Editorial

Must we MST?

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Introduction

Among the most highly touted and admirable trends in US public education is subject-matter integration. And among the best and the brightest in the technology education profession are those who are laboring to organize, develop, implement, and assess the integration of mathematics, science, and technology.

But among the most lopsided ideals in our profession is the degree to which the worth of the field is predicated on its image as a full member of a math-science-technology troika.

That's not to say that these researchers and practitioners should abandon this line of integrative research; surely it is worthy of pursuit. But unfortunately, our profession seems to be redefining itself: technology education is incrementally becoming math-science-technology, or "MST." Before we solidify this move, fundamental questions about the relation between technology education and the other school subjects need to be asked.

Addressing Some Questions About MST

Admittedly, asking questions is easier than answering them. However, it is probably much better to question while answers are difficult than to reserve questioning until answers are futile. With this in mind, several points relative to the problem of redefining technology education as MST will be addressed. These relate to the technology education profession's advocacy of MST; the benefits ascribed to MST; the goals of the science-technology-society (STS) movement; the awareness of math and science professionals of technology education; our attraction to MST; and the future of math, science, and technology in MST.

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1. Is MST being strongly advocated by the profession?

As Daugherty and Wicklein (1993) said, technology education has a "stated role of providing interdisciplinary settings for the applications of mathematics and science concepts" (p. 30). They further described "mathematics and science" as "disciplines with which we choose to associate" (p. 30). Technology-education-as-MST seems to be prevalent theme at all levels, from the classroom (e.g. Daiber, 1992) to teacher education (e.g. LaPorte & Sanders, 1993); from state association journals (e.g. Seymour, 1992) to state conferences (e.g. Connecticut Technology Education Association, 1992).

The International Technology Education Association heavily advocates MST ("ITEA in Action," 1993). Two of three refereed articles in a recent issue[2] of *The Technology Teacher* (TTT), its official journal, described math-science-technology projects; the third, written on a technical topic, contained a "math interface" section and a "science interface" section. A recent "Educator to Educator" feature in that journal intended to "answer your questions," posed to prominent educators, about MST. But as opposed to featuring a debate among leaders as to the value of this approach, the respondents were all leaders of existing MST programs; without exception, the questions themselves assumed a great value in MST.

The TTT is not the ITEA's only outlet for MST promotion. Its "very popular" (ITEA, 1993, p. 14) promotional memo pad presents this definition: "Technology Education is: Applying math, science, and technology; solving practical problems…" (p. 14). The association's Council on Technology Teacher Education, in conjunction with NCATE, has put into effect teacher preparation guidelines which "clearly emphasize the importance of the integration of science, technology, and mathematics" (Gloeckner, 1991, p. 80). In other words, technology teacher education programs must demonstrate MST integration in order to be accredited.

Technology-education-as-MST is increasingly becoming popular politically as well as professionally in technology education. In the campaign for 1992-1993 ITEA president, Steven Moorhead ran on a platform encouraging "the active involvement of Technology Education with Math, Science, and other curriculum areas…" ("Candidates for ITEA," 1990, p. 12). Moorhead won the election and delivered on his promise (e.g. "Interdisciplinary approach," 1991, p.10).

2. What are the benefits of MST?

Presenting on the topic of technology teacher education at the Camelback Symposium, Householder (1992) discussed "the preparation of teachers of mathematics, science, and technology in a unified undergraduate program,"

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adding that this could "enable the profession (technology education) to take advantage of funding opportunities currently available only in science and mathematics" (p. 8). Wescott (1993) noted that "the current emphasis on mathematics and science provides a unique opportunity for technology education to establish itself as a viable discipline to be studied by all students" (p. 177).

LaPorte and Sanders (1993) mentioned several benefits of MST, including elevating technology education to the status of academic subjects in the middle school. Sinn, Walthour and Haren (1993) described "education about technology, science, mathematics and quality" as "part of the historical basis of American greatness in education and industry" (p. 29).

Certainly MST, if nothing else, is an example of an integrative approach — an important methodology in technology education (e.g. Zuga, 1988). But it is a rather lopsided example which ignores the social studies, as well as other, typically cultural, aspects of the curriculum, such as language and art.

