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Excerpts From and Inserts Into My January 23 Talk at the Mathematics as a Humanistic Discipline Session

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When Alvin White invited me to join this panel, I felt very much as if I were joining a conversation whose beginning I had missed, and that I therefore was in danger of bringing in observations that had already been discussed, followed up, resolved, transformed.

On the other hand, I don't like those panel discussions in which each panelist presents his Weltanschau ng as if the other panelists didn't exist, and where the audience, directed to ask questions, has the job of making some coherent picture out of this performance, but where there is never enough time for discussion because the panelists feel they need every allotted minute to get their philosophies across.

Nor am I comfortable in a situation where I am expected to respond immediately to the remarks of preceding panelists, because I am a slow listener (and reader) in the sense that I need to mull over what I have just heard (or read), and my nervousness at having to address many people interferes with my attention to what is being said. My responses will not be ready for public consumption when my turn comes.

Alvin had asked me for a title, and I tentatively said Our Fragmented Curriculum. But I felt I needed a little more guidance, and so I wrote him the following letter:

Dear Profession White:

Just a note to let you know roughly what I plan to say at the Mathematics as a humanistic discipline session on Friday morning, January 23.

The title, our Fragmented Curriculum, is perhaps too specialized; for I want to talk about putting together fragments not only of the curriculum, but of many other things:

1. Human learning involves both, the learner's intellect and his emotional attitudes. Mathematics instruction should not be divided into therapy for the "math-anxious" and instruction in mathematical concepts and techniques; instead the human student should initiate and develop his subjective mathematical inquiry using his psychological traits as well as his personal mental powers. He or she must get acquainted with both.

2. Humans retain what they learn best if they can put new material into a human context, e.g. connect it to past experience, future aspiration, previously acquired mental structures.

3. Mathematical reasoning is a natural part of general reasoning. Yet it gets pushed out of other school subjects (like social science, literature, even the natural sciences) into mathematics classes, which then become cluttered with bits and pieces of tools whose use is not made clear. The early elimination of reasoning from the humanities, separation of reading from writing, listening from speaking, are instances of harmful fragmentation of human activities.

4. The isolation of mathematics from the rest of life causes further fragmentation of mathematics itself into arithmetic, algebra, geometry, etc., and these subdisciplines get cut up into sections or modules or skills to be mastered, tested and forgotten.

It is not surprising that adults, schooled in this manner, remain dependent on "experts" (accountants, lawyers, ...) in their private and community life, and that they see little relation between their jobs in the work place and the general purpose of the enterprise which employs them. Unfortunately, our education enterprise, at all levels, is no exception.

These things probably need not be said to the people who are meeting in San Antonio. Indeed, members of this group are doing great things to counteract the robotization of students. There are, moreover, lots of excellent recommendations for educational reforms made by various prestigious committees composed of knowledgeable dedicated people. What needs to be discussed are perhaps the difficulties in implementing good ideas.

I could describe my recent experience in urban public schools, the unreasonable pressures on teachers, the contradictory messages received by teaching and administrative staffs and the social problems compounding the difficulties. But I can also describe a few instances where teachers have successfully involved students in meaningful responsible learning, through innovative use of writing, reading, respectful listening and thoughtful guiding of student explorations.

I would observe that we, who teach, are also victims of this fragmentation; we are experts in this or that, we care about our own learning and that of our students. Few of us are renaissance people or generalists. But we have observed or experienced how people in different fields with different personalities occasionally supplement one another's strengths and interests, become intrigued with one another's work and begin a stimulating and fruitful collaboration which leads to promising educational programs. I don't know any recipes that lead to the building of such communities of collaborators and I don't believe such activities can be mandated. But I do believe they are most likely to happen in the same kind of learning environment as the one we strive to create for our students. We need to find out how such collaborations get started and what makes them thrive. I don't have much faith in replicating any particular "program" or "project", but I do have great hopes for replicating the spirit that often inspires and initiates it.

I should appreciate your opinion on what needs emphasis in San Antonio.

Best regards,

Anneli

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Alvin responded. He expressed the hope that this San Antonio meeting would encourage that community and collaboration by making more people aware of the widespread interest and support for the concept of Mathematics as a Humanistic Discipline.

