

Is educational research in university mathematics possible from a global social perspective?

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Are the problems in university mathematics education really that important compared to the catastrophes of famine, war, terrorism and exploitation of countries in Africa, Asia and Latin America? What do the political debates tell us? What are the realities in the departments of mathematics?

Pictures and interpretations and mathematics education

I live in Denmark, one of the richest countries in the world, a small democratic kingdom in the western world. I am a white male living in a welfare society with all the commodities of the western way of life based on mathematics, science and technology. I have free access to education even to all the universities, I have free access to medical care, I live in a peaceful neighbourhood, I can walk on the streets in the middle of the night without any fear of being attacked in any part of my city, I will not have to sell my home or change my life drastically if I loose my job, I have never starved, I have democratic rights to vote and to participate in political life, I do not risk discrimination or being arrested at random. I live in a country where everybody gets what he or she needs and deserves. This is one picture of Denmark.

How can I, as a Ph.D. student in university mathematics education, do research in such a country? Three kinds of answers come to my mind. I can deny or ignore any relation between the larger society and mathematics education. I can also choose to believe that mathematics education is one of the basic institutions that are crucial for all the welfare in my society. One way to proceed from these first two kinds of answers could be to study how the individual learner of mathematics learns mathematics and how this learning can be more effecient. This could easily be done in relation to university mathematics education. I would be at ease with myself if I could believe this picture and these interpretations of this picture of Denmark (and at the same time forget about the rest of the world), and I would gladly do my job as a researcher in mathematics education. It would certainly make my job easier and less stressful. But, I *cannot* believe this picture, and this is the third answer - rejecting the picture and the two interpretations.

Another way to experience my country is to take a walk in the red-light district near the railroad station or simply take a walk down the main shopping street. There you *will* notice the junkies and homeless people that nobody wants. They get pushed around between different places in the city. Some of the homeless and alcoholics used to drink their strong beers near a traffic junction in the middle of Nørrebro where a lot of people pass by. They used to sit there peacefully, (at least as peacefully as you can be being an alcoholic and having lots of other problems), until the authorities took their bench. They simply

removed it. Now they are at another place where they do not ‘disturb’ the people that have a job and who ‘contribute’ to ‘our’ society. These people are near the bottom of our small peaceful society, but they are not alone down there, the others are just harder to notice, but they are there - for numerous of reasons. They are being rejected by the peaceful, democratic and just Danish welfare society, they are not considered good for anything (other than trouble and someone to spend ‘our’ money on).

I am concerned about this development and I want to understand what is going on and I want to do something. As with the other picture of Denmark there are different interpretations of this picture, which give me different answers to my question. Some try to tell me that this picture has *nothing* to do with mathematics education and especially *university* mathematics education; others try to tell me that what ‘we’ need is *more* and *better* mathematics education. Still others try to tell something like what is mentioned in the aims of this MES-conference: “Mathematics qualifications remain an accepted gatekeeper to employment. Thus, managing success in mathematics becomes a way of controlling the employment market. Mathematics education also tends to contribute to the regeneration of an inequitable society through undemocratic and exclusive pedagogical practices which portray mathematics and mathematics education as absolute, authoritarian disciplines.” I believe and share the concerns of this last voice, but unfortunately that does not answer my question about university mathematics education.

Yet another way to experience the world (and not only Denmark) is to take a plane from inside to the outside the Western World (or more correctly from inside to outside the industrialised world and it’s holiday resorts in the sunny or ‘exotic’ parts of the not-so-industrialised world). Here you can meet hunger, war, serious environmental problems, cultures being destroyed, peoples and countries being plundered, torture - disasters and crimes of any kind.¹ (Well - not personally - you probably have a nice room in a hotel and a return ticket to your home country in your pocket.²) What are the problems of Denmark compared to these problems of the world?

I hear the same kind of voices again. Whispering different suggestions in my ear - mathematics is the hero of civilization or mathematics is innocent. They continue – whispering seductively – ‘these problems that you see are only small errors in the system and if only people would not resist the system these errors would be fixed easily.’ But I can also hear other people, for example in

¹ I would like to mention only two numbers, namely the number of 1.200.000.000 and 7.000.000. The first is the number of persons in the world today that daily have under 1 dollar to live on. The second is the number of *children* that die every year of hunger, compare this number the 5.000 people that died when the WTC was destroyed.

