# Polarities in (Nordic) Mathematics Education: Scaling the field

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Abstract: *Mathematics education research in the Nordic world is compared to that occurring elsewhere by using the metaphor of scaling. Mathematics education as a research entity is scaled with respect to the knowledge industry, namely economics, its place within professional societies, and disciplines such as mathematics, social sciences, psychology and the humanities. Polarities, consistencies and contradictions are discussed in the role of an (external) observer and a collaborator with researchers in the Nordic mathematics education milieu. Some implications for the future are elaborated*.

*Töluð orð verða ekki aftur tekin*[1]
*(You cannot take back spoken words)*
*-Icelandic saying*

## Introduction

Geographical comparisons of any domain of research, involving human subjects situated within institutional and societal structures is problematic. This is particularly true of mathematics education, in which comparisons are in general difficult to conduct given the variation of historical context, school systems, and local culture. Historical comparisons of how mathematics education developed in Germany, France and Italy from the Renaissance until the post-modern period have been attempted with the conclusion that geographic comparisons are possible within the realm of educational philosophies, curriculum, textbooks and some narrow focal points of research (Sriraman & Törner, 2008). However compared to rest of the world, the Nordic world is often perceived by outsiders as more or less homogeneous partly due to comparative studies in the post TIMSS and PISA phases which correlate math and science achievement with dimensionalities of socio economic status (SES) and other demographic characteristics of Nordic societies and school systems. In general there is less variation in cultural dimensions within Norway, Sweden, Denmark, Iceland and Finland in terms of community, school and home resources for individuals (Yang, 2003), in comparison to say the U.S or other countries within Europe.

The objective of this paper is therefore not to simplistically compare the mathematics education research occurring in the Nordic world with that occurring elsewhere. Instead, the objective is to create a perspective via which the scope and significance of the research coming out of the Nordic world may be better understood in relation to the field.

[1] This paper is written in as close a form as possible to the plenary talk at NORMA 11.

Most standard dictionaries define *polarity* to mean an intrinsic separation, alignment, or orientation, especially of a physical property. Examples from physics and chemistry are *magnetic polarity*, *ionic polarity* etc. Polarity also means an indicated (polar) extreme or the possession and manifestation of two opposing attributes, tendencies, or principles. Seen in Hegelian terms, a polarity creates a dialectic or ant-thesis, with the possibility of a forward moving synthesis. The general questions addressed in this plenary in order to compare Nordic mathematics education to the rest of the field are:

(1) How does one scale mathematics education to begin with?
(2) How can one scale Nordic mathematics education research?
(3) Is mathematics education as a field insular, plural or polar in terms of its historical development?
(4) Are Nordic schools of thought within mathematics education - insular or plural or polar?

**Scaling- Magnitude matters**

The term "scaling" as used in this paper is both a metaphor as well a tool to compare mathematics education research occurring in the Nordic world to that occurring elsewhere. Scaling connotes a comparison to make something understandable or comprehensible, as well an ascendance, such as to scale a wall. Scaling mathematics education is not a trivial enterprise since we are not dealing with purely a mathematical problem. For instance, one cannot allocate a rational number between 0 and 1 to reflect the magnitude or the scope of the research produced by one region of the world as a proportion of the total research output occurring, nor can one ascribe ascendance to one region over others.

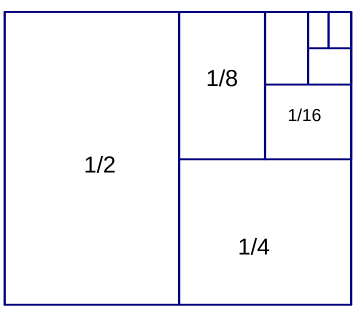


Figure 1: Scaling a geometric series in terms of area of a unit square.

