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► **To cite this version:**

Johan Prytz. Models of school governance and research implementation: A comparative study of two Swedish cases, 1960–2018. Eleventh Congress of the European Society for Research in Mathematics Education, Utrecht University, Feb 2019, Utrecht, Netherlands. hal-02429788

HAL Id: hal-02429788

<https://hal.science/hal-02429788>

Submitted on 6 Jan 2020

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Models of school governance and research implementation.

A comparative study of two Swedish cases, 1960–2018

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This paper concern the role of research and models of governance in two Swedish reform programs: the New Math project in the 1960s and 70s and the Boost for Mathematics project in the 2010s. This historical comparison study aims to deepen our understanding of how research results in mathematics education are implemented in Swedish schools today. Theory and results from implementation research are used to pinpoint and justify the choice of the object of analysis. The analysis focuses on the role of research and the researcher in the preparation of the two projects. The main sources are reports and governmental decisions concerning the two projects, but sources also include material used in these projects.

Keywords: Governance, Educational change, Educational research, Innovation, Implementation.

Introduction

Between 1960 and 2018, the policy of governance of Swedish schools has shifted from being primarily centralised to being primarily decentralised (Prytz, 2017). To a great degree, this shift meant that teachers had more autonomy to choose what teaching methods and teaching materials to use. For example, since 1994, the national curriculum does not provide guidelines about teaching methods. About the same time, the review of textbooks was abolished. However, little is known about how this overall change in governing policy has influenced how research findings are implemented in schools.

In Sweden, the development of research on mathematics education has paralleled the change from centralisation to decentralisation. The number of researchers has increased greatly and mathematics education has become an established field of research at most Swedish universities. However, this does not entail that research in mathematics education did not exist in the 1960s – it did. However, in the 1960s research was conducted to a large extent by the central school authorities rather than by researchers in universities. Perhaps it is not entirely correct to refer to this enterprise as research, but there was cooperation with researchers and the methodologies were similar to those found in educational research today.

The study presented in this paper deepens our understanding of how research results in mathematics education are implemented in Swedish schools today. To this end, this paper compares two historical cases: The New Math project (1960–1975) and The Boost for Mathematics project (*Matematiklyftet*) (2011–2016). The two projects differ in many respects, but they also share some characteristics: both projects were run by central school authorities and both emphasised teachers using research findings to develop teaching strategies. The analysis is descriptive and concerns how the implementation of these projects was prepared. The analysis and the research question address the function of educational science as a base of knowledge for designing teaching innovations.

More precisely, I describe different phases in the preparation process and the role of research in this process. Further details are presented in the section ‘Theory and method’.

The paper contains five sections: ‘Theory and method’, ‘Contribution to previous research’, ‘The New Math project’, ‘The Boost project’, and ‘Conclusions and discussion’. ‘The New Math project’ and ‘The Boost project’ sections include a short background of each project as well as a more detailed description of the role of research in each project. In ‘Conclusions and discussion’, the two projects are compared with each other and I discuss the role of research and modes of governance.

Theory and method

Innovation is a key concept in research about implementation as it is the innovation that is to be implemented (cf. Century & Cassata, 2016; Fullan & Pomfret, 1977). This paper concerns the preparation of the innovation. In an early overview on research about implementation and education, Fullan and Pomfret (1977) note that this phase can be determinant for the rest of the implementation process.

In a more recent overview, Century and Cassata (2016) discuss research about implementation and education and how innovation relates to knowledge. In an educational setting, knowledge can come from two sources: research and practice. This paper focuses on how educational research or science has functioned as a base of knowledge when innovations were designed; in brief, I call this the function of research.

In comparative historical studies in education and other subjects, it is imperative to have a common unit of comparison (Bray et al., 2007). In my analysis of the function of research in the two projects, the common unit is the researcher. The basic question of this paper is formulated as follows: How did researchers prepare the innovations? For example, the researchers can design the innovation by compiling results from other researchers outside of the project or the researchers can design the innovation by doing their own experiments or trials.

This analysis relies on official reports about the New Math project and the Boost project and teaching materials. However, when discussing the New Math project, I do not refer to the original sources but to a previous study, Prytz (2017), which includes an analysis of the New Math project in Sweden.

In addition, I analyse the organisational factors influencing the function of research. According to Century and Cassata (2016), these factors can influence the implementation of an innovation. In particular, I am interested in how policies of governance (centralisation or decentralisation) and scientific policies influenced the role of the researchers: How extensively have researchers been pursuing policies of governance and science?