² This comment could be applied to what I am doing here; in some sense this paper is also exploiting the people in hopeless situations.

the field of ethnomathematics³, that try to tell me a more critical story: “The critical strand [of ethnomathematics], for example, is not just interested in the mathematics of Angolan sand drawings and their use in story telling, but also in the politics of imperialism that arrested the development of this cultural tradition and in the politics of cultural imperialism that discounts the mathematical activity involved in creating Angolan sand drawings. The critical approach views ethnomathematics as a counter-approach to both the “exotica” strand and to Eurocentrism in mathematics education.”⁴ These voices say that mathematics and mathematics education might not be innocent and might not be our hero and problems might not just be errors, but mathematics and mathematics education might have something more substantial to do with all these problems.

So what?

But here I am - in Denmark! What can I do in university mathematics education in Denmark that does not make me feel ridiculous because I feel I am helping reproducing structures that produce all these disasters? I am not sure, but one thing I know is that I would be choosing, not as a Ph.D. student in university mathematics education. But I would be choosing as a *person* (or citizen), with these things on his mind, to be a Ph.D. student in university mathematics education *because* maybe that could make a difference in relation to the problems of global and local society.

Then let me try to choose. First of all I refuse to accept the first picture as a picture of the world I experience, I find the two other pictures of the Danish society and the global society much more convincing. The questions are now, how should these pictures be interpreted and what kind of research do these interpretations suggest. In the next section I will try to listen more carefully to some of the voices that try to convince me that mathematics is innocent or a hero. Here I will only briefly try to sketch why I do not feel that the voices, telling me a more critical story, are telling me much about the universities.

If I look at the second picture of Denmark and the aims of the MES conference, I see concern for the people that are learning mathematics, identifying structural problems: “mathematics qualifications remain an accepted gatekeeper to employment.” and “Mathematics education also tends to contribute to the regeneration of an inequitable society through undemocratic and exclusive pedagogical practices”. These two problems focus on the structures of the society, which I think is a good place to look put focus. But if I look at the university mathematics education with these problems in my mind, I find that the employment market is very small for mathematicians, and that the number of persons that would be my focus would be very small.⁵ This argument

³ See for example (Powell and Frankenstein, 1997) and for a discussion of ethnomathematics see for example (Vithal and Skovsmose, 1997).

⁴ (Powell, 1998, p. 45)

⁵ Approximately 100 persons get a university degree in mathematics every year in Denmark.

presupposes that I am focusing directly on the students and not thinking of the inequalities that university mathematics education could help reproduce indirectly, for example through the later activities of the students after they graduate. The same argument can be used against the second problem.⁶ So, the conclusion is, for now, that it is not clear what kind of research in *university mathematics education* that the ‘MES-aims’ suggest.

The second inspiration is that of ethnomathematics and similar kinds of research. Well, what about ethnomathematics applied to university mathematics education in the western world? A counter-approach to the eurocentrism in a European mathematics education! This sentence seems to be a contradiction in terms, and again I am left without answers to my question.

Lastly I would like to mention critical education, represented by for example Peter MacLaren⁷ and Paulo Freire. I share their concerns, but the problem is here that they are not saying much about mathematics and nothing about university mathematics education. So, at best this is inspiration for a new way of doing research in university mathematics education. Compared to the loud voices of the ‘normal’ research this voice is very weak.

What I end up with when I reject the first picture, which would otherwise give me a good idea of what kind of research that I could do, are some inspirations that either seem not to be transferable to universities or that are almost too vague to be directly useable.

The problems of the researchers

So, either I give up or I try to listen more carefully to some of the voices. I must admit that I am close to giving up, but I will try to listen.

I have not been able to find much research focused on university mathematics education⁸, and what I have found totally ignore any discussion of the larger society that these educations are a part of. For example the ZDM index includes a subsection of “Teaching methods. Classroom techniques” devoted to universities (D45), but not a subsection of “Objectives of

⁶ It would also apply to some of the research of the critical kind for example (Skovsmose, 2001).