**Scaling in Economics**

Scaling as employed by the field of economics gives a better handle on the problem (Gallegati, Kirman, Palestrini, 2007). Economic theories typically idealize real world phenomenon by scaling the system (up or down), and simplifying the constraints inherent in a dynamical system. The fluctuations in world economies and stock market crashes in the last decade have shown mathematically idealized economic models are not only unreliable predictors of outcomes, but also practically non-sustainable. On a more historical note, if we compare macro-economic models to micro economic models, the role of human decision making (and group rationality and irrationality) emerges. Collectivism as implemented on a large scale in the Soviet Union was a catastrophic failure, but collectivism works on a much smaller scale, such as in the kibbutzim in Israel. One reason for this might be that there is more transparency and accountability at the individual level in time apportionments and the sharing of goods. More sinister examples from the failure of economic models that assume rationality but do not take into account human greed are the implications of market failures [banking systems, housing loan schemes, white collar corporate crime] on different economies. The failure of the banking system in Iceland could be attributed to approximately 30 individuals out of 300,000 in Iceland [1: 10,000], whereas the egregious white collar crime in the U.S could be reduced to the culpability of 30 out of approximately 300,000,000 [1:10,000,000]. However there were more immediate consequences such as currency devaluation and accountability from other nations for the repayment of debt in the case of Iceland, whereas a much larger economy like the U.S is able to defray the consequences of such crime by simply selling its debt to countries like China, with a promise of repayment. The current budget crisis in the U.S polarized by competing plans and political ideologies for allocating and reducing U.S debt that is in trillions of dollars suggests that even larger economies are not immune to flaws within economic models which predict unmitigated growth without taking into account human and natural constraints such as disasters.

**Scaling the Knowledge Industry**

The Knowledge Industry can be viewed as part of the larger economic structure consisting of publishing conglomerates with publicly traded parent investment firms. For example, the well known publishing giant in our community Springer Science and Business Media (SBM), one of the largest academic publishing companies in the world (after Elsevier, and Taylor& Francis) is partly owned by the Government of Singapore Investment Corporation, and EQT, a private equity firm based in Sweden. Springer currently owns 60 subsidiary publishing houses that hold 13 different subject collections embodied in 2,000 academic journals and 6,500+ new books published each year. In 2009 Springer Science and Business reported annual revenues of close to 850 million Euros, which converts to approximately 1 billion U.S. dollars. But SBM is only the third largest publisher! Their scale is one order of magnitude smaller than the largest publisher (see footnote 1).

Translating scholarship into dollars is not as bizarre as it may seem, since at the individual level, scholarly productivity is rewarded by institutions in the form of tenure, promotion and associated salary increases (Sriraman, 2011a). The point here is to scale this in terms of the individual at the other end. For instance, if we take the approximately $1000 per individual publication reward offered by some institutions (in Europe, Scandinavia and other countries) for publishing in a prestigious (indexed) journal, and compare it average annual revenues of the publishing house that owns that journal, the scale is typically 1: $10^6$. This puts into perspective what individual scholarship amounts to when viewed from the perspective of the worth of a publicly traded Knowledge company (Sriraman, 2011a). The relationship between scholarship and its commoditization in the market place is prevalent in today's global knowledge economy (Peters, 2002). Francis Bacon's (1561-1626) view that knowledge is power is interpreted differently by critical theorists in the postmodern age as: knowledge is not only power, but also money (Ernest, 2009, p.68). Now the question is how does one scale mathematics education?

**"Scaling" Research in Mathematics Education**

If one wanted to feel really small within the larger economic structures that govern human life, we could estimate the total revenue generated by research in mathematics education in terms of publishing output in journals, books and other outlets, in comparison to the total revenue of the three largest academic publishers, namely Elsevier[2], Taylor& Francis[3] and Springer. The Fermi estimate[4] in terms of order of magnitude calculated by the author is 4.0 x $10^6$: 4.3 x $10^9$ (or approximately 1: 1000), i.e., mathematics education as a research discipline generates a little less than 1 dollar to every 1000 dollars made by the three major publishing conglomerates that host every disciple under the sun. But as an academic discipline, a comparison strictly in terms of revenue seems distasteful. So a different sense of scale can be generated as follows. Within the field of education in North America, the American Educational Research Association (AERA) has mathematics education reduced at 1 Special Interest Group (SIG) out of a total of 152 Special interest group. The scale 1: 152 is more palatable that 1: 1000. If one wishes to feel more important, we can look within the discipline of mathematics as opposed to education, and note that the American Mathematical Society has reduced mathematics education to one category out of 97 categories. The scale is now 1:97, which is better than 1:152.

Arguably, there may those that consider mathematics education as a social science and wish to consider a scaling based on a comparison within the field of social sciences. This is very easily done from a bibliometric point of view. Currently we have one research journal, namely the *Journal for Research in Mathematics Education* (JRME) out of approximately 200 in the social sciences within the *Social Sciences Citation Index*. As of 07/25/2011, the author was told that three more journals have now been indexed within SSCI, namely *Mathematical Thinking and Learning* (MTL), *Educational Studies in Mathematics* (ESM), and the *International Journal of Science and Mathematics Education* (IJSME). This means within the social sciences as scaled by Thomson's Social Sciences Citation Index, the scale is 1:50, a slight improvement to 1:97. What if we scale mathematics education with respect to psychology and the humanities? One way to do so, is to peruse other indexes such as Psych Info, or Wilson Select that include mathematics education practitioner journals in addition to research journals. Then we have roughly 25 journals out of 1000 within the disciplines of Education, Psychology and the Humanities. This results in a scaling of 1:40. If one wishes to feel *even* more important one can look at the classification of mathematics education in Europe within the European Educational Research Association (EERA). Mathematics education is one of the 27 networks within this organization. Now we have improved the significance of the field to 1:27.

