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Abstracts of Plenary and Invited Lectures

Section:

18. Teaching and Popularization of Mathematics

A Debate on Teaching the First Years of University Mathematics

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Collegiate Mathematics Instruction for the 21st Century – A Panel Discussion

In the last quarter century two developments have occurred that have had great impact on beginning collegiate instruction in North America: a changed constituency and technology. Today a far larger percentage of 17-20 years olds attend university and nearly every program of study requires knowledge of the calculus, linear algebra and statistics; but students arrive with weak backgrounds and are not well motivated. Modern technology has provided cheap graphical calculators and computers with which the students have had exposure; television and computer games have reduced reading, weakened the ability to visualize from the written word, and have led to the expectation of immediate response and satisfaction. Deferred gratification, once common among physical science and engineering students, has disappeared. These developments have led to considerable dissatisfaction with instruction in introductory mathematics by all concerned. These attempts have led to many experiments and much debate. Since other areas of the globe are affected by these developments it is hoped that other than North Americans will participate in the panel's discussion of learning environments for the 21st Century.
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For decades there has been the widespread observation that undergraduate mathematics education is falling short. This has created an atmosphere in which all feel compelled to do something, and the world looks to mathematicians to fix the problem. Accompanying this pressure has been the explosion of technological gimmicks from graphics calculators to super computers. In response, university administrators and government agencies are supplying money to solve our problems, and numerous calculator, computer and software manufacturers are hoping to assist, and in doing so, open vast new markets.

In my presentation, I hope to consider the original problem, the public pressures, the funding issues and the industry contributions in order to examine whether this mix of concerns and solutions can improve mathematics education.

Finally I shall try to call attention to what I believe are the major, mostly unaddressed problems facing us. I shall suggest that a positive first step in reform might be the elimination of technology from calculus instruction and from all instruction prior to calculus.

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Renewal in Collegiate Mathematics Education

My presentation will start with a list of skills and attributes that prospective employers expect of college graduates – not because we are engaged in vocational training, but because these employers speak for or heavily influence all the major sources of support for the educational enterprise.

To identify problems with American collegiate education, I will contrast the desired outcomes with some of the features of our enterprise, based on demographics, ideology, unsupported beliefs and fears, lack of standards, and a professoriate highly knowledgable about subject matter, but less so about pedagogy.

In that context, I will describe the primary achievements of the "Calculus Reform Movement": getting "educators" to talk about and learn about education, shifting discussions from teacher-centered instruction to student-centered learning, and demonstrating that new knowledge can be translated into effective learning programs. In particular, I will note how recent research on the biology of the brain confirms earlier research on the psychology of learning, and how both support emerging "best practice" in pedagogy.

Finally, what is the role of technology in educational renewal, especially in mathematics? Technology is neither "the problem" nor "the solution". Rather, it is a fact of our students' lives – before, during, and after college. For the faculty, this fact presents opportunities (a) to rethink a mathematics curriculum heavily weighted (in lower-division courses) with pre-computer techniques, (b) to create learning environments that accord with best practice, and (c) to shift the primary focus in our courses from manipulation to thinking.

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