An Alternative Course for the "I Hate Math and I've Never Been Any Good At It" Student

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We've all encountered this student. Probably his (or her) dislike of mathematics comes from his previous lack of success with mathematics courses. His understanding of what constitutes mathematics is usually limited to visions of very complex arithmetic manipulations, with perhaps some x's and y's scattered throughout.

A high school student such as this is one whose career goal probably does not include college, or, if it does, not in a discipline where any knowledge of algebra is required. This student is either unprepared for or uninterested in first-year algebra; perhaps even unprepared for or uninterested in a general mathematics course. Many states have a graduation requirement of one year of mathematics. What opportunities can we offer this student to meet such a requirement? Should he be "retreaded" in a course containing the type of mathematics with which he has already had difficulty and which aims to prepare him for a level of mathematics he will probably not use?

Some schools are trying an alternative approach by offering a mathematics course designed to awaken the student's appreciation of mathematics in his world. Facility with computation is not one of the objectives of such a course, but hopefully the student will have a better understanding of mathematical thinking in a wider sense and be aware of uses of mathematics which affect him as a citizen, regardless of his occupation.

At the college level, similar problems exist with a large number of students. Why should an English major learn how to solve a quadratic equation? Can't we offer something more appropriate to satisfy a graduation requirement? In this article, we will discuss an alternative mathematics course which we developed at Indiana University - Purdue University at Indianapolis (IUPUI). There is nothing in the course, either in content or prerequisites, which makes it necessarily a college-level course. In fact, almost the same course is offered in several local high schools. If you are interested in developing an alternative mathematics course for your own school, the following discussion may prove helpful.

In all phases of setting up our course at IUPUI, that is, in the formulation of objectives, selection of text and topics, choice of methods of presentation, et cetera, we attempted to keep in mind the special needs and attitudes of the group of students who would take the course. In particular, we anticipated that many students would dislike or fear mathematics due to past failures; would have little awareness that mathematics enters into aspects of life where, as educated citizens in a technological society, they should strive to make informed

decisions; and would think of mathematics as pretty dry and uninteresting stuff. Many of our students did indeed fit this picture, but we were pleasantly surprised at the number who really did not dislike mathematics - they simply had no need for traditional mathematics in their course of study.

At the beginning of the course, we shared with the students three broad objectives which had been formulated, namely:

1. to give you an insight into mathematics as a way of thinking, as an area of human endeavor, an art and a science that has been both useful and interesting to mankind throughout history;
2. to help make you aware of the ways in which mathematics touches your everyday life;
3. to show you that mathematics can be fun.

As part of the course evaluation at the end of the semester, we gave the students another copy of the objectives and asked how well they thought each had been met. There were surprisingly positive comments; in fact, this was overall the most highly rated item in the course evaluation.

Choices that we made in each of the following four categories were influenced by our desire to achieve the course objectives.

1. Textbook

We used *Mathematics, A Human Endeavor*, by Harold Jacobs, W.H. Freeman and Company, 1970. This is a visually appealing book in an easy-to-read format. It does not overwhelm the student, but at the same time has a number of interesting problems which do require thinking. In addition, there is an excellent teacher's guide to accompany the text, which is filled with ideas for additional discussion, demonstration, et cetera. This guide, unlike many others, is a truly practical supplement.

2. Topics

We covered the following topics from the textbook: inductive and deductive reasoning, number sequences, counting, probability, statistics, topology. In addition, we included a unit on metric measurement and one on computer science. These were done in the same spirit as the material found in the textbook. The text contains enough material to be used for a one-year high school course.

3. Course Requirements

Grades in the course were based on homework problems, a series of short tests, a brief term paper and class participation. Often, the class broke into small groups and the members of each group worked together on homework problems. There was a test after each topic. The tests grew progressively harder during the course of the semester, but the students did not seem to notice, or at any rate did not object.

We provided three topics for the term paper - Fibonacci numbers, magic squares, and the four-color problem. Each of these is a topic which is easy to understand, interesting, and about which there is a lot to say; of course, there is more now to say about the four-color problem than there was when we first taught this course! We provided a short list of references for each topic, but a number of students found additional references and wrote quite good papers. A student could also write a paper on an approved topic of his own choice. Class participation was a component of our grading scheme because it was essential to the success of the method of presentation we used.

4. Method of Presentation

This was probably the most unique feature of the course. We decided that mathematics did not need to be presented as a spectator sport, and we attempted to involve each student in an active learning experience. We never gave a single lecture in the course. Instead, the students participated in activities or experiments designed to lead them to ask questions and formulate and test conclusions. Some of the activities were individual, some were done as demonstrations by volunteers from the class, but most were done within the small groups mentioned earlier. The membership of the groups developed quite naturally, and as the semester progressed there was a lot of mutual help and support going on in the individual groups.

We used a lot of instructional aids - posters, models, overhead transparencies, handouts, demonstrations, readings or pictures from other books - to stimulate discussions. The teacher's guide to the text provided many excellent suggestions, such as the "paper cutting race," to introduce the Moebius band and the topology unit. At the very least, it was impossible to sit passively in this class, and we certainly kept everyone awake!

There was one more unusual feature to this course. We submitted a course proposal, which was approved a year before the class was scheduled. The semester before the course was offered, both of us were involved in planning the course objectives, content, and requirements, as well as in developing and collecting instructional materials.

When the class actually began, we used what might be called "cooperative teaching." Each of us attended every class, and while one person was responsible for directing the class sessions during a given topic, the other person knew what was going to happen each day and could aid in guiding the discussion, setting up for a demonstration, or working with the groups. The short tests for each topic were designed jointly; we conferred on assignment of final grades. Because this is not a cost-effective way to teach any but a large class, we have not repeated this arrangement, but it was a good way to initiate a course of this nature and was an interesting experiment. You and another teacher might want to try this arrangement if you have the opportunity to combine several classes.

How successful has this course been? From all reports, the high school course has been well received and has apparently reached some previously turned-off students. Our own course at IUPUI has received high student evaluations and has grown slowly, in spite of the fact that mathematics is not a specific graduation requirement for many programs.

If you are interested in beginning such a course at your own school, you may encounter some opposition from faculty or administrators who feel the course is not sufficiently mathematical (read computational). One reply to this is that the student has not benefited much from his past computational courses; at least in an alternative course such as this he has a chance to learn some new mathematical ideas and develop a new and more positive attitude toward mathematics. One of our students said, while working with geometric sequences, "I was never any good at mathematics, but *this* is *fun*."