



Calhoun: The NPS Institutional Archive
DSpace Repository

NPS Scholarship

Publications

1990-06

Calculus Reform - Revisited (version 2)

Hamming, Richard W.

Monterey, California: Naval Postgraduate School

<https://hdl.handle.net/10945/63714>

This publication is a work of the U.S. Government as defined in Title 17, United States Code, Section 101. Copyright protection is not available for this work in the United States.

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>

note

CALCULUS REFORM - REVISITED

R. W. Hamming

Naval Postgraduate School

June 1990

Serious proposals for the reform of the teaching of the calculus reach back at least 15 years. I recall attending one such meeting in New York City and deciding then that indeed reform was necessary if we were to maintain our technological and scientific excellence. It seemed to me that almost all of the participants in the conference were going to talk a lot about the emergency but in fact would do nothing in the form of producing text books which are essential if any reform is to be widespread. Therefore I decided to write a text book of the form that I felt was needed and that they were recommending. Since I doubted the sincerity and commitment of many of the speakers, and certainly the desire for reform on the part of the standard teacher of the calculus, I assigned a probability of success of 2-3% - and I was right! The book has been ignored, though it often meets many of the claims still being made as to what various speakers want.

Any one who does not recognize that we are in a crisis in this matter of maintaining excellence in science and engineering cannot read, is stupid, or simply is all wrapped up in themselves. The crisis has been discussed endlessly and is well documented, hence I shall not dwell on that aspect of the problem further.

The First David Report on the state of mathematical education in this country observed that we needed action on three fronts, (1) Government in the form of grants, etc., (2) industry support, and (3) efforts in the Universities. The recent Second David Report (whose press conference I attended) observed that progress, though not as much as was recommended, was observable in the first two groups, but that there was no perceptible change in the Universities. For the other hard sciences there has been some motion, but in mathematics none that the Report could find. Again, it is hardly necessary to document this fact further.

The question to be examined is why, after all these years, the Universities have failed so miserably (there may be exceptions here and there, perhaps). In order to answer this question I surveyed a large number of people (not a formal statistical survey but rather questioning, and arguing with whatever replies they gave to find the essential beliefs they held). I found the following, and you should not be surprised since I did not confine my questioning to mathematicians but rather to a great ex-

tent I asked fellow professors.

First, and foremost, the trouble is the mathematics professors themselves! They are said to be "researchniks" (remember a computnik seldom does useful computing). Teaching is not only ignored, it is professionally looked down on and avoided whenever possible! Yes, that is the opinion of your colleagues!

Second, though it is obvious that the situation is threatening to the mathematical community, the professors are (on the average) so wrapped up in themselves and their work that they are indifferent to anything else! Again, that is the opinion of others. It is based greatly on the fact that the mathematicians deliberately isolate themselves and contribute very little to the University as a whole, they prefer to concentrate their attention on their publications - if they do that much! The stories I heard about avoiding office hours, discouraging student interactions, being more interested in getting in their game of "racket ball", etc. would astound you. No doubt the stories were exaggerated sometimes (perhaps out of envy?) but they were told to me just the same. No department on the campus, on the average, is so despised, though at the same time reluctantly admitted to be prestigious.

University professors generally are well aware of what they feel they are entitled to from the University and from society in the form of salaries, research grants, nice offices, light teaching loads, sabbaticals, assistants, travel allowances, etc.; they are less able to articulate their obligations to others beyond "doing their thing". Again, of all departments, the mathematics department is the extreme in this matter.

Are these complaints justified? I fear so! Just consider the calculus courses of 500 students in one class taught, not by the inspiring teachers but by the time servers, with the quiz sections apparently run mainly by foreign students whose command of English often baffles the poor lost students. No wonder 50-60% flunk rates occur! To many observers the fact that the mathematics departments tolerate this is proof of their indifference to teaching that is claimed (and at times bragged about) by some mathematics professors! Indeed, this attitude is automatically communicated to the graduate students in many ways (certainly they see that in getting their degree the quality of their teaching will have no, or possibly negative, effect). Thus the attitude of service to the University and the society that pays the bill is completely missing and will stay that way in the next generation of mathematics professors.

It is also true that there is essentially one calculus text since I find only miniscule differences between those I have taught from in recent years (I often teach calculus for the Mathematics department). It is true that a number of inspired mathematicians have written good calculus books, but these are generally ignored and are not selected. The detailed contents of the course in the form of selected topics, proofs, worked exercises and problems (professor's favorites) are hardly as impor-

tant as some inspiration to the student! In the texts used one sees not one iota of all the proposals that have been learnedly turned out in the many meetings that have been held. To me it could hardly matter which new, modern approach that contained inspiration and interesting topics we adopted - any of the many new style books now available would be better than those we now use - but the committee that selects seems to be dominated by politics and not by imagination and inspiration. Why make any effort to change when that would put a burden on the professors who might have to read, think, and replan his (hers) standard lectures and of course affect subsequent courses across the campus.

I fear that after this length of time I am cynical about the intentions of most mathematics departments and of most mathematics professors - of course there are exceptions, but what we see is the result of the average behavior, and as the Second David Report states clearly, the Universities have done essentially nothing in the area of mathematical reforms that are so desperately needed - and there seems to be no reason to think that they will in the near future!

But teaching is a two way street - there are both the professors and the students. Let us look at the students. They, as we all know, have been raised on TV, where the only people they see working are the police, lawyers, doctors, nurses, and a few reporters. Most people, if they are supposed to be working at all, are clearly on their coffee break. Who works in our society? No one but a fool!

As to the value of an education, just look at what the young see, at the salaries of baseball players and other athletes, at the glamour and prestige of rock musicians (for which apparently an education would be detrimental), at the stock market swindles, at the legal shenanigans that reap the lawyer millions without regard to honesty, etc., all to the point of nausea.

It is a characteristic of the entertainment field that apparently luck plays a large role, and it is mainly the entertainers (as portrayed by the entertainment field) that is seen on the TV and in movies. The whole picture the student gets of life is instant gratification, that success is a matter of luck (and the State even encourages this with Lotteries!), that no one but a fool works at what they do not want to do at the moment. No, any viewer with much brains will see that school learning is for the fool since the corresponding rewards for it, in any form they can see, are minimal. The role models which TV presents, (of which so much is said in education and in the women's movement), currently probably outweigh all other sources. This hardly suggests that the student comes to the University prepared to major in the hard sciences, and least of all in mathematics.

So, while we may castigate the mathematics departments for their indifference, we must at the same time realize that there is a deep seated effect in the whole of our society. Ask yourself, having been exposed to the many, many hours of TV that the average student has, what do you expect of them when they hear,

quite correctly, that the hard sciences and especially mathematics, are indeed hard to master and require effort over long times. A few who are inspired and have an innate love of the topic may persist for a time, but the calculus course will probably eliminate many of them from further study, regardless of whether or not they pass. There is a saying that people get the kind of government they deserve - they also seem to get the kind of educational system they deserve.

I ask myself, "Are my attitudes and beliefs merely an effect of my old age?" When I try to be objective and talk to others I find that both young and old seem to have many of the same beliefs. One can only wonder if after this long a time of pretending to reform our science and mathematics teaching, which seems to be so vital to our society, that we will pull ourselves together (especially the mathematicians) and avoid the predicted future. Time will tell! I am deeply pessimistic.