⁷ See for example the foreword by Peter McLaren in (Castells et al, 1999)

⁸ Not much research in the area of university mathematics education is going on in Denmark, but for example there is (Winsløw, 2000) and there are a few PhD. students. There are some developmental projects (10 projects in mathematics funded by CEDUS alone), these include an attempt to integrate Maple in courses at the University of Copenhagen and the development of Internet based material for courses in statistics at the University of Odense. This information was retrieved from <http://www.dcn.auc.dk/Research/udviklingsprojekter/udvikpro.htm> the 27th of September 2001. Internationally there is some research, see for example Tall (1991) and the papers from PME 24: (Bezuidenhout and Olivier, 2000), (Chin and Tall, 2000) and (Ubuz and Kirkpinar, 2000). Though the discussion document of the ICMI-study “On the Teaching and Learning of Mathematics at University Level” (ICMI, 1998, p. 57-61) does recognise some of the aspects of the relations between mathematics and the larger society.

mathematics teaching” (D30) devoted to universities. By ignoring these discussions, I believe a certain concept or idea of ‘good’ research in this field is constructed in a ‘hidden’ way. This construction implies that the referred kind of research can take place and get funding easily without any justification and my question can only be asked and to some degree be accepted as relevant with a much longer argumentation.⁹

Furthermore, if I turn to the mathematicians, I see that they are supporting this kind of research. They are telling me to listen to the other researchers in mathematics education. Why?

The mathematicians problems

Some of the problems that I have heard talked about, listening informally to some of the voices in my department of mathematics at the University of Copenhagen, are economic problems and pedagogical problems. The first kind is caused by the decrease in the number of students studying mathematics¹⁰ and the second by the fact that the student population is becoming more heterogeneous¹¹ and that the students lack motivation. The first problem is obviously a problem, since economic problems will mean less funding for the researchers in the department. The second problem consists partly of increasing difficulties teaching at a level where as many as possible benefit and partly of many students having trouble passing the exams. (Furthermore, there is also the problem of many students studying in too many years, but this problem only became a serious problem for the department when the department was evaluated externally.)¹²

What I think is characteristic of these problems is that they focus on economics and on the individual students. Again, this focus draws attention and funding away from what I think are important problems in university mathematics education. For example, there is not much attention on mathematics itself; no one asks why there is such a thing as university mathematics education, or what kind of mathematics should be taught or takes seriously the relation between mathematics and the larger society. The focus is

⁹ For example when I am trying to tell my story at the ‘Center for Naturfagsdidaktik’ at the University of Copenhagen I am met with confusion and disbelief, and at the same time people are telling me about their projects where they try to figure out how to use IT-technologies in the mathematics education, or try to figure out how a certain concept is learned and try to show that it is cultural-independent by comparing with students in Uganda. What is the rationale for these studies? And why can they get away with that so easily when I cannot?

¹⁰ In Denmark some of the funding of the universities are partly dependent on the number of students.

¹¹ This means that there is a group of about 20% that finds learning mathematics easy and a group of about 80% that has difficulties, at least according to some of the lecturers in the department.

¹² See (Evalueringscenteret, 1999).

on how mathematics should be taught so that more students want to study mathematics and so that they complete their study faster and so that they become better mathematicians. Of course, there are structures that have been decided by politicians that constrain the actions of the mathematicians and educators, but other reactions are possible. Furthermore, I take very seriously the cultural and ideological environment of the larger society that university mathematics education is a part of.

This identification of certain problems is not innocent. It has caused different actions to be taken, that tells me a certain story of what research in university mathematics education should be and what I ought to do to be a 'normal' researcher. For example, there is a suggestion of making elite courses and normal course to accommodate the problem of a heterogeneous student population. There has also been build a Centre for Science Education¹³ (science includes mathematics in this context) with research and development of the mathematics education to make it more 'sexy'¹⁴ and thereby attracting more students and motivating the students. This is not innocent because the group consisting partly of mathematicians has the power to get funding and attention for their ideas, which again gives more power to the groups that like to think of research in mathematics education as finding out how to get more and better students through the education system faster.

This points to research in university mathematics education that I will call research in 'efficiency'; more students, faster and better. And this is why they support the researchers in mathematics education.

But all these economic and pedagogical problems cannot be understood without a look into the political debates (and decisions). I believe it is important to understand the larger ideological and cultural movements that the university mathematics education is a part of. It is not sufficient to look at the institutions as if they were disconnected from the rest of the society.

The problems of the politicians

I have chosen to listen more carefully to some of the discussions of the role of the university in Denmark. I have tried to understand the kinds of arguments and understandings of the universities and society. The reason for this choice is that it is difficult to find any discussions of the specific role of the university mathematics education in Denmark, so I tried to look a little more broadly and focus more on the university education and society, though science and mathematics education are subject to some discussions. Another reason is that it is partly a political decision what kind of universities and what kind of university mathematics education there are, and these voices are dominant in the discussions, so these voices are very important to listen to and try to understand.

¹³ The centre's homepage is <http://www.naturdidak.ku.dk>.

