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Advancements In Mathematics: How The Education Could Be Changed ?

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Abstract

Mathematical activity (research, applications, education, exposition) has changed a lot in the last 50 years.Some of these changes, like the use of computers, are very visible and are being implemented in mathematical education quite extensively. There are other, more subtle trends that may not be so obvious. Should these influence the way we teach mathematics? The answer may, of course, be different at the primary, secondary, undergraduate and graduate level. Here are some of the general trends in mathematics, which we should take into account. The size of the community and of mathematical research activity, New areas of application, and their increasing significance, New tools: computers and information technology, New forms of mathematical activity such as Algorithms and Programming , Mathematical experiments, Problems and conjectures , Modeling , Exposition and popularization are some of recent trend.This paper fully focuses on some innovative techniques and recent advances in mathematical education.

Keywords--*Mathematical research activity , Computers and information technology , Algorithms , Modeling , Exposition , Popularization .*

Introduction :

Mathematical activity (research, applications, education, exposition) has changed a lot in the last 50 years. Some of these changes, like the use of computers, are very visible and are being implemented in mathematical education quite extensively. There are other, more subtle trends that may not be so obvious. Should these influence the way we teach mathematics? The answer may, of course, be different at the primary, secondary, undergraduate and graduate level.Here are some of the general trends in mathematics, which we should take into account:

1. *New areas of application and their increasing significance*. Information technology, sciences, the economy, and almost all areas of human activity make more and more use of mathematics, and, perhaps more significantly, they use all branches of mathematics, not just traditional applied mathematics.

2. *New tools: computers and information technology*. This is perhaps the most visible feature, and accordingly a lot has been done to introduce computers in education. But the influence of computers in the field of education is also changing fast: besides the design of algorithms, experimentation, and possibilities in illustration and visualization, we use email, discussion groups, on-line encyclopedias and other internet resources. Can education utilize these possibilities, keep up with the changes, and also teach students to use them in productive ways?

3. *New forms of mathematical activity*. In part as an answer to the issues rose above, many new forms of mathematical activity are gaining significance: algorithms and programming, modeling, conjecturing, expository writing and lecturing. Which of these non-traditional mathematical activities could and should be taught to students?

New Areas Of Application And Their Increasing Significance:

The traditional areas of application of mathematics are physics and engineering. The branch of mathematics used in these applications is analysis, primarily differential equa- tions. But in the boom of scientific research in the last 50 years, many other sciences have come to the point where they need serious mathematical tools, and quite often the traditional tools of analysis are not adequate.

For example, biology studies the genetic code, which is discrete: simple basic questions like finding matching patterns, or tracing consequences of flipping over substrings.

Even physics has its encounters with unusual discrete mathematical structures: elementary particles, quarks and many other ; understanding basic models in statistical mechanics requires graph theory and probability.

Economics is a heavy user of mathematics and much of its need is not part of the traditional applied mathematics toolbox. The success of linear programming in economics and operations research depends on conditions of convexity and unlimited divisibility; taking indivisibilities into account (for example, logical decisions, or individuals) leads to integer programming and other combinatorial optimization models, which are much more difficult to handle.

Finally, there is a completely new area of applied mathematics: computer science. The development of electronic computation provides a vast array of well-formulated, difficult, and important mathematical problems, raised by the study of algorithms, data bases, formal languages, cryptography and computer security, VLSI layout, and much more. Most of these have to do with discrete mathematics, formal logic, and probability.

A very positive development in recent decades is the decreasing separation between pure and applied mathematics. I feel that the mutual respect of pure and applied mathematicians is increasing, along with the number of people contributing to both sides.

How to give a glimpse of the power of these new applications to our students?

New Tools: Computers and Information Technology

Computers, of course, are not only sources of interesting and novel mathematical prob lems. They also provide new tools for doing and organizing our research. We use them for e-mail and word processing, for experimentation, and for getting information through the web, from the MathSciNet database, Wikipedia, electronic journals and from home pages of fellow mathematicians.

There is experimentation with Maple, Mathematica, Matlab, or your own programs. These programs open for us a range of observations and experiments which had been inaccessible before the computer age, and which provide new data and reveal new phenomena.

Electronic journals and databases, home pages of people, companies and institutions, Wikipedia, and e-mail provide new ways of dissemination of results and ideas.