As to the historical context of governance of each case, I have not done my own analysis but have relied on extensive previous research. Of course, there are different views on certain aspects, but there is strong agreement about the overall narrative: from about the mid-1970s up to about 2000, the policy of governance of the Swedish school system changed from mainly centralised to mainly decentralised. In all three areas of governance (economical, judicial, and ideological), the general

ambition was to give local actors the power to make decisions (e.g., local politicians, headmasters, or teachers). We also find this overall narrative in university textbooks and in research papers (see Prytz 2017 for an overview).

Contribution to previous research

Focusing on methodology, this paper shows how historical studies can be used in research about implementation and education. Historical comparison is a rarely used methodology in research about implementation and education as evident in its lack of mention in quite old as well as more recent international overviews (cf. Century & Cassata, 2016; Fullan & Pomfret, 1977). The lack of historical comparisons is also evident in the field of mathematics education, where implementation research is a fairly new topic. For example, historical studies about implementation have not been an issue at the previous CERMEs.

A principal argument of doing historical comparisons is that they provide perspectives on contemporary phenomenon, a view that cannot be attained through the study of contemporary sources alone. Typically, historical comparisons help bring into relief what is stable and what is not (cf. Tosh, 2000). This study found that the role of educational research and the researchers preparing reforms co-vary with basic policies of governance. This co-variance can be a problem if we believe that research should be autonomous and follow its own logic.

This paper also contributes to the research about the Boost project. As with this study, Boesen et al. (2015) focused on design and planning to examine how the project was informed by research. However, Boesen et al. considered how references were made to different types of research publications, whereas my study focuses on the role of researchers. Another difference is my historical perspective and my comparisons of policies of governance. The Boost project has also been evaluated two times and a third is on the way. One of the evaluations (Österholm et al., 2016) uses a scientific approach. Not in any of the evaluations, the preparation of the program and the role of researchers are considered; the focus is on the outcome.

The New Math project

The New Math can be seen as an international reform movement that aimed to innovate and improve school mathematics from year 1 to 12. The innovations were supposed to be based on contemporary science: The content of the teaching should be updated to reflect the advancement of the scientific discipline of mathematics, and teaching methods should be based on modern psychological and pedagogical research. By the end of the 1950s, the movement had accumulated great momentum. Internationally prominent researchers supported the project, including the mathematician Jean Dieudonné and the psychologists Jean Piaget and Jerome Bruner. In addition, international organizations such as OECD and UNESCO contributed by funding conferences and publishing reports (Prytz, 2017).

Quite early, Sweden became part of the movement. In the late 1950s, representatives from Sweden attended the international conferences on the New Math. In the early 1960s and in cooperation with other Nordic countries, except Iceland, development began on a new curriculum based on New

Math. The project was initiated, financed, and driven by central school authorities. These preparations lasted until 1968 (Prytz, 2017).

The role of the researchers during the preparations of New Math in Sweden was to lead and work in a research-like enterprise gathering and analysing extensive empirical data. The development of the innovations, which largely concerned the development of textbooks, was an extensive enterprise. The testing of new textbooks involved thousands of students in the Nordic countries. In addition, teachers completed questionnaires that addressed how teaching had progressed and how the material could be improved. In one part of the project, a new type of textbook based on New Math went through five rounds of development and trials. At the end of another part of the project, trials with experimental groups and control groups were conducted that lasted for two or three years. These trials ended with knowledge testing. The tests indicated that the new material was functional and which groups of students were served best by the new material (Prytz, 2017).

A central component of the New Math was set theory. The idea was that set theory, already from year one, should form the basis of all other areas of school mathematics, such as arithmetic, geometry, algebra, and statistics. The inspiration came from the scientific discipline of mathematics, where set theory functioned as a basis for other parts of mathematics. In school mathematics, however, it was not just a question of adding a common ground for the content of the courses; set theory also had an educational or methodological purpose. It was supposed to create clearer connections between the various topics, both for teachers and for students. In addition, explanations and illustrations should be based on concepts from set theory. Interestingly, concepts from set theory alone did not fill this role. The 1969 curriculum also emphasised the number line and images of numbers as positions on a number line (Prytz, 2017). Thus, the New Math project brought not only a general theory about teaching and learning, but also detailed guidelines about how teachers should communicate with students.