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[2] Elsevier is the largest publishing house in the world, predominantly a publisher of medical, legal and science literature, with a publicly traded parent body Reed Elsevier, listed in major stock indices such as the FTSE 100 and FT500. The company is publicly traded as REL in the London Stock Exchange, ENL and RUK in the New York Stock Exchange. In 2010, the company listed their annual revenue at 6,055 x $10^6$ pound sterling, which is roughly 10 billion dollars!
There have been numerous controversies with Elsevier with regards to the steep institutional subscription rates of many of its journals. For instance, the prestigious journal *Topology* formerly published by Elsevier changed its publisher to the London Mathematics Society because of being unable to get the publisher to lower its institutional subscription price. The entire editorial board of this journal resigned in 2006 over the failed negotiations with the publisher.

[3] Taylor and Francis is owned by the parent company Informa, publicly traded in the London Stock Exchange as INF. In the 2010 annual report, the company reported their annual revenue was more than 2 billion dollars.

[4] The estimate is based on the following (modest) ball-park calculation:
Revenue Ratio = [(#math-ed journals and book series with 3 major publishers) x (average # institutional subscriptions) x (average cost of institutional subscription) – (estimated average expenditure)] : (average of annual revenues of Elsevier, Informa, and Springer).

So there you have it, we have cascading scales - 1: $10^6$, 1: 1000, 1:152, 1: 97, 1:50, 1:40 and finally 1:27. One can decide for themselves which one is the most appropriate depending on their orientation towards mathematics education. Hopefully by now the reader is convinced that in the general scheme of things, mathematics education (research) is a small enterprise, and the Nordic world within mathematics education is even smaller. The question then is how would one compare the scale and impact of Nordic mathematics education research in comparison to the rest of the world? The astute reader would have noticed that mathematics education has been scaled strictly in terms of its economic value for a publicly traded investment group, in terms of the economic value for the individual, in terms of a professional entity within the disciplines of education, mathematics, social sciences, humanities and psychology. A brief scaling of the field in terms of its history will persuade the reader that these comparisons within other disciplines were justifiable since mathematics education is best viewed today as an interdisciplinary area of inquiry at the nexus of numerous other disciplines.

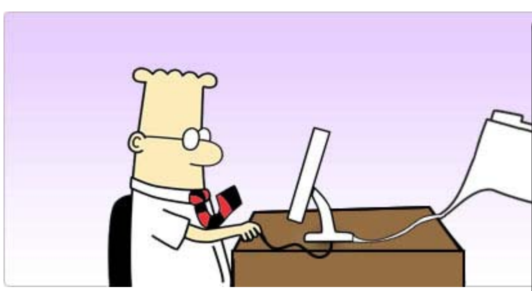
**Scaling mathematics education historically**

This section begins with the assumption that mathematics education emerged as a discipline in its own right with its roots in mathematics.

Hilbert (1862-1943) in the introduction to *Geometry and the Imagination* states that

> *In Mathematics, as in any other scientific research, we find two tendencies present. On the one hand, the tendency towards ABSTRACTION…and the tendency toward INTUITIVE UNDERSTANDING that fosters a more immediate grasp of the objects one studies, a live rapport…which stresses the concrete meaning of their relations.*

Today, given the ways in which mathematics education has developed over the course of the last 100 years, we could have Dilbert, the cartoon character created by Scott Adams, famous for his biting office satire write an analogous book about *Mathematics Education and the Imagination* in which the capitalized words from Hilbert's quote, namely ABSTRACTION and INTUITIVE UNDERSTANDING, are replaced with the words THEORIZING AND EMPIRICAL GROUNDING



***©Scott Adams 2011, http://www.dilbert.com/***

> ***Mathematics Education and the Imagination***
> *In MATHEMATICS EDUCATION, as in any other scientific research, we find two tendencies present. On the one hand, the tendency towards **THEORIZING** and…the tendency toward **EMPIRICAL GROUNDING** that fosters a more immediate grasp of the subjects and objects one studies, a live rapport…which stresses the inter-textual meaning of their relations.*

Figure 2: Dilbert on mathematics education

Dilbert's satirical quote about mathematics education has an element of truth to it in the recent discussions of how theory development within our field has happened rather haphazardly (Jablonka & Bergsten, 2011; Sriraman & English, 2010; Sriraman, 2011b). A discussion of this particularity of the field is saved for the last section of the paper where I discuss the Nordic milieu. To reiterate the question being discussed in this plenary: How does one compare the scale and impact of Nordic mathematics education research in comparison to the rest of the world? If one uses a historical approach to scale the field, in terms of epochs, not necessarily disjoint, and using 1900 as a starting point, a picture of how research is evolving in the Nordic world slowly begins to emerge.