¹⁴ As I heard one of the speakers as at the opening of the centre the 27th of March 2001.

One thing that is striking in these debates on university and society is the use of a certain idea that is always connected to the role of the universities; the idea of a knowledge society. This idea is used to refer to the kind of society that we live in (at least in the western world) and by connecting to the universities via the idea of knowledge a certain perspective on universities is constructed that dominates the debates. The idea comes in the different versions. As with the concept of *a learning society* in Michael Young's *The Curriculum of the Future*¹⁵ I think of the knowledge society as a *contested concept*.¹⁶ This means that different groups in society (not necessarily political parties) with different interests try to gain the power to define the idea of a knowledge society and to connect it with other different ideas. This would help the groups gain the power to define facts, problems and solutions concerning, among other things, the university and the role of the university in the knowledge society.¹⁷ In other words, they try to make their ideology hegemonic. Some groups try to connect the idea of a knowledge society with the ideologies of business and management using ideas as production, competition, management, and markets. Other groups try to connect the knowledge society with the idea of democracy with emancipation, the risk society, and ethics.¹⁸

The typical argument goes like this: a statement that we are in, or partly in, a knowledge society, therefore the role of the universities have changed in a certain way and we, as a society, have to react responsibly to these new conditions. This is the general form of the argument, when it is presented like this it is obvious that defining the knowledge society to some extent determines the new conditions of the universities and thereby the kinds of reactions there are. What is also obvious is that in this form of argument there are *reactions*, not actions. This supposes that the universities have the role of reacting to the conditions in the society, and not the other way. This makes the university a 'service' institution of society, making sure that the right amount and kind of knowledge is produced, and *not* an institution that can critically examine parts of the larger society (including itself!). This idea of a 'service' institution nicely fits with the idea that research in university mathematics education is 'efficiency' research, that never gets critical in any profound sense, but only makes sure that the 'service' institution is as efficient as possible.

¹⁵ (Young, 1998, 137-155)

¹⁶ More correctly I think the concept is *partly* contested because the dominant part of the debates actually agrees to a large extent. But there are also many disagreements.

¹⁷ I must admit I am a little uncertain about this formulation. I do not want to think of the idea of a knowledge society as something that one can apply or use like a tool to gain power, it is more like something that is a part of the construction of the way one is perceiving the society and one's identity. I am not sure if I really end up doing what I do not want in this paper.

¹⁸ These ideas of how ideas, concepts and power interact are to a large extent inspired by Michael Apple. See for example (Apple, 2001).

As examples of different more or less contested ideas of the knowledge society I will take a look at the book ‘Universities for the future’¹⁹ and some articles from ‘Education’²⁰. Sometimes there is a small description of what is meant by a knowledge society, which normally focuses on economic aspects of the knowledge society. There are no discussions of the processes that have led to this development or the adequacy of the concept itself. It is taken as a fact that we live in a knowledge society and that this is a fact that we have to adjust to and in particular the universities have to adjust to. These kinds of description and this kind of construction of necessity are also found in many of the political policies on education of most of the political parties in Denmark.²¹

In this context economy connects to competition, markets and freedom (the Bologna declaration can be seen as an attempt to clear the way to a massive marketification of the area of university education).²² The economic description of the knowledge society is almost always followed by some kind of description of a globalisation process, constructing a link between the success of ‘our’ welfare system and how competitive our country is. And if knowledge is the most important factor for competition between countries then the success of our welfare system is depending on the success of our society as a knowledge society.

After establishing the fact that we have to react to the emerging knowledge society the writers start to draw conclusions about the role of the university. Everybody agrees that it is a very important institution and much more important than it used to be. They see it is an institution where knowledge is ‘produced’ mainly in two forms; as research results and as academic workers. Both are conceived as inputs to the private corporations that are so important for our welfare system. This means that universities, as a knowledge society, are conceived only from an economic perspective and not from a cultural or political perspective.²³ This means that changing the structure of the universities will have effects on the economy; and more importantly, it means that this is the only relation that is conceived in the relation between university and society.

¹⁹ My translation of the title ‘Universiteter for fremtiden’ published by Rektorkollegiet (Maskel and Jensen, 2001). This book consists of articles written by politicians and others.

²⁰ My translation of the title of the Danish magazine ‘Uddannelse’ published by the ministry of education, see <http://www.uvm.dk/uddannelse/> for the latest issues of the magazine (only in Danish).

²¹ See for example the Conservative Party’s paper on higher education in the global world at http://www.konservative.dk/1qp/konservativ_politik/udd00.htm.

