèves
de l'Enseignement Officiel.

Figure 2: Invitation flyer for a gathering of parents in Liège on June 23, 1969

The headlines of articles in the Francophone press of the period were telling: “La guerre des maths aura-t-elle lieu?” [Will the maths war take place?] (*Spécial*, March 6, 1968, p. 16), “Sur le front des maths” [On the maths front] (*Pourquoi Pas?*, August 29, 1968, p. 105), “Des cobayes pour les Papystes” [Laboratory animals for Papy’ists] (*Spécial*, April 9, 1969, p. 15), “À quand un cessez-le-feu et une commission d’armistice? Le pénible spectacle offert par la ‘guerre des math’ ” [When will there be a ceasefire and an armistice commission? The painful spectacle offered by the “math war.”] (*Le Soir*, April 27–28, 1969, p. 7), “Nouvelles maths: pour ou contre?” [New maths: for or against?] (*La Libre Belgique*, June 12, 1969, p. 5). The leftist press was mostly sympathetic to the reform initiated by Papy and his Centre, not only because Papy was a socialist, but also because there was a vague belief in the emancipatory power of the project.

The war was eventually won by Papy and his proponents. Minister Dubois, also a socialist, stuck to the decision of his predecessors. In an address delivered at the teaching college in Nivelles on April 27, 1969, he stated:

The new curriculum is the Belgian version, very pragmatic and very adaptable, of a mathematical conception which is now being introduced in all industrialized countries; ... it constitutes a clear obligation for all schools run by the state; no one, my predecessors nor myself, has ever envisaged reconsidering it. (Dubois, 1969, p. 3)

When from September 1, 1969 all students of the first years of secondary education, both in the general and in the technical sections, without any exception, were subjected to modern mathematics, the late 1960s math war ended quickly. The official programs of the technical sections were similar to those of the general sections except for a few details. For Dubois, this was a deliberate decision, even a matter of principle, viz. an occasion to eliminate, maximally, divisions between different types of education (and thus to upgrade the status of the technical schools).

It would be unacceptable if not [the same programs were applicable] and that, with the introduction of the new program, the harmful division between general and technical education, each in their respective fortresses, would be continued. (Dubois, 1969, p. 3)

Conclusion

In the Belgian modern mathematics movement of the 1960s, technical secondary education entered the picture relatively late. The technical schools did not ask for the reform, but when it became clear that they would be involved, reactions were mixed. Ridiaux and some like-minded teachers adhered and tried to make the best of it, explaining in a newly founded journal *Matmo* how to incorporate modern elements into mathematics for technical education; others, such as Inspector Becquet and the members of MATEC, chose to resist. After a bitter math war in 1968–1969 between supporters and opponents of Papy, especially in French-speaking Belgium, modern mathematics was also implemented in technical secondary education, one year later than in general secondary education but with an almost identical program.

Future research could clarify the specificity of the Belgian modern mathematics movement in an international context. However, despite increasing scholarly interest and some single analyses with a specific scope (e.g., Kilpatrick, 2012; Vanpaemel & De Bock, 2019), comparative research on the international “New Math” phenomenon is still in its infancy.

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