Electronic publication is gradually transforming the way we write papers. At first sight, word processing looks like just a convenient way of writing; but slowly many features of electronic versions become available that are superior to the usual printed papers: hyperlinks, colored figures and illustrations, animations and the like.

The use of computers is an area where often we learn from our students, not the other way around. The question here is: how to use the interest and knowledge in computing, for the purposes of mathematical education? Most suitable for this seem to be some nonstandard mathematical activities, which I discuss next.

New Forms of Mathematical Activity:

- **Algorithms And Programming**

The traditional 2500 year old paradigm of mathematical research is defining notions, stating theorems and proving them. Perhaps less recognized, but almost this old, is algorithm design (think of the Euclidean Algorithm or Newton's Method). While different, these two ways of doing mathematics are strongly interconnected.It is also obvious that computers have increased the visibility and respectability of algorithm design substantially.

Algorithmic mathematics (put into focus by computers, but existent and important way before their development!) is not the antithesis of the "theorem--proof" type classical mathematics, which we call here *structural*. Rather, it enriches several classical branches of mathematics with new insight, new kinds of problems, and new approaches to solve these. So: not algorithmic *or* structural mathematics, but algorithmic *and* structural mathematics.

The route from the mathematical idea of an algorithm to a computer program is long. It takes the careful design of the algorithm; analysis and improvements of running time and space requirements; selection of (sometimes mathematically very involved) data structures; and programming. In college, to follow this route is very instructive for the students. But even in secondary school mathematics, at least the mathematics and implementation of an algorithm should be distinguished.

An important task for mathematics educators of the near future (both in college and high school) is to develop a smooth and unified style of describing and analyzing algorithms. A style that shows the mathematical ideas behind the design; that facilitates analysis; that is concise and elegant would also be of great help in overcoming the contempt against algorithms that is still often felt both on the side of the teacher and of the student.

- **Modeling**

To construct good models is the most important First step in almost every successful application of mathematics. The role of modeling in education is well recognized, but its weight relative to other material, and the ways of teaching it, are quite controversial.

Modeling is a typical interactive process, where the mathematician must work together with engineers, biologist, economists, and many other professionals seeking help from mathematics. A possible approach here is to combine teaching of mathematical modeling with education in team work and professional interaction.

- **Mathematical Experiments**

In some respects, computers allow us to turn mathematics into an experimental subject. Ideally, mathematics is a deductive science, but in quite a few situations, experimentation is warranted:

(a) Testing an algorithm for efficiency, when the resource requirements (time, space) depend on the input in a too complicated way to make good predictions.

(b) Cryptographic and other computer security issues often depend on classical questions about the distribution of primes and similar problems in number theory, and the answers to these questions often depend on difficult problems in number theory, like the Riemann Hypothesis and its extensions.Needless to say that in such practically crucial questions, experiments must be made even if deductive answers would be ideal.

(c) Experimental mathematics is a good source of conjectures; a classical example is Gauss' discovery of the Prime Number Theorem.

There are several excellent books about experimental mathematics . Programs like Derive, Maple or Mathematica offer us, and the students, many ways of experimentation with mathematics. A simple example: a student can develop a real feeling for the notion of convergence and convergence rate by comparing the computation of the convergent sums.

Mathematical experimentation has indeed been used quite extensively in the teaching of analysis, number theory, geometry, and many other topics.

There are many new software and programs in the field of mathematics education which are as follows:

Tux Math

is a completely different genre that makes mathematical learning fun with its gaming functionality. It is an open source and free math learning software for kids that help them to learn mental arithmetic by playing with the flying moon rocks which are in reality are space multiplication, division, and subtraction. All they have to do is find the answers and destroy them. This math game combo software is developed for kids between 7-13 years of age and offers them a host of missions that need calculations.

