

How can you popularise mathematics? Why is it difficult to popularise mathematics?

Seminar about popular science and mathematics NCM 29th of April 2009

Attending the meeting:

Marcus du Sautoy, Prof of Public understanding and mathematics, Oxford University

Jana Madjarova, on the board of Swedish association of Mathematics (SMS), Gothenburg university/Chalmers,

Nils Dencker, Prof of mathematics, Chairman of SMS, member of Royal academy of Science, Lund University

Torbjörn Lundh, Chairman of Swedish Committee on Education in Mathematics, Associate Professor of Mathematics, Gothenburg university/Chalmers

Ulf Person, Professor of Mathematics, Gothenburg university/Chalmers, editor of newsletter of SMS, European Mathematical Society, and the journal *Normat*.

Bengt Johansson, Director of National Center of Mathematics education (NCM), Gothenburg university

Anette Jahnke, organizers of the seminary, NCM

Ola Helenius, editor of *Normat*, NCM, Jesper Boesen, NCM, Lars Mouwiz, NCM

Lars Gustafsson, NCM.

Ola: The Mathematics Delegation from 2004 had four main proposals to improve mathematics education in Sweden. The very first proposal concerns raising the awareness and interest in mathematics, see in English <http://kollegieblocket.ncm.gu.se/node/127> and in Swedish <http://kollegieblocket.ncm.gu.se/?q=matematikdelegationen>
This meeting today are focusing on: How can you popularise mathematics? Why is it difficult to popularise mathematics?

Torbjörn: Sometimes it is in the nature of mathematics that makes it difficult, the terms and symbols. How should you tackle that you might need to adjust the truth in order to give people a chance to understand? I am thinking of the episode in your BBC series, that a plum weights four grams. You needed to actually use a Chinese weight system – which might be ever more confusion. Instead you chose to used grams – but all know that a plum weigh more than four gram. So, there was another problem. How to do this? Correct or make it possible for people to understand in some sense?

Marcus: When doing popularisation it is important to tell the truth, but there is a balance. I have learned a lot while trying to popularise. Dialogue and feedback is important. I have editors, which plays that irritating reader or viewer. Hilbert said *A mathematical theory is not to be considered complete until you have made it so clear that you can explain it to the first man whom you meet on the street.*

But you talked also about the terms and symbols of mathematics as a problem but I do not think it is not just that. Today people can grasp words like "cell" and "DNA" why do they get panic by words like "derivative" ? I have actually heard they talk very casual and natural about prime numbers in a radio program - that is one of the goals. Other sciences are like many different castles while mathematics is like a pyramid. Here could be some problems.

Ulf: One word or concept which every ones know and which is highly complicated is "human body" or "cell". We do not have this common known words or concepts in mathematics.

Torbjörn: Another problem is that understanding or not understanding mathematics seems by people to be close to the core of ones personality which makes it even more sensitive

Marcus: We need to connect mathematics to people's everyday surroundings. I connected the mathematics of Carleson to Ipod, see

<http://www.guardian.co.uk/science/2006/mar/24/scienceprizes.news>

Jesper: Science and mathematics it is not only subjects, it is formed by the *people* working and developing mathematics.

Ulf: Yes, in our community of professional mathematicians there are people that are timid and arrogant.

Marcus: Empathy is necessary. You need to be able to put yourself in another person's position. We are bad at this, how many of us has not been at these lectures where the lecturer lost everyone after two minutes.

Ulf: What should you do? People need to take more active role and ask questions.

Nils: It takes a lot of courage to ask questions.

Marcus: Something we are really bad at is to communicate between ourselves, professional mathematicians. One of the books I got from my teacher (which I talk about in my lecture today) when I was ten was *A Mathematicians Apology* by Hardy where he says, "*The function of a mathematician is to do something, to prove new theorems, to add to mathematics, and not to talk about what he or other mathematicians have done.*" This attitude still exist.

Nils: Look at physicists and biologists, they are much better at communicating their research to the community of researchers. They get more research funding. Chemists also have problems like mathematicians. Communication is important for getting funding.