Mathematics education can be broken down into five epochs (Törner & Sriraman, 2005). Using the geological term "epoch" may seem askew in describing a 100 years of growth. However when seen in Lamarckian terms, i.e., in terms of cultural evolution- the paradigm shifts, and branches in which the field has grown from its origins in mathematics and subsequently mutated has been truly Lamarckian (i.e., rapid). Similar Lamarckian descriptions of disciplines such as music are found in the literature (e.g., Molino, 2000). The five epochs stated in very simplistic terms are:

*Epoch 1: The pedagogical tradition of mathematics teaching - mathematics has an educational value:* (*Mathematics at the center)*. In this epoch one sees the influence of mathematicians like Felix Klein in developing the field, and the inception of ICMI as a professional organization in 1908. One of the founding goals of the field was to develop textbooks that made mathematics accessible to students. In other words, the field consisted of mathematicians interested in the developing methodologies that made the content relevant and accessible.

*Epoch2: The influence of Psychology*

This epoch can be traced back to the advent of psychometrics, harking back to the ideas of intelligence of the likes of Francis Galton, and the development of what is today called the Stanford-Binet test for measuring intelligence [IQ]. Narratives of the development of mathematics education like to point to the interest in psychological principles underlying the understanding of arithmetic as being a starting point for the influence of psychology. However an oft-over looked historical point is Piaget's work with Theodoré Simon (1872 - 1961) on the development of the Binet-Simon test, and his subsequent interest in investigating errors made by students on the test to understand children's ways of thinking, as opposed to scoring it for correctness [the pre-cursor to the IQ cursor]. Simon himself was not an advocate of a measurement scale for human intelligence, particularly its inappropriate use, and remained critical of its use. If one traces the history of the ways in which the scale has been normed and re-normed, a very interesting and useful picture of the field of educational psychology and standardized testing emerges. Indeed one of the greatest challenges confronting mathematics education is the dissonance between the demands of standardized testing in the school setting and the findings of cognitive psychology on the development of mathematical structures. Presmeg (2009) points out that the influence of psychology and psychometrics in mathematics education research was due to the "admiration for the relative certainty of results obtained by researchers in the hard sciences, in which empirical investigation was used to confirm or disconfirm theory…early researchers in mathematics education (especially in the 1960s and

1970s) tried to emulate this research" (p.135). Mathematics education research, particularly in the U.S.,has recently witnessed a pendulum swing after the release of the National Mathematics Advisory Panel Report, and its advocacy of aptitude-treatment-interaction studies that characterize experimental psychology.

*Epoch 3: Piaget/ Vygotsky and the Constructivist Dogma*
This epoch started in the early 1980's with a shift in the development of theories of mathematical learning based on the Piagetian work in developmental psychology, and Vygostkian cultural-historical psychology. Various schools of thought emerged within the mathematics education community in the 90's as witnessed in the debates between the radical constructivists and social constructivists.

The last two epochs more or less define the last two decades of the field in which methods borrowed from the social sciences increasingly began to characterize the reported research in journals and books.

*Epoch 4: Debates on Methodologies*
Mathematics education viewed as a social science allows for use of methodologies from anthropology (ethnography), sociology (grounded theory, action research), phenomenology (hermeneutic methods) etc.

*Epoch 5: Influence of other disciplines: Mathematics at the periphery*
The last epoch termed "influence of other disciplines" characterizes the field today where newer developments in areas such as linguistics, ethno mathematics, complexity theory, neurosciences, modeling, critical theory, feminist theory, social justice theory and networking theories are increasingly influential (Sriraman & English, 2010). There is criticism from some that mathematics no longer seems to be at the center of mathematics education but relegated to the periphery (Eisenberg & Fried,2009).