It was in connection with the methodological ideas about set theory that Piaget and Bruner were of particular significance. They argued that there are similarities between mental structures and mathematical structures, which they thought should be used in teaching. The idea was that a stronger focus on structures would provide better understanding, which in turn would result in better learning. Set theory, but also the number line, would provide a structure to create better learning. For this reason, set theory, along with the number line, should primarily be seen as a methodological innovation that concerned all parts of school mathematics (Prytz 2017).

However, Piaget's and Bruner's theories should be considered hypothetical guidelines. Few studies provided specific guidelines for how to design teaching. In the final report about the Nordic New Math project, we see only a few examples of these types of studies. A centre piece of that report is the development phase and the trials of new types of textbooks (Prytz, 2017).

In the 1970s, the reform was being implemented. The new curriculum based on the New Math was ready in 1969 and it took effect in 1970. By and large, all teachers in mathematics in year 1–9 received further education in New Math. A large majority of the textbooks followed the new curriculum (Prytz, 2017).

The Boost project

The Boost project was an in-service training program for teachers and was prepared between 2011 and 2012 and was launched in 2013. The final decision about launching the program was taken in 2012. It ended in 2016 although much of the material is still accessible through the central school authority's website. It was a major program as 76% of all mathematics teachers (1–12) followed the program (Source B). At this point, we can spot a great difference in comparison with the New Math project: the time allotted for preparations.

Unlike the international New Math movement, the Boost project was an all Swedish enterprise. The justification of the project was that the results of the Swedish students had decreased for about 15 years, according to national as well as international evaluations. This was clearly stated in the final government decision to start the Boost project (Source A). The results in PISA and TIMSS had indeed decreased significantly, especially in the ten years before the Boost project. In fact, the decrease was greater than in any other country.

The same government document identified the cause of the problems. On the basis of several investigations, the document concluded that students mainly worked alone with the textbook and too little of the teaching were led by teachers, limiting the possibilities to learn about reasoning and argumentation (Source A). This view of the problem was reflected in the overall aims of the project. The aims were to change the culture of teaching and develop a new in-service training culture (Source B). Neither the justification nor the aims of the project had any direct connections to the new curriculum that was launched in 2011.

The Boost project was administered by the central school authorities in co-operation with the national centre for mathematics education at Gothenburg University (Source A). To ensure scientific quality, the work to develop the educational material, so-called modules, was distributed among several university departments with research in mathematics education (Source B).

The basic principle for organizing the program was peer learning among teachers with support from external experts. Experts in this case were researchers at the university departments. However, experienced and highly skilled teachers led the peer learning sessions with the teachers (Source A). These experienced and highly skilled teachers received special training at the university departments for eight or nine days. As I understand it, the researchers' main responsibility was the teaching material and the special training of the highly skilled teachers.

The choice of a peer learning program was justified by a reference to a report issued by the Ministry of Finance (Åman, 2010). In turn, the author of that report referred to another report (Timperley, 2007) issued by the Ministry of Education in New Zealand, an international overview of research on teacher training. The report clearly recommended peer learning, but it provides no explicit recommendations about how researchers, or experts, and teachers should interact. However, the report implied that this relationship is crucial since it emphasised the importance of the content of the teacher training program; in fact, this was considered more important than anything else.

This leads us to the teaching material and how it was developed by the researchers. The material, or modules, comprised scientific articles in mathematics education along with films, audio clips, web

texts with instructions, and questions for lesson activities and peer learning (Source B). Each module covered one topic (arithmetic, geometry, etc.) in the curriculum. In addition, each module focused on four areas: abilities, formative assessment, interaction, and socio-mathematical norms.

The scientific articles in the modules included different types of texts: an international overview of each topic and the four areas mentioned above and articles about Swedish mathematics education. The later type of texts was by no means dominant (Source C). My point here is that the research results presented to the teachers largely did not stem from research on Swedish students and teachers.

One major role of the researcher was to use information from previous research to produce the modules. To secure high quality material, each module was also reviewed by several other researchers. According to the final report about the project, there were no trials of the modules with teachers before they were published and used (Source B). However, in the same report, it is stated that there were follow-ups (school visits, interviews, and surveys) after the publication and these resulted in revisions of the modules (Source B). To what extent and for how long these follow-ups lasted is unclear. Another report noted that there was a test round with 300 teachers in the autumn of 2012. The program was then launched in the autumn of 2013 (Source B). Thus, it appears there was only one round of trials where the teachers could provide the researchers with feedback.

