The Faffufnik-ChaimYankel Effect: A Cautionary Tale

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This conference is historical in nature. It looks at how things have changed over time. The author of this paper wishes to examine changes in the pattern of how projects and programs are evaluated. In particular we have been asked to discuss the evolution of theoretical frameworks in mathematics education. Admittedly my own experience is primarily with programs in the U.S., notably in curriculum reform and materials production, but I believe that the trends discussed here are global in nature and represent a danger to our profession. First we will describe the Faffufnik-ChaimYankel Effect (FCE) and then give some specific instances, as we sound a warning to the field.

In the U.S. as in many countries and more global entities, in order to receive funding for a major project, one has to submit a proposal. As anyone who has ever written one knows, writing a proposal is an unnatural act. Normally literate persons are reduced to using words such as *input* as a verb, as well as *facilitating* and *orientating*, and talking about *stakeholders* and *meta-cognition*. But large projects often require large budgets and as painful as the process may be, we write the proposals and fill out the myriad forms required.

In the U.S. most of the money for math education projects that comes from federal sources is given in grants from the National Science Foundation (NSF). NSF uses a peer review process to determine which projects are funded. Panels of approximately six people are formed to review a set of proposals. The proposals in each panel are graded and compared with the grades from several other panels that are convened at the same time. The programs are ordered by grade and funding proceeds on that basis. In fact what actually happens is that on a first pass a number of projects are graded highly enough to be assured of funding; a number are graded so low that they are immediately declined; and there is a group in the middle (said to be on the bubble) whose fate is decided sometime later when the final yearly budget for these programs is negotiated. The criteria for reviewing proposals that are specifically cited in NSF guidelines are intellectual merit and broader impacts.

The Consortium for Mathematics and Its Applications (COMAP) has been submitting proposals and administering projects for over 27 years. In the ‘good old days,f’ if one had a good idea and a good staff of people to carry out that idea, then funding usually depended upon impressing one of the program officers who worked at the Foundation. Outside reviews were mostly handled by mail and were considered advisory. The bottom line was that if the NSF program officer thought a project should be funded—it was. Admittedly this created something of an old boy network. People and institutions with a good track record of success tended to continue to receive funding, while those who were not yet members of the club had a hard time joining. This has given way to the more overtly democratic process described above where the reviewers' opinions rule.

It should also be said that if one goes back 20 years or so, most of the principal investigators (PI's) on math education projects were Ph.D. mathematicians who had so to speak 'given their youth to the devil and were giving their old age to the lord'. In other words, they had taken an interest in mathematics education later in their careers. And to be honest many other math educators were persons who had originally tried to pursue careers as research mathematicians but were unable to complete their degrees. In any event, the PI's on these projects had extremely strong mathematics backgrounds.

In the U.S. at least, this has changed significantly. Mathematics education is now a well-established field unto itself and in many cases people highly successful in the field have relatively weak mathematical training. Increasingly, they are the principal investigators on new projects in mathematics education and they are the reviewers. They help decide what projects get funded and what projects don't. And increasingly they are responsible for the Faffufnik-ChaimYankel Effect. What exactly is the FCE?

Years ago a typical review of a COMAP proposal would read, "This is an excellent idea with an excellent staff with an excellent track record, we recommend this project for funding." The FCE refers to more typical current reviews that read, "This is an excellent idea with an excellent staff with an excellent track record. However, we have to recommend against funding because they don't make any reference to the seminal research papers of Faffufnik, nor do they plan to use the statistical protocols of ChaimYankel. The reviewers may very well be students of Faffufnik and/or ChaimYankel.

Of course there are some sour grapes here. I am not a member of the Faffufnik and ChaimYankel club. And now as opposed to the good old days it is members of this club who get funded. But there is much more to be discussed. There appears to be an underlying assumption here that mathematics education projects must proceed in the following way. First, they must be based upon research. Therefore, we heavily quote the results of prior research (See the papers of Faffufnik). Then based upon that research we make a new research hypothesis and test it with a small number of students. If at all possible we make this experiment as close to a 'gold standard' double-blind medical approach as possible. Then using certain statistical protocols (See the work of ChaimYankel) we conclude that there is some measurable effect and write a new proposal to test this effect on a larger population. This process is then iterated. This is now a necessary condition for funding—independent of content and the strength of the ideas being considered.

The problem is that while this may very well help to make mathematics education research be seen as more of an established discipline, it is a criteria divorced from classroom practice. And we forget that we separate our efforts in education from the classroom at our peril. There has to be a way for good ideas, that hold the promise of increasing student learning, to be funded and for good people to work on them. Math education is an art as well as a science and it cannot simply be reduced to a set of research protocols and statistical tests and procedures. It is simply not possible to prove that an approach to teaching and learning will be effective before the fact.