**Scaling mathematics education research in the Nordic world**
Mathematics education as a domain of knowledge can be viewed as a creative activity that involves a group of individuals situated within institutions engaged in research that is socially and culturally situated. The problems tackled by the discipline range from individual cognition to school to system wide issues pertaining to assessment, curricula etc. The latter includes international comparative studies on development of teachers, students from different cultures such as the *Learners Perspective Study* and large scale assessments such as *PISA*.

In the field of creativity, three factors are considered important within any domain of knowledge, namely the timing of ideas, institutional/group support for the work and its relevance to the group (Runco & Albert, 2010). For instance, someone embarking on re-doing problem solving research in the Nordic world, would find it difficult to justify its novelty to someone in North America or the field for that matter, who is familiar with the empirical research done in the 1970's and early 80's, even if the work is published under the guise of being situated in a different socio-cultural context. Similarly someone claiming to re-conceptualize affect would have little credibility within the larger domain of psychology where affect has been empirically studied for decades and several empirically sound theories of motivation are available.

Paradoxically enough, the impetus for research on affect, at least in the U.S, was the failure of problem solving reform within the curricula (Schoenfeld, 2007). In this case, the audience or the professional society to whom the "new" idea is presented is relevant.

The other issues are fitness of an idea- i.e., is a new program of research considered useful within the institutional or social milieu, and does new research undergo the necessary social confrontation from others within professional societies and gatekeepers such as journal referees/editors etc? Creativity seen from a systems perspective is triadic and occurs within the interaction of the individual, domain and field (Czikszentmihalyi, 2000). So the question now is: are there identifiable individuals, institutions and "products" – namely theories, models, dissertations, journal articles, citations etc from the Nordic world that have made an impact on the larger field of mathematics education? It is important here to state that using a citation counting device such as the *Social Sciences Citation Index* would be unfair, since many of the senior scholars from the Nordic world did not publish in SSCI journals, but did publish in journals such as *Educational Studies in Mathematics*, and numerous Kluwer (now Springer) products.

Nordic researchers like Stieg Mellin-Olsen (Bergen) and Ole Skovsmose (Aalborg) were early proponents of incorporating political philosophy into mathematics education from a social sciences viewpoint. The Aalborg group has been very active with its program of Critical Mathematics Education, and numerous books and dissertations produced by this group have influenced the researchers outside the Nordic milieu, particularly Skovsmose's (1994) book *Towards a Philosophy of Critical Mathematics Education*. Similarly, Mellin-Olsen's (1987) book *The Politics of Mathematics Education* is cited frequently in the literature/studies addressing philosophy, contextualization and enculturation in mathematics education. In addition his 1981 paper "*Instrumentalism as an educational concept*" is another gem that shows a way of conceptualizing mathematical thinking analogous to that developed by Richard Skemp. Other Nordic researchers like Mogens Niss (Roskilde) have approached mathematics education in schools and policy from the paradigm of applied mathematics, and developed a framework for developing mathematical knowledge through modeling, as well as assessing it through the framework of math competencies. There are similarities in this approach to the work on modeling conducted in the U.S (Mousoulides, Sriraman, Christou, 2008). Niss's writings on the role of mathematics in society (e.g., Niss, 1994) provide a useful lens through which the significance of mathematics education in schools can be examined. There is an interesting dichotomy in the approach to modeling activities or the very notion of modeling in the work of the Roskilde group in contrast to the Aalborg group. The former argues for the significance, uses and understanding of modeling within the instrumentalism of mathematics in real world decision making in institutions and society, whereas the latter views modeling from a critical theory and political standpoint in the unchecked use of models in society by decision makers (often) in a very undemocratic ways (e.g., Skovsmose, 2004).

To come full circle with the notion of "polarity" stated earlier in this paper- the two views are somewhat polar, but complementary when one examines the use of mathematical models in economic theories and the ensuing decision making of politicians and financial institutions. The sanitization of these models in the assumed rationality of human decision making, leads to egregious errors in real world implementation of such models (Bernartzi & Thaler, 1995; Daniel, Hirshleifer & Subrahmanyam, 1998; Sen, 1977). While individual mistakes or biases in rationality are supposed to "average out" and preserve market stability, social or group biases do not and often lead to vicious feedback loops that create market bubbles and unrealistic speculations. Examples of these are:

(1) The speculation of real estate prices to continue indefinitely on an increasing trend in the U.S- with banks loaning individuals money for second and third houses based on such a projection, with the resulting real estate market crash and scandals in the U.S banking industry.

(2) The procuring of loans/deposits by dangling unrealistic interest rates to investors and then being unable to roll-over or sell the accumulated debt to the free-market in the case of Iceland.