Conclusions and discussion

The role of the researchers in the New Math project and the Boost project fits the narrative of an educational system that changed from a centralised to a decentralised system. In the New Math project, the state-financed researchers applied one specific theory about cognition and learning to find out what is efficient teaching in all subtopics for all school years. This research ended in detailed guidelines about how to teach all parts of mathematics such as how to explain new concepts and what type of illustrations or pictures should be used. These guidelines were then dispersed through the national curriculum. Thus, the decision about what is good teaching was centralised and the researchers were supposed to deliver detailed guidelines about teaching that all teachers were to apply. In the Boost project, much of the decisions related to learning and teaching were decentralised. The researchers did not have to apply one specific theory on cognition and learning. Moreover, the role of the researchers was not to provide more definitive answers, for example, through guidelines in the national curriculum about what is an efficient teaching practice. Moreover, the idea of peer learning theory, which was the overarching theory of the Boost project, is that teachers, with support from researchers, should develop their own teaching strategies. Another aspect of decentralisation was that the teachers choose to study two of several modules. Thus, the teachers decided which part of their teaching needed most development. As I see it, the role of the researchers in the Boost project was to gather a smorgasbord of teaching solutions the teachers could choose from. Thus, in both projects, the researchers were operating according to the policy of governance of each period.

Now we turn to the issue of pursuing scientific policies. The New Math project was driven according to one explicit general theory about cognition and learning mathematics. However, this theory was hypothetical as it did not deliver concrete solutions about how to teach. In practice, this meant

developing and testing teaching and support material, not the least of which were textbooks, for six years. During this time, new material was tried in five development cycles. The project involved thousands of teachers and students, and the material was also tested with experimental and control groups after two or three years of teaching. Important to notice is that the many years of testing were relevant from a scientific point of view since little empirical research results were available to develop the New Math project. In the Boost project, the situation was different. Time for development was brief, about a year, and the material given to the teachers, the modules, was tested just once and with few teachers. That is, rather than relying on results from trials (i.e., applying a more empirical and inductive mode of reasoning), the researchers had to work in a more deductive fashion (i.e., take and derive solutions from previous research results).

I am not saying the Boost way of preparing materials for teachers is unscientific or ineffective, but I am questioning if it is optimal. Are we today in the position to replace or drastically reduce the type of preparations we see in the New Math project? The methods applied in the New Math preparations still are relevant for development projects and they are a part of normal research methodology. Moreover, is it possible to derive functional material, both with respect to design and content, in a brief period from research results that in many cases do not stem from studies on Swedish students and teachers? If we consider the overview on implementation research by Century and Cassata (2016), their view seems not to include positive answers to these questions:

It is not uncommon for developers to be unsure about which elements are indeed most critical [...], and there is a tendency for innovation creators to identify the majority of components as “very important” [...] and to hold holistic views of their innovations (i.e., as “packages”), leading to component descriptions that lack specificity. [...] For these reasons, researchers are encouraged to use multifaceted approaches to identifying innovation components that combine information from developers and other experts, from end users, from observations of innovations in practice, and from reviews of artefacts, such as practice guides and other program materials. (Century & Cassata, 2016, p. 182)

This passage indicates that the development of the innovation should take some time to identify and develop core components in different ways. In fact, the preparations of the New Math reform fits this passage quite well since it combined information from developers, experts, and users as well as observations of innovations in practice.

So, why was the Boost project prepared in this way? Why was not more time and resources allocated to researchers and the development of the material? I suggest this decision, at least in part, was related to a policy of governance – i.e., decentralisation. This policy does not fit the idea of researchers in a central position deciding what is good material for all teachers. Moreover, the absence of more precise material, which Century and Cassata (2016) are asking for, is less of a problem if teachers are supposed to make decisions on their own. Here it is important to notice that the scientific report referred to in the planning of the Boost project that recommended peer learning (Timperley, 2007) gave no explicit recommendations about how researchers and teachers should interact. However, the report did imply that this relation is crucial since it emphasised the importance of the content of the teacher training program.

In the future, I think researchers as well as politicians and school administrators should consider the relation between governance and research more closely as they plan major development projects. To a great degree, they are probably interested in the same goal: to change the behaviour of teachers and students. However, their means to achieve the goal may or should not always be the same.

Sources (unpublished)

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