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Q.M.I.

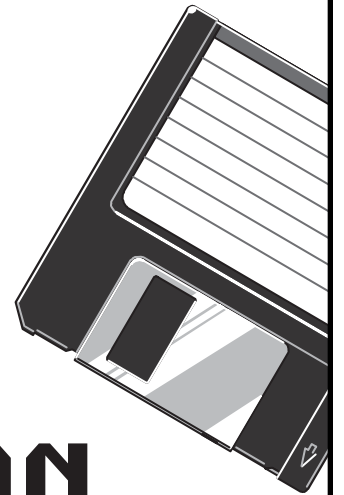
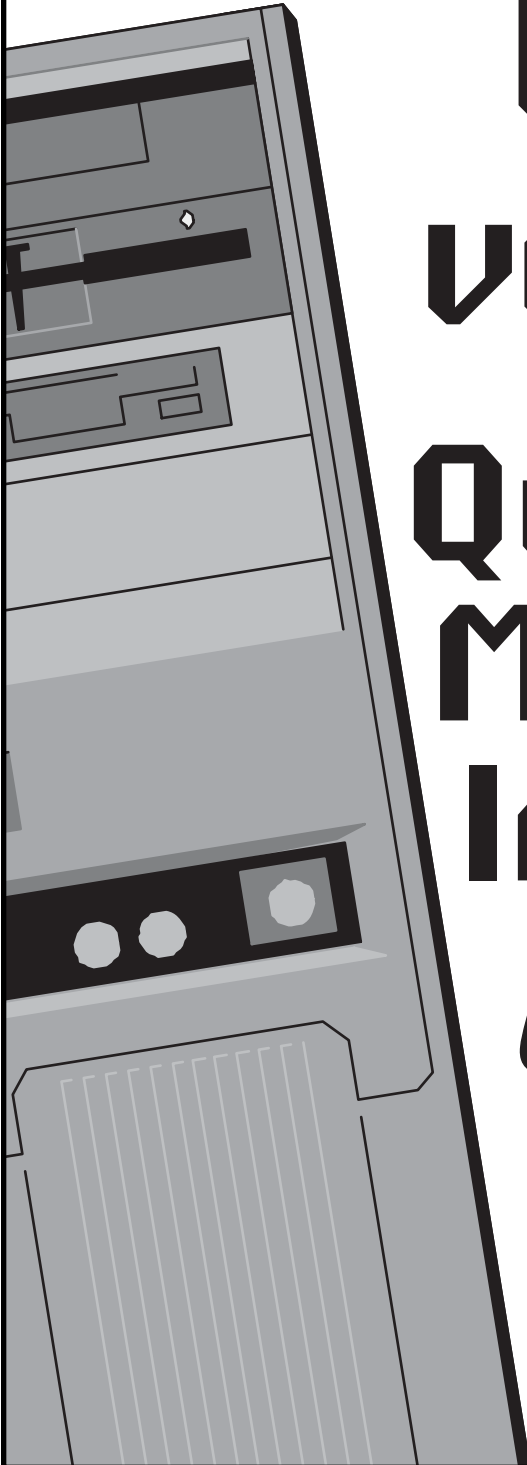
VERSION 4.5

**QUALITY
MATH**

INSTRUCTION

***UPGRADE YOUR
TEACHING FROM:***

- COVERING THE MATERIAL 1.0
- REGURGITATION 2.2
- BEHAVIOR MOD 3.1
- EDUCATIONAL TRENDS 3.5



THE 4¹/₂ PRINCIPLES OF QUALITY MATH INSTRUCTION

What makes a good teacher? This question was posed to me by a colleague, Dr. Howard Judson, a high school economics teacher with a doctorate in political philosophy. He asserts that everyone on campus knows who the good teachers are and by examining their common traits, the qualities of a good teacher can be deduced. A study based on this premise was actually conducted by two educators in New York, and they summarized their findings in an article in *Phi Delta Kappan* (Cohen & Seaman, March 1997).

Dr. Judson has formulated his own theory, based on their findings, as to what these traits are: intelligence, enthusiasm and a good rapport with the students. This is a very strong hypothesis, especially since Dr. Judson possess all three qualities in abundance and is a reputable instructor in his own right. However, these three points do not make up the entire picture. After all, if anybody who is smart, enthusiastic and works well with kids were thrust into a classroom, that person would not necessarily be an effective teacher.

Dr. Judson further offers that good teachers are traditional in their methodologies. I would have to disagree here, for as I look back at the good teachers in my own experience, many of them stuck out because their styles were different. In fact, methodology is not part of the answer at all.