Torbjörn: As a professional mathematician, it is unfortunately not a merit but almost a demerit to popularise or communicate mathematics.

M: During my first time in Oxford I happen to sit next to a journalist at a dinner. I told him about my research. He asked me to write an article. I did not do it, it may sound arrogant, but I did not see it as my responsibility. But do you not be funded by public money? he asked. Years later we meet again at Oxford. He remembered me and asked, you never wrote me that article! So, I started to write. I got a lot of help from journalists. I expected critic after writing my first article. I got two letters, one very arrogant from Ms Quick. When I meet a colleague in History in the lunchroom, he asked if I got a letter from Ms Quick yet? I guess you have to get used to critic both from the public and your own community.

Torbjörn: I got a lot of criticism when I had just done my thesis. I had to write a short version in layman terms, which was blown up in newspaper and media. In our community, and as a young mathematician, I got the reaction "who do you think you are?"

Marcus: But it is changing. The Universities need to get students. We need to be proactive.

Bengt: I have two questions, in mathematics metaphors are used, can you reflect on that? Good or bad to use? The other question is that in UK you have "undergraduate ambassadors" who come to a local school and participate in classrooms. Should we do this in Sweden? See, <http://www.uas.ac.uk/>

Marcus: Metaphors can simplify but also confuse. It is a very powerful way to communicate. Riemann's zeta function is difficult. I asked myself what do the do who study this? I created the metaphor "landscape" and the prime interest to the mathematician is to investigate sea level in this landscape.

With Fourier analysis you can turn to music, but also music can confuses. Imaginary numbers sounds much better than complex number, which can put people off.

Concerning the project with ambassadors it is a win-win situation. The project started by author Simon Singh. Undergraduates can practice in real life in schools, get credits and pupils can get to know a person which can be like a role model.

Jana: I want to come back to the difference between other sciences and mathematics. In other sciences you ask a question and the answer is the result, so it is easy to present to the public. But in mathematics the interesting thing is the process, the arguments and not the theorem itself.

Another thing, why do we always need to justify that we do and teach mathematics? We pose ourselves in a defensive position, this is not constructive.

Nils: The same I guess in physics? There it is the experiment, which is interesting and beautiful?

Marcus: I do think it is important to give the public a feel, and sensation that they do understand. People do really enjoy mind games. Puzzles.

Nils: The use of mathematics is often in focus. You can point at the applications. But now the government want to give the money directly to applied mathematics and industry.

Marcus: There are many different ways of presenting mathematics - the abstract science, the applications, the social, cultures and historically dimensions.

Ulf: It is important to mediate excitement to do mathematics. But it needed to be mathematics. In your book there is a lot which is not mathematics.

Marcus: When I wrote the book I started with the persons and the culture. The stories in mathematics are intriguing. Then after that you can open the door to mathematics and invite people. I imagine the reader to be anyone interested in popularise science, and with no background in mathematics.

Nils: Professors in other sciences do know very little about mathematics. This is also an important target group.

Marcus: One of my goals is to get scientist to talk to each other. That is a good start.

Torbjörn: We do not really meet each other and there are a lot of confusion about fundamentals like what we really mean by a model. But, back to the metaphors. It is an art to use. Could we use metaphor in order to communicate how it feels like to work with mathematics? Can we describe "aha"?

Lars M: Mathematics is always described with out any "subject". The human - the mathematicians is hiding. No emotions. It is like mathematics is developing by itself.

Nils: In schools people get a limited view on mathematics.

Ulf: Need to see the difference between arithmetic's and mathematics.

Marcus: We need to inspire. You do not need to understand everything.

Nils: Unfortunaely, lots of talented pupils find mathematics boring.

Marcus: Yes, when I look back. In my school we actually did some topology, axioms and so on. In literature we read King Richard The Third by Shakespeare! Even if we did not understand all of it as ten year olds, you did get a feel for the language. Why are not schools doing more of small "King Richards" of mathematics?

Ulf: An artist highest wish is to be inside his painting. How do we transfer this to mathematics – the desire to be inside mathematics?