"One major difference between traditional industrial arts and contemporary technology education," said Kemp and Schwaller (1988), "is the inclusion of the *social and cultural* aspects of technology" (p. 21). The contentiousness of this statement aside, every major definition of *technology education* contains a rider clause pledging social concern (e.g. Savage & Sterry, 1990; Israel, Lauda, & Wright, 1993). So where is social studies integration in technology education? And why doesn't it garner the attention MST does?

3. Isn't technology education integrating social studies via STS?

Perhaps on face value, the educational movement "Science-Technology-Society" (STS) might appear to integrate the three school subjects in its name. But even the sketchiest overview of contemporary STS literature suggests that this movement is primarily a context for science instruction, and that what we would call "technology education" is not at all considered to be part of STS.

"Science-Technology-Society has been called the current megatrend in *science education*," Robert Yeager (1993), former National Association for STS president, wrote recently. "Others have called it a paradigm shift for the field of *science education*…the National Science Teachers Association (NSTA) called STS the central goal for *science education* in its official position statement for the 1980s…" (emphases added) (1993, p. 145). In discussing these conceptions of STS, Yeager did not mention technology education or social studies — perhaps because STS is "a new kind of science education" (Solomon, 1993, p. 15) — not a kind of social studies education and not at all a kind of technology education.

Even when invited to write an article in the *Journal of Technology Education*, STS pioneer Rustum Roy (1990) characterized STS as "an approach

to 'science' education" (p. 14) and "*learning science* through contact with applied science (italics added)" (p. 15).

4. Are math and science leaders conscious of technology education?

While STS leaders rarely seem to recognize the technology education profession when discussing "technology," the perceptions of other math and science educators revealed in the literature are even less flattering to our field.

In introducing his article *Technology Outlook on Math and Science: Conversations with Experts*, Stinson (1993) wrote that "technology is fueling a revolution in America's science and math classrooms…Now, teachers can conduct experiments without the need for highly expensive chemicals or in fear of explosions…" (p. 24). Language used regularly in *The Mathematics Teacher*, an official journal of the National Council of Teachers of Mathematics, is similar. The term "technology" frequently means calculators and computers, and almost exclusively describes what we would call "educational technology;" (e.g. Stein, 1993; Day, 1993). Even well-known math and science leaders use the term in this way (e.g. Usiskin, 1993).

An impartial observer might be inclined to conclude that in general, math and science educators are unaware of attempts by technology education to integrate math, science, and technology — and perpaps that they are unaware of technology education itself.

5. So why is MST so attractive to technology education?

It will not come as a surprise to many technology educators that apparently ours is the only educational profession to use the term "technology" to mean anything other than "educational technology." But when leaders in math and science education use the term in this fashion repeatedly, MST begins to look less and less like a coordinated, three-part alliance and more and more like wishful thinking on the part of technology education. In fact, it goes beyond what Petrina (1993) called "discipline envy —" it's attempted discipline by association.

Pucel (1992) considered it a "given that technology has content of its own" (p. 8). He hardly seems alone in taking this position. Use of the term "discipline" to refer to industrial education was common during the early 1980s (e.g. Balisteri, 1982; Hales & Snyder; 1982, Lauda, 1982), and is now more common than ever. Many in our profession have for some time advocated the "disciplining" of technology and technology education. Clearly math and science are disciplines. Perhaps we find MST attractive insofar as it allows us to associate with what we aspire to be.

Moreover, some public-school industrial arts teachers feel that "technology" has been handed down to them without an instruction booklet, except for ivory-tower curriculum documentation. So far this has succeeded in

further clouding the issue of what public school teachers are supposed to teach (e.g. Hutton, 1992; Nee, 1993). MST may do the opposite by narrowing the scope of technology education to the point where it may be manageable to teach. Certainly the prospect of determining our content base is attractive to our profession.

6. Will public school math/science integration ever happen?

In its recent standards document, the National Council of Teachers of Mathematics emphasized mathematics as communications, reasoning, and problem-solving. Increased material manipulation is being emphasized in school mathematics (NCTM, 1989). The American Association for the Advancement of Science's landmark Project 2061 (in which several technology educators were involved as reviewers) contains "benchmarks for science literacy." In addition to those which relate to general science, physics, and biology, they include "The Mathematical World," "The Nature of Mathematics," "The Nature of Technology," and "The Designed World" (AAAS, 1993). Clearly, the distance between school mathematics and science is small and getting smaller. Our fantasy role as the interface between math and science may become unnecessary before it can become reality.

