

BOOK REVIEWS

Edited by ANDY LIU

Assessing Calculus Reform Efforts : A Report to the Community, edited by James Leitzel and Alan C. Tucker, 1995. Paperback, 100 + pages, US\$18.00, ISBN 0-88385-093-1.

Preparing for a New Calculus, edited by Anita Solow, 1994. Paperback, 250 + pages, US\$24.00, ISBN 0-88385-092-3.

Both published by The Mathematical Association of America, Washington, DC 20036. *Reviewed by Jack Macki, University of Alberta.*

Anyone who attended the January 1995 joint meetings in San Francisco could not help but be struck by the contrast between the evident malaise on the research side of the meeting and the enthusiasm, energy and high quality of the discourse on the educational side.

These two books, very different in nature and content, together represent enormously persuasive documentation of the on-going revolution in teaching and curriculum design at the University/College level. They describe the past and present of reform in undergraduate calculus, and evaluate the situation in a thorough and realistic manner.

Assessing Calculus Reform Efforts is one of the best presentations ever of the history, present activities and future plans of the movement for reform in the design and teaching of the undergraduate mathematics curriculum.

The history begins with the founding of the Committee on the Undergraduate Program (CUP) in 1953. The authors describe the debate between Anthony Ralston and Ron Douglas which led to the famous Tulane workshop in 1986 (with 25 participants, four of whom were research mathematicians). They follow the entire development of the reform movement, carefully describing the key players, and the roles of NRC and NSF. They present all kinds of surprising (at least to this reviewer) information along the way — did you know that in 1985 the IEEE, deeply dissatisfied with existing texts, published a calculus book? In the nine years since that seminal Tulane conference, reform has clearly moved into a central position in the mathematical life of North America.

The effort of key individuals to convert the research community to believers (and activists) makes fascinating reading, beginning with a widely disseminated article by Peter Lax (UME Trends, May, 1990) which was highly critical of the attitudes of the majority of research mathematicians. Very determined department chairs at Stony Brook and Michigan convinced their departments to adopt reform texts. Said Don Lewis, chair at Michigan, “An NSF grant providing two months of summer salary is icing on the cake. The cake is calculus.”

The editors are very tactful in their presentation, but the lack of interest in education of the majority of research mathematicians in the United States

(and Canada?) comes through quite clearly. They present the results of four surveys carried out to date, and discuss the issue of “cosmetic” versus “real” change. The bottom line:

- By Spring 1994, three-quarters of responding departments (1048 respondents) had some reform under way, one-quarter of the respondents were conducting major reforms.
- The Graduate Record Exam has been changed to reflect reform.
- The NSF continues to fund reform initiatives at the level of about \$2.7 million per year.
- Sales of reform texts have increased to 108,700 annually (552 institutions) in Fall, 1994 (not counting the 375 high schools which use them).

The main part of this book has only 44 pages of text, and then concludes with 50 pages of important and highly readable appendices: data on enrolments, copies of surveys, text-by-text description of reform materials presently available, and a very detailed list of NSF-funded projects.

If you have colleagues who pooh-pooh the reform movement (and who doesn't?), get them started on the path to rightness with this book. If they can read it and remain unwilling to look at change, order them coffins, they probably died a long time ago!

Preparing for a New Calculus is the proceedings of a conference held at the University of Illinois in April, 1993. Eighty individuals attended, 40 of them associated with projects at colleges or universities, 25 of them associated with projects at the high school level, seven from community college projects, and eight from organizations like the MAA, NSF, NCTM, etc., and publishers.

Part I contains seven background papers, which were provided to participants before the conference. The first paper cites some impressive figures: well over 100 schools use the Harvard Consortium Project materials; 27% of all college-level calculus students in the State of Washington are in a reform course. All seven papers offer several important observations based on experience, for example:

- There is no correct way to do a reform course, there are many ways to treat calculus effectively.
- Reform courses have fewer topics with much richer content.
- The “rule of three” (graphical, numerical, analytical) should be replaced by the “rule of four” (writing) or “five” (oral).
- It is mindless to ask a student who has access to a calculator to approximate $\sqrt{17}$ using a differential, but one can instead study Euler's method for solving the logistic differential equation before the students know any integration theory.

- Reform makes *appropriate* use of technology; technology does not equal reform.
- While most mathematics professors believe that learning is transmitted (I call this the “I am God” theory of learning), most evidence points to the correctness of the constructive theory of learning, which emphasizes that most learning is constructed by the learner in response to challenges to refine or revise what he/she already knows in order to cope with new situations. Sally Berenson, North Carolina State University:

“Telling is not teaching, listening is not learning”.

- Never underestimate the importance and difficulty of educating faculty for real change. Teaching reform courses is very hard work.
- Creating a cooperative learning environment is not easy, but pays off for all students, especially minorities.
- It is very useful to carry open-ended long-term applied problems through one or, even better, several courses. At the U.S. Military Academy at West Point, they begin with a few core applied problems and proceed to attack them with non-calculus methods, leading to a semester’s study of difference equations and the associated linear algebra. Calculus starts in term two! K. Stroyan of the University of Iowa starts his course by asking “Why is it we can eradicate polio and smallpox, but not measles and rubella?”

You get the picture, there is just a tremendous amount of experience and insight available in these seven articles — and wonderful quotes: The chairman of physics at Duke, Larry Evans, when asked to comment on changes in the teaching of calculus:

“There is nowhere to go but up.”

Other important themes: downgrading of exams, strong emphasis on (and evaluation of) writing, emphasis on cooperative learning. And don’t expect all students to love the changes — students who are successful in standard courses often react negatively to being saddled with lab partners and being evaluated in unfamiliar ways. In fact, several authors emphasize that student questionnaires cannot be the sole means of teaching evaluation — one needs to talk to students who have gone down the road a way in order to get a fair picture.

The second part of *Preparing for a New Calculus* reports on the workshops, one each on the topics of content, teaching strategies, and institutional context. Each report has a long and useful list of suggestions and observations. Among them:

- Characterize and reward that which constitutes effective teaching.

- Allocate time as a resource to support involved faculty.
- Every person involved with evaluating staff should read Ernest Boyer's Carnegie Foundation Report "Scholarship Reconsidered".

The third section consists of five contributed papers of very high quality on topics ranging from calculator courses, to the gateway exam at Michigan. The final piece is a thoughtful article by Peter Renz of Academic Press on Publishers, Innovation and Technology, which should be required reading for all university mathematics professors. Many of the articles in this book have extensive lists of very timely and useful references.

All in all, *Preparing for a New Calculus* is an excellent detailed introduction to calculus reform, to be read after *Assessing Calculus Reform Efforts*. Anyone who can read them both and not be interested in and excited about reform doesn't need a coffin, they've been dead too long!

Introducing the new Associate Editor-in-Chief

For those of you who do not know Colin, here is a short profile:

Born:	Bedford, England ¹
Educated	Bedford Modern School University of Birmingham, England University of London, England
Employment	Queen's College, Nassau, Bahamas Sir John Talbot's Grammar School, Whitchurch, England Memorial University of Newfoundland, Canada
Mathematical Interests	Mathematical Education History and Philosophy of Science Nineteenth century Astrophysics

¹ Bedford is halfway between Oxford and Cambridge (just an average place).