Jesper: In the discussion we have referred to the *art* of popularising. What is the scientific way – what do research say about popularisation and public understanding? What is done? What is working?

Marcus: I am learning by doing. Media is very open for ideas. Really need to have empathy. The biggest mistake we do is to overestimate what the audience now about mathematics. Need to make the subject teachable. I have needed to develop writing skills. Actually in one article the editor put back a formula.

Jana: A formula can be beautiful, even for those who do not understand it completely.

Lars M: If you start "this is going to be popular" you will fail.

Marcus: My books should be read at the beach. They should be entertaining. It is easy for us to be too much of a teacher.

Nils: One needs to trigger the curiosity.

Marcus: I have done a TV-Series with the comedian Alan Davies. I got questions like; do you need a comedian to communicate mathematics? Yes, why not.

I got an offer to design a suit for Golce & Gabanna. How could I use this to get out mathematics? Well, I gave lectures in the suit. Now they asked me for a TV-series about cooking. Could I get this to work? I guess so.

Nils: Can you make money from this?

Marcus: Well no really. How to encourage people popularise? Why should your department value you doing this? In everything I do Oxford gets out its name and I do get grants to my department to do my teaching.

Nils: In Sweden it is a part of the third assignment of every University to inform the society about research. But very few do.

Ola: Where do we popularise? The form? Twitter, blog, books, articles and TV. What is the content?

Ulf: Have all this had impact on you as a mathematician? Your own view off mathematics?

Marcus: Yes. I have learned a lot about mathematics. I am not here to boast. The public is the important part. I had ten years of free research - but I need to do something else also besides research. I enjoy the adrenalin kick of talking live on radio.

Ola: How should we get mathematicians to write for Normat?

Marcus: This is my new goal to try to get more mathematicians to engage. It is very hard. I know that New scientist wants more articles. Need to find more who wants to write. Similar problem in UK.

Torbjörn: I had a discussion with some friend very late at a bar one Friday night. I claimed football was very random and any team could win basically. The discussion got very animated. The day after I thought that would be a nice subject to actually study quantitatively in order to show that mathematics can handle both high and low. I came up with a suggested measurement how to compare different tournaments, and different sports. It got published in Journal of Quantitative Analysis in Sports.

http://www.math.chalmers.se/~torbjrn/finalmanuscript_tournament.pdf

At that time I grossly underestimated the interest of such a question. In the issue after, a group of physicists at Santa Fe published a piece with similar conclusion but in a more “catchy” manner: European Sports are more interesting than American.

Ola: This is different you did something new with mathematics. Often we take old mathematics and try to explain.

Marcus: I got column in Times online. If you have some ideas to, please email mail. I always look for a story. A picture can do all of it.

Bengt: Mathematics education research can give you knowledge how pupils think about mathematics. This might improve the impact of popularisation and also give respect for the field.

Marcus: I have done some investigations. Variation seems the key. It has been a learning process to write books. In my first book I used the word “clock-arithmetic” and not modular. Maybe I got a little braver in Moonshine.

Ulf: Yes in one of your books you start with tuff mathematics and it gets simpler. In the book Moonshine you starts with simple mathematics and then it gets more complex.

Bengt: A teacher asked a ten year old, what number will added to 7 make 5. The child said, it's easy, $7 + 10$ is 5 - just use 12 as the biggest number, like your watch. It could be any number, he said, for example $7 + 8$ is also 5 if you use 10 as the biggest number.

Marcus: All can do math. In the TV-series the comedian and I scan our brains while doing mathematics. I was very nervous and got one mistake on the easy level. I got $8+7$ to 16 and I tried to explain it with modular instead.

Well, there was nothing special with my brain!

Torbjörn: So in school they get used to everyday mathematics, mathematics should be applied to something close to pupil's own reality. Reaction to this has been Sunday math like Sudoku. I am looking forward to see this, may I call it, Friday maths (as my football example emanating from my bar experience), from you and this comedian? We should not forget to try slipping in mathematical words in our everyday language like derivative. I think that would be a good mission for us all.