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Black Boxes and Teaching Mathematics

One of the most important points of the common self understanding of mathematics teachers is the rule that everyone should understand the teached mathematics. The use of black boxes is not allowed. In every day life school teachers resign sometimes: They hope that everyone has understood everything and go on to the next step. If students use a powerful tool like a CAS they use a black box. There is no hope that each student learns everything that happens inside a CAS (and this is good! – Why should each student learn that?) . But many teachers hope that the use of a CAS improves the quality of teaching mathematics. How should we handle this contradiction?

Contradictions are always a motivating starting point for research and discussion. In this electronical document I will outline my research results and my point of view. One main idea is to have a look at other parts of our society: Are there any black boxes acting? The answer is simple: Yes, they are everywhere. Our technological society is based on them. And what is the basic technology? Mathematics!

About these theses W. Schloeglmann and I wrote some papers about 10 years ago. One of them is published in English: J. Maasz/W. Schloeglmann: The Mathematical World in the Black Box – Significance of the Black Box as a Medium of Mathematizing, in: Cybernetics and Systems: An International Journal, 19:295 – 309, (1988).

If these theses are accepted we have to look at the typical process of teaching mathematics at school. Are there any black boxes? Yes! Each algorithm is a black box. Perhaps students understand why they are working when they learn to use them. But after some time they forget this and work with it as a black box. They put in some number and get out a new one, the result.

If this is right, the started question has to be changed. The question is no longer „Is it allowed to use black boxes in the mathematics course?“ The more exact question is: „Is it allowed to use a new type of black boxes?“ Electronic calculators and computers are from my point of view only a new type of black boxes.

From this point of view it is easier to think about CAS and mathematics teaching. It is clear for me that CAS should be used if the result is positive. I do not think that it is possible to judge about the results in general now. What „good“ teaching and successful learning is depends not only on the use (or not use) of a CAS. We have to look closely at a lot of single lessons at school. We need much more empirical studies to find general theories about teaching with a CAS.

Finishing this short overview I want to add an idea. Mathematics has a strong power to analyse (mathematical) black boxes. Put in some numbers and have a look at the output. What variation of the input causes which type of different output? Is there for example a quadratic function inside? The methods to analyse black boxes are well known but not a typical part of mathematics teaching. Why not? I think these methods give a new view on mathematics (more experimental) and offer some interesting lessons.

(see more about this idea in: J. Maasz, W. Schloeglmann: Black Boxes im Mathematikunterricht, in: Journal für Didaktik der Mathematik 1/1994)