Education, as a scientific discipline, is a young field with an active community focused on R&D—research on learning coupled with the development of new and better curriculum materials. In truth, however, much of the work is better described as D&R—informed and thoughtful development followed by careful analysis of results. It is in the nature of the enterprise that we cannot discover what works before we create the what. Curriculum development, in particular, is best related to an engineering paradigm. In order to test the efficacy of an approach, we must analyze needs, examine existing programs, build an improved model program, and test it—in the same way we build scale models to design a better bridge or building. This kind of iterative D&R leads to new and more effective materials and new pedagogical approaches that better incorporate the growing body of knowledge of cognitive science.

To illustrate the point, we will now briefly describe two projects for which to date we have failed to achieve funding—victims of the FCE. The descriptions have been purposely left in their original language of proposalese.

Mathematics is Everywhere

Mathematics is everywhere. It is in the CAT scans at a hospital. It is in the e-mail and search engines of the Internet. It is in your hot dog; in the gasoline pump; in court; in the election booth; in your wallpaper, your fingerprints—in the genes that make you. There is no place, no object, in which math does not play a vital though often hidden part. Yes, mathematics is an important academic discipline, but it is more—much more. Mathematics is the tool for modeling our world. And it is crucial that informed citizens know and understand not only the nature of mathematics but the ways in which it helps us build modern society.

We propose to produce materials for a television series entitled *Mathematics is Everywhere*, consisting of 13 half-hour programs, as well as an associated Website and Web materials including online text, expert interviews and transcripts, applets, animations and a glossary to better enable viewers to strengthen their understanding of the underlying concepts. Our intended audience will be interested non-specialists. While we fully intend to demonstrate the nature of mathematics as a discipline, our focus will be on its important contemporary applications and the process of mathematical modeling.

We will demonstrate how mathematical ideas, once thought to be esoteric, are being applied to important timely issues. We will show how the same mathematics can help analyze and solve problems in amazingly diverse fields. We will see and talk to the people who create mathematics, the people who apply it, and the people who use it day to day. We will make clear that mathematics is truly everywhere.

Tentative program locations include: a hospital, a car, a supermarket, a stadium, a farm, an athletics track, an office, an (election) polling site, a bank, an art gallery, a power plant, a video rental store, and an airport.

NSF Legacy Project

Over the past 50 years NSF has funded a large number of programs in mathematics and science education. These programs have had a profound effect, not often captured in the annual/final project reports, other written documents, or statistical studies. In fact, current NSF program officers and administrators are by and large unaware of the impact of the programs that have been funded. In part this is due to the frequent turnover of NSF personnel in recent years and in part because much of this information is historical and anecdotal. Also, many of the benefits of a given project may not be apparent for several years after a project is first funded, maturing in future work by project staff and faculty. Sometimes small projects have had long term effects beyond what was anticipated while seemingly larger projects have not had as lasting effects as hoped. These are stories that need to be part of the record. They need to be told both so that people can understand the enormous benefit NSF has been to our nation’s science and mathematics education efforts and to let practitioners learn and benefit from past practice

Much of this information resides in the memories of project directors, program officers, faculty and student participants of NSF projects. This information/data needs to be collected before it is lost forever. NSF RFP's of the past grew out of perceived needs and concerns at the time. With hindsight we can look at the extent to which the goals of the RFP's were accomplished. In many cases the side effects that grew out of these RFP's outstripped the effects of the original actions. NSF needs to understand all the effects-primary, secondary, and tertiary-of its efforts. The successes of NSF programs in building infrastructure and capacity as well as recruiting and training generations of math and science educators must be made transparent.

We need to capture the multifaceted effects of NSF programs. Much of this can be accomplished through an interview process compiling a kind of oral history of math and science education (as it specifically relates to NSF). The impact that NSF has had needs to be documented and understood especially by NSF and the legislators who fund the Foundation.

As stated, these and a number of other ideas have fallen victim to the FCE including the establishment of a research to practice journal intended to give teachers, in jargon-free language, results from educational research that could inform and improve their classroom practice, as well as a project to create a series of modules for use in undergraduate mathematics classes which would be organized around, ‘what do you say to the student who asks….?’ The latter project would treat all undergraduates as potential mathematics teachers and use hypothetical questions to enhance student’s pedagogical content knowledge and help prepare those who chose to go on into teaching.

I wish to be clear. I recognize that Faffufnik has done important research. I recognize that Chaim Yankel’s protocols can help quantify our results. We have to learn from the past and theoretical frameworks are important for future work. But we also have to recognize that quoting Faffufnik and ChaimYankel is not a substitute for imagination, creativity, and the application of common sense. The problems of mathematics education are difficult and will require the work of many people over a long period of time. We cannot afford to lose sight of this, even as mathematics education becomes a more established research discipline.