²² See <http://www.unige.ch/cre/activities/Bologna%20Forum/Bologna1999/bologna%20declaration.htm> for the text of the declaration. There is resistance to this declaration from for example the Attac-movement.

²³ Young has identified a similar trend in public education: “they treated public education as an instrument of *economic* policy.” (Young, 1998, p. 156).

It is only at this point that the greater disagreements begin, though there have been voices at least saying something else in the meantime, among them is the minister of education Margrethe Vestager²⁴.

I think this focus on the university as one of the important producers of knowledge and thereby one of the crucial institutions of our knowledge society, is supporting the idea that university mathematics education is one of the heroes of our society. It is also a focus that to some extent ‘fits’ with the suggestions from the departments of mathematics, and thereby giving power to this conception of a knowledge society and to the construction of ‘good’ research in university mathematics education.

The progressive suggestions

As I mentioned before the knowledge society *is* a contested idea. There are more ‘progressive’ conceptions of it, even the minister of education could be said to be progressive since she is talking about democracy and citizenship, but let us have a closer look at some of the ideas that *are* getting support from the progressive side.

Individual ethics is replacing politics

One problem that is felt by educators is that chemistry and other sciences have lost their innocence (arguably they did that a very long time ago). This loss is believed to be manifest in the protests and criticisms of genetically manipulated plants, nuclear power, cloning and so on. There have been roughly two kinds of reactions to this loss, the first is to arrogantly say that the common woman and man have not understood anything and the solution is to explain it to them better. The other, more progressive reaction, is to argue that what we need is more ‘ethics’. In some cases this is interpreted as a need for courses in ethics, for example related to the use of biotechnology for different purposes. Would that be a good suggestion for university mathematics education as well?

In my opinion there are potentially four things wrong with this conception. Firstly, it could mean that ethics replaces politics, reducing political decisions to individual ethical decisions. That could corrupt the political system and supporting a focus on, and a certain conception of individuals and their responsibility. Secondly, potentially it could very well in practice be a course that was completely separated from the rest of the curriculum and that did not open a discussion of the relations between mathematics and society. With these comments in mind, I think it would not be impossible implement this idea in a direction that would make sense in a global social perspective. Thirdly, it could be a course that enhanced the picture of mathematics as a hero or as innocent. Lastly, it might not be the right place to implement progressive ideas, since the

²⁴ Now former minister of education. The liberal conservative party is now in power after the election the 20th of November. The new minister of education is the Ulla Tørnæs from the liberal party (Venstre).

effects of a progressive course in the ethics of mathematics could be absorbed by the ideological and material conditions in the larger society. As an example think of the mathematician refusing to work for the military because she finds it unethical, then another mathematician will take her place. So all she can do is to ignore her own ethical considerations or become jobless. So, with the present discourses in the universities and society I think it would be very difficult to implement the idea in a sensible way, this is a serious challenge.²⁵

Project or group organised studies

This is one of the suggestions that are often heard from more progressive educators. In Denmark there were established two universities in the seventies that focussed on project work in groups. The 'Right' and industry considered them with suspicion, and I think they had reason to do so, because one of the aims of these universities²⁶ was to educate citizens and not only workers. But what have become of these universities now 25 years after the optimistic beginning? They have become the *best* suppliers of workers *because* they focus on project work in groups and the old universities more or less try to copy their ways of organising the educations.²⁷ To me, this story shows how progressive work can be corrupted and finally more or less taken over by groups with an opposite perspective.

Then what?

If I again try to concentrate on the picture of war, famine and plundering, I feel I am somehow wasting my time looking for answers to my question. This paper might be called some kind of obscure research in mathematics education, but is it 'serious work' from a global social perspective when I know that every day that I am considering my question thousands of children die from hunger?

I do not find it possible to answer my own question, nor do I see any easy way of answering it. Instead the uncertainty and insecurity might be a more profound condition for working from such a perspective in the world as it looks like today. Maybe the hope of answering the question with certainty is part of the kind of research that I do not want to be a part of. I do not know, but let us keep hope with us!

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²⁵ Also the present debate of a mandatory introductory course in philosophy of science (or mathematics) in the universities in Denmark would be interesting to discuss, since there are many groups with much different agendas interested.

²⁶ Actually they were 'University *centres*'.

²⁷ In (Kjersdam and Enemark, 1994) there is a presentation of Aalborg University as a success in the sense that they supply the employment market with some of the best workers.

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