Furthermore, the AAAS and NCTM documents are K-12 curriculum statements. Among technology educators, references to "K-6 technological awareness" may suffice, but even if we were offered a full partnership with math and science, how could we possibly excuse or explain our apparent lack of concern for students until they're half-way through school?[3]

7. Is the curriculum of MST really big enough for all of us?

In less than a decade, the School Science and Mathematics Association will be celebrating its 100th anniversary; to be sure, "science and mathematics have allies in their role as a necessary component of public educational institutions, where IA/TE has not been championed to the same extent" (Volk, 1993, p. 54). If math and science really have these bases covered, what benefit could math and science leaders see in including what they still percieve as industrial arts?

Meanwhile, our own confusion is abetted by the common lack of distinction, for example, between mathematics as a pure science and the study of

[3]Although it is beyond the scope of this article, it could be demonstrated that the original intent for "industrial arts" was exclusively as an elementary-school study. Its originators at Teachers College, Columbia University, expected the manual, domestic, and home-economics subjects to take on a vocational nature in secondary education. But to a degree the opposite of this has happened. High School industrial arts (technology education) has commonly been taught as a general education subject separate from vocational education, while the elementary grades have been largely ignored.

mathematics.[4] Both the NCTM's *Standards for School Mathematics* (1989) and the AAAS's *Benchmarks for Science Literacy* (1993) unequivocally consider mathematics to be a "science," which, in differentiating that term from "technology," Dyrenfurth (1990) defined as the "explanation of nature" (p. 13). But when Dugger (1994) described mathematics as "dependent upon technology" (p. 8), one might assume he was suggesting that the *study* of mathematics depends upon technology (i.e. computers, compasses, calculators, etc.) — not that technology, which is human in nature, can have any impact on the laws of mathematics.

Clearly, the laws of science and mathematics can and have existed without technology. They do not need technology; they do not depend upon technology. Furthermore, human beings do not need technology to study them.

However, it must be conceded that nearly all studies of science and mathematics have been made possible by the *products* of technology — from the pen and paper a zoologist uses to record the movements of animals in nature to the compass and straightedge a mathematician uses to perform a geometric construction (n.b. Maley, 1985). If the field of technology education really believes that natural scientists (including mathematicians), are concerned with "detached" and pure, as opposed to applied, knowledge (Wright, 1992, p. 16), then scientists and mathematicians must be seen as the consumers of the products of technology — not consumers of the knowledge of technology.

But technology need not be defined solely with respect to the natural sciences. It need not be relegated to the objective, analytical, "detached" studies. And it need not be regarded as a discipline of the order of mathematics and science. Technology can be viewed broadly as a "total social phenomenon" (Pfaffenberger, 1988 p. 236) — not simply as a would-be partner to mathematics and science.

This directs attention back to the question: why are we defining technology education as MST? Lewis (1994) recently implored our field to "abandon attempts to acquire social status, and, instead, to be true to itself — to become authentic" (p. 23). Perhaps we should consider that in its original general-education conception, technology education (industrial arts) was to be entirely integrated — integrated with the whole curriculum, not just one or two subjects. "It is not a special subject in the sense of being unrelated to other subjects, but, quite the contrary, it is rather the most general subject of all in its far-reaching relationships" (Bonser & Mossman, 1923, p. 74). For technology education, acheiving a balanced integration would be acheiving authenticity.

[4] A discussion of the failure to distinguish between natural science and its study would take the same course. Mathematics is used here as an example.

The Final Question: So What?

Perhaps it is true that technology education is attempting to gain credibility by associating with reputable school subjects. Perhaps it is true that teachers of those school subjects feel they are already teaching technology. Perhaps it is true that MST is an example of successful integration which ignores some school subjects.

So what?

Unfortunately, what makes technology-education-as-MST so easy for us to swallow is that it is that part of industrial education which math and science teachers are expected to teach. If we strongly identify ourselves as MST, and if math and science teachers begin to really teach what they claim as their subject areas, technology education could quickly become an unnecessary duplication of services.

The ideals behind MST are noble: to capitalize on the similarities between school subjects, and to draw often distant areas of the public school curriculum together. But for the technology education profession to do this to the exclusion of subjects much more closely related is at best a misrepresentation of the nature of technology; and to do so in an attempt to establish our body of knowledge as a discipline hopefully isn't a last-ditch grasping at respectability.

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