BACK

SOME QUESTIONS ABOUT TECHNOLOGY AND TEACHING

Matija LOKAR
University of Ljubljana, Faculty of mathematics and physics,
Matija.Lokar@fmf.uni-lj.si

Abstract
Even when someone is convinced that technology should by all means be used in the teaching of mathematics, he usually asks himself several questions. How to find proper answers to them, especially when you are in the position of trying to convince someone about the benefits of such an approach? Unfortunately this paper does not bring answers, it merely presents some questions.

Introduction

In this paper some thoughts and questions concerning the usage of technology in the teaching mathematics are presented. They simply appeared to me when I was doing some projects in the connection with the usage of technology in the teaching of mathematics. Also when writing and talking about the usage of CAS in the teaching of mathematics, which I strongly advocate, I often found I was not convincing enough. The questions and thoughts are in quite a random order, far from being sorted according to their importance. Many questions are skipped and presented questions should be explained in more detail. But due to limitations on the length and as this paper is intended mostly as a basis for a discussion, it should suffice. Aditional questions as well as adittional references can be found in [Lokar 2000].

Questions and observations

Losing capabilities: Introduction of technology often leads to people losing certain capabilities - how could this be avoided when introducing computer algebra systems? Especially, how to recognize those capabilities that are

valuable? As one teacher observed: "Sure, nowadays it would be ridiculous to use a slide ruler for computation. But students who used them had a much better sense about the magnitude of the numbers." And if we identify this sense to be an important one, it is necessary to prepare activities that will serve as a substitute for gaining those capabilities previously obtained directly just by using different way of teaching.

Forbidding certain aspects of tools: Mostly all CAS have much too powerful capabilities, especially at a certain moment of teaching. It is easy to forbid using Solve for example - but does this not introduce a negative attitude from the students towards the subject as whole, expressed in thinking like "Why do I have to learn this tedious algorithm about solving the quadratic equation when my calculator solves it immediately?" or "If I am going to be allowed to use it next month why am I not allowed to use it now?" Take for example a group of students allowed to use CAS to compensate for their weakness in algebraic simplification when they are learning the Gaussian elimination. But if these weak students have to master their paper and pencil skills of algebraic simplifications later, the teachers could have a hard time of convincing them that CAS is not allowed any more.

Success in projects due to motivated teachers: There are many papers describing success in incorporating technology in the teaching of mathematics. But one aspect is often missing. Almost all projects are conducted with teachers that usually do a lot of work towards the success of the research. But when we are faced with a much larger number of teachers and many of them not enthusiastic about new ways of teaching [Lokar 1998], will the learning process still be as successful? Also a considerable amount of time is devoted to these projects. Let us assume that sometime in the future CAS and similar technology is used in the math

curriculum. Then several projects about using paper and pencil "technology" are started with similar effort and enthusiasm as CAS projects nowadays are conducted. Wouldn't those projects be successful as well?

Resistance of teachers: I have already mentioned my fear about what will happen when the teachers using the technology will not only be those who are willing to. It is remarked in [Sierpinska 1999] that the resistance of teachers to the implementation of a technology-based curriculum is probably more widespread than we can possibly imagine. In the analysis about the usage of CAS in Slovenian secondary schools in [Lokar 1998] it is observed that about 17% of teachers are categorically against CAS's in the classrooms. And if we add to them just one half of the 40% who did not respond, we get more than one third of teachers strongly against CAS in the classroom. The majority of teachers also think CAS should not be used neither at internal nor at the final external examination. Only about 10% of the answers were in favor of using CAS in the assessment.

What is mathematical knowledge: We mostly talk about knowing calculus, knowing concepts such as factoring polynomials, etc. We argue how, for example, introduction of CAS can give students better understanding of the concepts and similar (for example, [Tynan, Asp, 1998]). But what about algorithmic thinking, pattern recognition, patience, exactness and many other aspects? Do we really know what we are learning when we are learning mathematics? Aren't the processes in the human brain so complex that will lose something important if we do not learn how to for example compute the square root with pencil and paper?

Education of teachers: How to educate future teachers of mathematic? How to find the proper ratio between the time devoted to "pure" mathematics and technology in itself? Namely, when a teacher uses certain technology in the classroom, he must be more than just familiar with its

use. The hardest part will often not be to change the curricula of primary and secondary schools or even allowing the use of technology in external examinations, but a proper incorporation of technology in the faculties educating future math teachers. There are also a lot of problems with in-service training, mostly because as Waits stated in [Waits 2000] "we can not expect the teachers to make fundamental change in their teaching without adequate, ongoing support. Teachers consistently request intensive start-up assistance and regular follow-up activities."

Limitations of tools – feature of the pedagogical use: Limitations of technology are often becoming a feature of their pedagogical use. For example, it is commented in [Stacy 1999] that they have frequently exploited the fact that the default viewing window did not show the significant features of a graph. But can we base our teaching materials and ways of teaching on limitations of technology that will most probably not be present in the next generation of tools?

References

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