Again, in both examples, "scale" matters. In the case of the U.S., there is the somewhat unchecked ability to sell accumulated debt to investors like China and even the E.U., under the assumption of a large economy balancing itself out in the future. The fact of the matter is that the accumulated debt of the U.S stands at close to $15 \times 10^{12}$ $- and to comprehend this order of magnitude, one would have to know that this is almost equal to one-quarter of the entire world's gross domestic product (GDP). In the case of Iceland, the accumulated debt when scaled down to the individual level is seen as unsustainable with the imposition of harsh conditions by bigger economies in the E.U. The hypocrisy of the world on these two contradictory conditions is hopefully not lost on the reader.

Leaving aside modeling scenarios and economic realities, there are newer groups within the Nordic world that are drawing their attention of the community outside through their publications. I will not attempt to be comprehensive and only mention those that have consistently reported on their research in journals and books or other web-based media.

These are:

(1) Agder (Norway)- LCM,TBM [School based teacher development projects]

(2) Umea (Sweden): Re-conceptualizing reasoning [with the larger goal of impacting items on national tests]

(3) The "Finnish" School of Beliefs: MAVI conferences and numerous publications of this group[operating under a very consistent paradigm within psychology; Reliable beliefs instruments are available]

(4) Gothenburg (Sweden)-NCM: Curriculum development, professional development, textbooks, bibliographic repository of mathematics education books.

The characteristic epochs of mathematics education are found in the different paradigms used by the various groups, which range from good old fashioned (German) Stoffdidaktik to psychology to social sciences to postmodern critical theory.