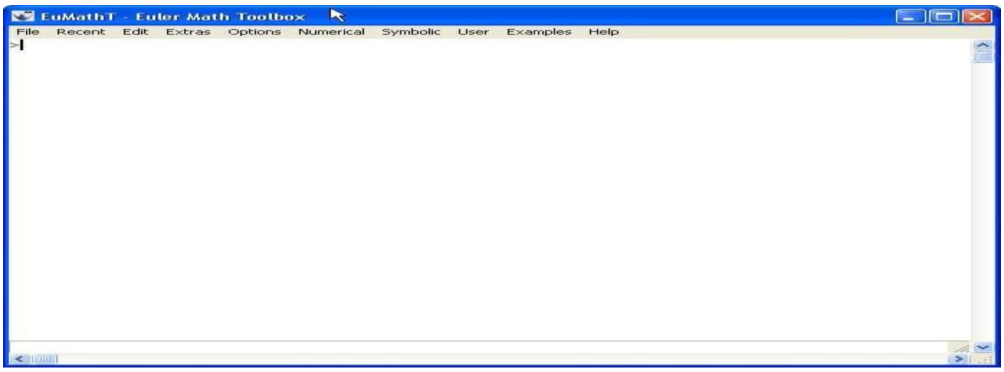
As you go higher in the level the problems get tougher and end up with a truly complex mathematical problem, like dividing negative numbers. The advanced mode offers fractions in form of asteroids which need to be destroyed by looking for the common denominator.

Gnuplot

Gnuplot is a free and open source software that is portable and runs on command-line based graphic tool. This is compatible with mostly all platforms including Mac OS, Linux, Windows, VMS and more. While it was initially targeted to help scientists and students visualize mathematical data and functions collectively, it now even supports many individual uses like web scripting.

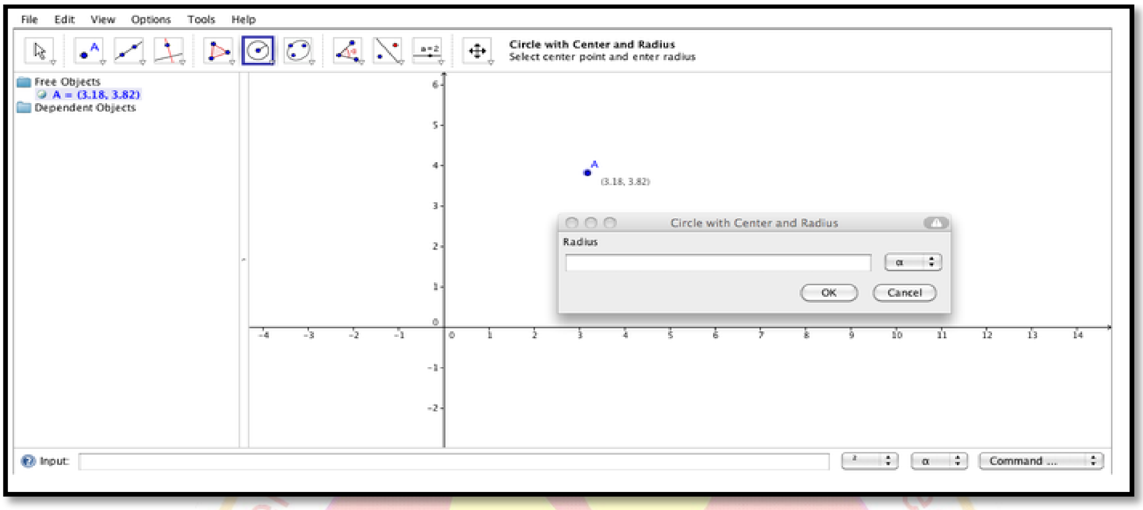
Even third-party applications like Octave use it as a plotting engine. It supports various types of plots like, 2D or 3D and can draw with the help of contours, surfaces, lines, vector fields, points and different related texts. It also supports various types of outputs such as mouse and hotkey, direct outputs to modern printers, and to different file formats like, PNG, PDF, JPEG, etc.

Euler Math Toolbox



Not just basic mathematical problems, but Euler Math Toolbox also helps you to solve any complex problems efficiently. This free math software can perform several different mathematical calculations like, multiplication, division, addition, subtraction to calculus functions, algebra, matrices and more. The chief idea behind this free software is provide everybody with a versatile tool that can help you solve almost all kind of mathematical problems.

Geogebra



Geogebra is a free math software that is useful for both teachers and students alike. While teachers can use this program to teach students, students can use it to learn mathematics. It is a powerful platform that helps students learn math effectively and solve math problems on different topics that include vectors, calculus, linear programming, algebra, complex numbers, statistics and more.