That lesson can be found in the Third International Mathematics and Science Study (TIMSS). In March of 1998, *The Math Projects Journal* was granted an interview with Dr. William Schmidt, the American Coordinator of TIMSS. He claims that among the top-performing countries in mathematics (no, the United States is not one of them) there is no common methodology, but there are common principles of instruction that all the top-performing countries share: teaching to conceptual understanding and teaching with mathematical substance. In his writings and public presentations he stresses two additional components: standards and accountability.

Here, then is an answer for Dr. Judson, regarding what makes a good math teacher. It is titled "The Four and a Half Principles of Quality Math Instruction," or in the vernacular of the information age, "Q.M.I. version 4.5." The first four principles come from the research shown in the international comparisons of the TIMSS report:



- 1) **STANDARDS:** Focus on a limited number of topics. Know in advance what you want your students to know; don't just cover the textbook.
- 2) **CONCEPTS:** Teach students to understand the topic, not just to memorize an algorithm.
- 3) **SUBSTANCE:** Intellectually challenge students; raise your level of questioning.
- 4) **ACCOUNTABILITY:** Hold students to knowledge and performance expectations that go beyond grades and unit credit.

The fifth principle comes from professional experience and opinion rather than research, and therefore, its emphasis is demoted to a half-principle.

- 5) **RAPPORT:** No philosophy, technique, methodology, instructional material or textbook can replace the student-teacher relationship. You must reach 'em before you teach 'em.

This list is by no means comprehensive. However, it would be difficult to refute that a good teacher has a clear idea of what students are to learn and aspires to have them understand the material beyond a superficial level. Furthermore, the most impactful teachers are usually those that intellectually challenge students and hold them to high expectations of achievement. After all, the best teachers are often the most demanding ones.

Continued on next page

Q.M.I 4.5 (CONTINUED)

Dr. Judson will find most of his criteria in this list of four and a half principles, too. A teacher must be both intelligent and enthusiastic in order to accomplish all of the above. And what of rapport? It goes beyond popularity and reaches towards respect. Look back on the great teachers that you have had, and you will probably see that they all had the respect of their students and gave respect in return. In most cases, the teacher and students truly enjoyed each other.

At the time that Dr. Judson posed this question to me, I was reading a book titled *Six Easy Pieces* by Dr. Richard Feynman. It caught my eye because the subtitle of the book was, "Physics Taught by its Most Brilliant Teacher." The preface of *Six Easy Pieces* is full of insights into the teaching philosophies and methods of one of the finest teachers of contemporary academia. Here are some quotes by Dr. Feynman regarding teaching:

Dr. Feynman on Standards

"First figure out why you want the students to learn the subject and what you want them to know, and the method will result more or less by common sense."

Dr. Feynman on Concepts

"I wanted to take care of the fellow who cannot be expected to learn most of the material in the lecture at all. I wanted there to be at least a central core or backbone of material which he could get...the central and most direct features."

"I couldn't reduce it [a particular scientific principle] to the freshman level. That means we really don't understand it."

Dr. Feynman on Rapport

"The best teaching can be done only when there is a direct individual relationship between a student and a good teacher — a situation in which the student discusses the ideas, thinks about the things, and talks about the things. It's impossible to learn very much by simply sitting in a lecture, or even by simply doing problems that are assigned."

So where is "the use of math projects" in the list? Math projects are not on the list, because in-and-of themselves they are not critical to quality math instruction. Projects are effective tools of instruction only when they embody these four and a half basic principles of teaching discussed herein — in particular, teaching to conceptual understanding and with mathematical substance. To gain further verification of the potential effectiveness of math projects, though, I once again call upon Dr. Feynman.

Dr. Feynman on Projects

"I think one way we could help the students more would be by putting more hard work into developing a set of problems which would elucidate some of the ideas in the lectures. Problems give a good opportunity to fill out the material of the lectures and make more realistic, more complete, and more settled in the mind the ideas that have been exposed."

Thank you, Dr. Feynman, for the encouragement to keep creating and implementing quality math projects and problems, and to persist in developing good student-teacher relationships. Thank you, Dr. Schmidt, for revealing to us the value in teaching to conceptual understanding and with mathematical substance, and for pressing us to see the need for standards and accountability. And thank you, Dr. Judson, for the impetus to explore the very nature of teaching, and for reminding us that in this "people business," the people — teachers and students — are the key. All your contributions have given our profession the gift of The Four and a Half Principles of Quality Math Instruction.