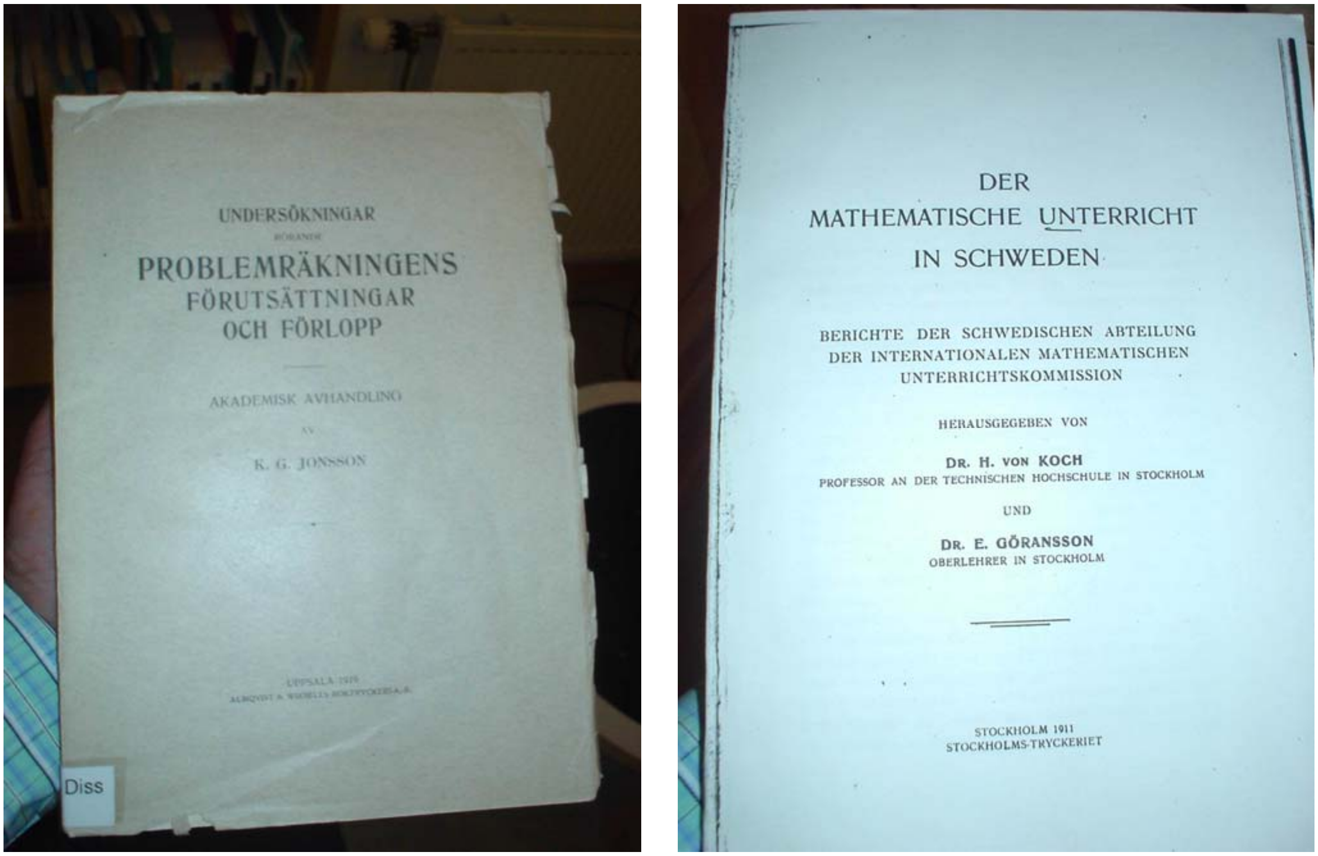



Figure 3: [Left] Doctoral dissertation of K.G. Jonsson- Uppsala University, 1919.
[Right]: Mathematics Teaching in Sweden- ICMI Report (edited by H.von Koch & E. Göransson), 1911

Mathematics education "research" is often viewed as being in its infancy by many Nordic researchers when they compare themselves to the Anglo-American world. The fact of the matter is that some of the oldest dissertations on the didactics of mathematics, as well as textbooks dealing with the pedagogy or psychology of arithmetic are on par with the work done in Germany until the 1920's. This is particularly true of the Swedish milieu, where one finds the influence of psychology developing in Germany prior to WWI in several dissertations in addition to reports compiled on the state of the art of mathematics teaching under the auspices of the International Commission on Mathematics Instruction (ICMI) formed in 1908. On a visit to the NCM in 2010, I was pleasantly surprised to find these historical documents very much intact [see figure 3][5].

[5] The author thanks Bengt Johansson from NCM for his hospitality, the arranging of time at the NCM Library and his permission to photograph archival material.

**Re-scaling Nordic Mathematics Education Research- Looking Ahead**

In the last decade there has been a dramatic increase in the number of doctoral recipients from the Nordic world, partly due to the inception of the Nordic Graduate School, a Supervisory Board, and External Experts invited to lead summer and winter graduate courses with cohort groups of doctoral students from different institutions participating in this a là carte program. The journal *Nordic Studies in Mathematics Education* has regularly featured articles and reports featuring the work of the new doctoral recipients. Many of the dissertations are from institutions that accept a dissertation via peer reviewed publications as opposed to the traditional monographs. There is diversity in the topics addressed in the dissertations as well as fluctuations in the quality of the dissertations. For instance, some dissertations by publication feature articles that have been published in peer reviewed journals with low acceptance rates, and there are others that consist of articles that have appeared in conference proceedings with high acceptance rates. One of the salient features of many dissertations is that most of them are written in English, and it is evident that students receive considerable support from the professional societies in place in the Nordic countries, much more so in comparison to the lot of graduate students in the U.S or U.K for that matter.

However, the considerable flexibility given to students to take a là carte courses at different institutions as part of their doctoral programs in the Nordic world is due to the fact that not all institutions possess a core group of mathematics education faculty necessary to run a program within their own institutional structure. As a result there is reduced or no emphasis on “core” knowledge, particularly quantitative paradigms, and although the programs are flexible they are under the whims of funding bodies. So, if a summer school or winter school gets cancelled, students have to wait to take a particular course, or substitute whatever is available. This has resulted in wide fluctuation in quality of dissertations. There are inconsistencies in the standards of institutions seen in doctoral dissertations.

There is also the tendency for home grown theories to develop without coherence or intertextuality to existing research reported elsewhere. Some dissertations utilize frameworks that are theoretically tenuous with over generalized claims and poor empirical grounding. There are self correcting mechanisms in place such as having critical opponents at defenses to help in the quality control mechanism, but in some cases it happens at a very advanced stage of a student’s dissertation, resulting in unpleasant circumstances for the student as well as the supervisor. On a larger scale, Jablonka & Bergsten (2010) critique various modes of theorizing, diverse enough to cover the spectrum of existing ”theoretical” trends in mathematics education, such as the PISA framework and the theory of authentic task situations (developed in Sweden), among others. In their article they point to definitional weaknesses in the notion of “mathematization”, and the dubious operationalization of constructs that are supposedly measured in PISA. The theory of authentic task situations is criticized for the arbitrariness of categories (or aspects) chosen in that operational framework, and an argument is made to show that relationships drawn between categories in this theory appear vague as well as empirically tenuous.