Maple :

Maple is math software that combines the world's most powerful math engine with an interface that makes it extremely easy to analyse, explore, visualize and solve mathematical problems. It gain insight into your problem, solutions,data or concept using a huge variety of customizable 2-D and 3-D plots and animations. It helps in developing complex solutions using a sophisticated programming language designed for mathematics.

GAP (Groups, Algorithms, Programs) (Version 4.4.12: Dec 2008)

Groups, Algorithms, Programming - a system for computational discrete algebra, with particular emphasis on Computational Group Theory. GAP provides a programming language, a library of thousands of functions implementing algebraic algorithms written in the GAP language as well as large data libraries of algebraic objects. See also the overview and the description of the mathematical capabilities. GAP is used in research and teaching for studying groups and their representations, rings, vector spaces, algebras, combinatorial structures, and more. The system, including source, is distributed freely.Coordinated by CIRCA at St. Andrews, UK.

Maxima:

a system for the manipulation of symbolic and numerical expressions, including differentiation, integration, Taylor series, Laplace transforms, ordinary differential equations, systems of linear equations, polynomials, and sets, lists, vectors, matrices, and tensors. Maxima yields high precision numeric results by using exact fractions, arbitrary precision integers, and variable precision floating point numbers.Maxima can plot functions and data in two and three dimensions.[a descendant of Macsyma, the legendary computer algebra system developed in the late 1960s at the Massachusetts Institute of Technology.]

Reduce:

a system for doing scalar, vector and matrix algebra by computer, which also supports arbitrary precision numerical approximation and interfaces to provide graphics.It can be used interactively for simple calculations but also provides a full programming language, with a syntax similar to other modern programming language.

Exposition and Popularization

The role of this activity is growing very fast in the mathematical research community. Besides the traditional way of writing a good monograph (which is of course still highly regarded), there is more and more demand for expositions,surveys, mini courses, handbooks and encyclopedias. Many conferences (and often the most successful ones) are mostly or exclusively devoted to expository and survey-type talks; publishers much prefer volumes of survey articles to volumes of research papers. While full recognition of expository work is still lacking, the importance of it is more and more accepted.

On the other hand, mathematics education does little to prepare students for this. Mathematics is a notoriously difficult subject to talk about to outsiders (including even scientists).I feel that much more effort is needed to teach students at all levels how to give presentations, or write about mathematics they learned.(One difficulty may be that we know little about the criteria for a good mathematical survey.)

Conclusion

I have shown a small but hope convincing selection of what the present allows and what the future holds in store.We have hardly mentioned the growing ubiquity of web based computation, or of pervasive access to massive data bases, both public domain and commercial.Whatever the outcome of these developments, we are still persuaded that mathematics is and will remain a uniquely human undertaking.One could even argue that these developments confirm the fundamentally human nature of mathematics. In the nutshell, there are many programs which could change the way in the field of teaching and learning of mathematics.

References

[1] J.M. Borwein, D.H. Bailey, R. Girgensohn: *Experimentation in Mathematics: Com- putational Paths to Discovery*, A.K. Peters (2004).

[2] S. Fajtlowicz: On conjectures of Graffiti, *Discrete Math.* 72 (1988), 113(118).

[3] S. Fajtlowicz: Postscript to Fully Automated Fragments of Graph Theory http://math.uh.edu/~siemion/postscript.pdf

[4]Discrete Mathematical Modeling, undergraduate course at the University of Washongton, http://www.math.washington.edu/ goebel/381/

[5]P. R. Halmos (1981), Applied mathematics is bad mathematics, in *Mathematics Tomorrow* (ed. L. A. Steen), Springer, 9-20.

[6] L. Lovasz: Algorithmic mathematics: an old aspect with a new emphasis, in: *Proc. 6th ICME, Budapest, J. Bolyai Math. Soc.* (1988), 67{78.

[7] L. Lovasz: One mathematics, The Berlin Intelligencer, Mitteilungen der Deutschen Math.-Verein, Berlin (1998), 10-15.

[8] S. Maurer (1984), Two meanings of algorithmic mathematics, *Mathematics Teacher* 430-435.

[9] *Modelling and Applications in Mathematics Education* (eds: W. Blum, P.L. Gal- braith, H.-W. Henn and M. Niss), ICMI Study No. 14, Springer, 2007.

[10] M. Niss: Quantitative Literacy and Mathematical Competencies, http://www.maa.org/Ql