As stated earlier, the Nordic mathematics education research community also has its own journal *Nordisk Mathematikk Didaktikk* (also known as NOMAD or *Nordic Studies in Mathematics Education*), supported by the staff at NCM. The journal has experienced episodes over the years with its regularity and accessibility. This has led to many PhD students publishing their research in outlets outside the Nordic world, and the journal not being able to sustain itself due to the fluctuations in submission rates. It is also problematic that the journal is not indexed in any of the standard databases that provide access to those on the outside. However, indexing comes with the caveat that the journal be able to produce issues on a regular basis. Journal articles from NOMAD are not frequently cited in journals outside the Nordic world- this has slowly begun to change with a new generation of researchers that are actively publishing in journals outside the Nordic community. Then again there is the tendency to ignore important citations within their own scientific culture, and instead cite the perceived mainstream for the sake of pleasing the gatekeepers of journals.

The most troubling development that I foresee for the Nordic community of researchers is increased pressure from their institutions to publish in ISI listed journals for the sake of furthering their institutions ranking within arbitrary schemes such as the Shanghai World Ranking of Universities, or for the sake of procuring extra-mural funding from external bodies that value citation counts. The basic purpose of citations is to lend credence or persuasion to a scientific idea with the idea of communal ownership (Sriraman, 2011a). Citations have an inherent duality- they are rhetoric because they establish links between bodies of scholarship, between the ideas in articles, sometimes even transforming or contradicting the original ideas. On the other hand they also serve to reward certain authors for the precedence or pecking order to a scientific claim or idea or finding (Cozzens, 1989).

The corporatization of universities in the Nordic world by borrowing or mimicking trends seen “across the (Atlantic) pond” does not bode well for scholarship or the basic purpose of academia. A system of rewards based solely on publishing research could prove particularly detrimental to researchers in mathematics education that engage in time consuming and sustained professional development with in-service teachers in schools, or those that engage in developing appropriate curricular materials for students- but are at Institutions that do not value such work in comparison to published research. Figure 5 depicts the vicious cycles that plague colleagues at institutions in the world, where the mantra is “publish or perish”.

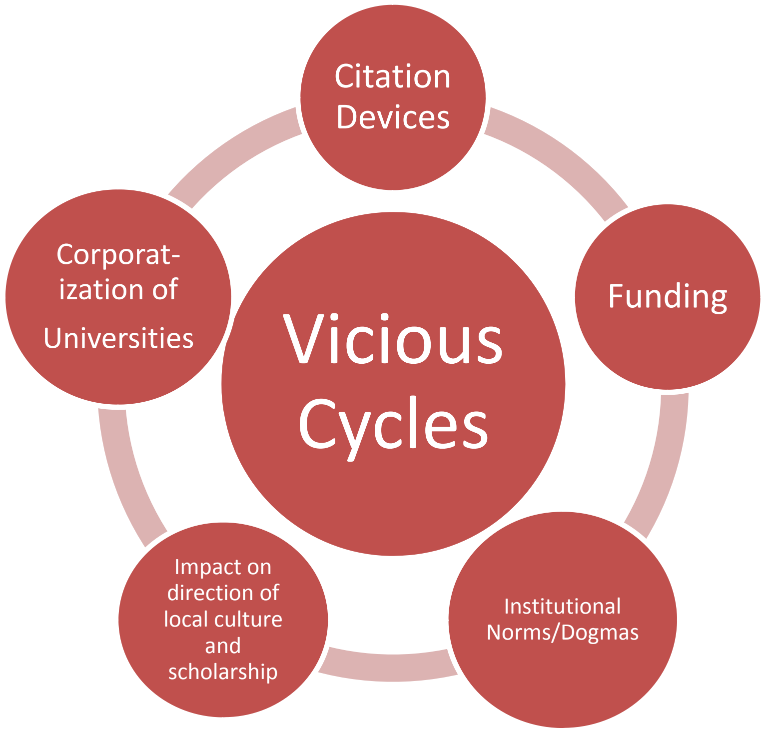



Figure 4: Factors impacting Scholarship at Universities

The Nordic world of mathematics education research is currently in a position where it can impose the “scale” of its own choosing. Only time will tell if the Nordic countries sustain their spirit of co-operation with one another, and the sharing of resources or whether they also succumb to the whims and vicissitudes of the competitive market economy. The goal of mathematics education is hopefully not to out-rank or polarize each other in arbitrary assessments, but to create a mathematically suave and literate society capable of solving its own problems- economic, social, migratory, political, or otherwise.

**Acknowledgements**

The author thanks Gudbjörg Pálsdóttir ,Guðný Helga Gunnarsdóttir, Freyja Hreinsdóttir, and the NORMA organizing committee for the honor of delivering a plenary at NORMA 11.

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