He also suggested that I illustrate the points in my letter with some specific examples from my recent experiences in some New York City public schools. I am sorry I did not manage to get these into my talk.

I was gratified to see, in the program of these San Antonio meetings, an extraordinarily large number of sessions devoted to educational concerns, with many thoughtful, concerned and experienced participants; in fact so many that it was difficult to attend any one of these sessions without missing some of the others. In spite of the small sample that I heard, let me use it as supplement to some other evidence I have come across in my reading to make a strong point for the pedagogical aspects of Mathematics as a Humanistic Discipline.

There are descriptions of programs - often targeted at special student populations - e.g. women, minorities, talented, learning disabled - which record with great insight how students have been turned off, and how the interests of many of them can be and have been engaged and maintained. In these readings, I have been particularly impressed and stimulated by specific anecdotal and nuts-and-bolts-y accounts. And in almost all cases, my reaction was that these little success stories were based on a spirit which was quite independent of the particular sub-population of students at which the effort was aimed. So I tried to formulate what that common underlying spirit was and came to the conclusion that the authors of all these vignettes had gone to considerable lengths to find out who the students in these programs were, where they came from what went on in their heads and their hearts when they worked on math and how well and by what means they could cope with problems in their out-of-school life. At Tuesday's MAA/NCTM panel, for example, there was a presentation by Carol Greenes which debunked the claim that learning disabled students could learn no mathematics except computation. She gave evidence that, on the contrary, these students had considerable mathematical skills in attacking real world problems from various fields, that computation per se was not their forte, but that they were able to maintain their computational skills, since they were using them in a meaningful context.

The point of this and other efforts referred to is that we need to listen to students. This is one of the first steps in getting them to become responsible for their own learning.

Now my experienced, seasoned colleagues who teach elementary mathematics courses know exactly which errors their students will probably make, are unhappy about not being able to prevent these standard erros and cheer one another up by joking about this predicament. Many have experienced utter shock when they asked, for example calculus students at the end of one semester, to tell (or to write) what a derivative is. The results were so painful that most will never ask again.

But some have discovered, by listening to students, that interesting things are in fact going on in students' heads. Students are thinking, seeing patterns and analogies, but not necessarily the ones the teacher had in mind. Moreover, these instructors find it much more stimulating to learn how various students explore a mathematical idea than they find lecturing, year after year, about that same mathematical idea or technique in vacuo, with the predictable result of being ineffective.

Learning to listen to students involves teaching students to express themselves so that their classmates and teachers can understand. It has been our experience that when students see that somebody is interested in what they have to say, they make a serious effort to communicate their ideas, and this alone is important training in the use of language skills.

I am convinced that the use of language - reading, writing, listening and speaking - is an essential part of learning anything, and especially mathematics. I am also convinced that having students talk and write about how and what they are learning naturally makes them connect new material with past experience and future goals, so that what they learn becomes part of them. Furthermore, this practice would give schools the opportunity to take advantage of the enormous heterogeneity of the students, especially in large cities. At present the cultural and linguistic diversity of student populations is regarded as an enormous obstacle because in spite of lip service to respect for the individual, we keep trying to impose crippling uniformity.

I am gratified that some of these humanistic aspects of mathematics instruction are being advocated by an increasing number of commissions and task forces. Although it is probably a bad idea to close on a negative note, let me list a few things that still need to be attended to.

The two attributes of mathematics usually cited by those who want to sell mathematics are: (1) its tremendous utility and almost universal applicability on the one hand, and (2) its playful, puzzle like, fun aspects. I have no quarrel with that. But I think an important third aspect is being neglected, namely the feeling of mental power, or at least mental fitness (a term coined by JoAnne Growney) on the part of those who use mathematical reasoning when appropriate. Just as having physical control and coordination over one's body adds to one's sense of well being and confidence, so does having mental control over one's thought processes. I believe most normal human beings would work quite hard to achieve both. Both help people gain control over their lives.

There is much criticism of our outdated curriculum and lively discussion about

1. How to up-date it for the 20th century (or the year 2061)
2. What to eliminate in order to make room for all the new stuff brought about by recent advances and future needs.

Even if there were an updated agreed upon curriculum, and even if it could be mandated throughout the school system, it would freeze and become obsolete, especially if a corresponding set of multiple choice tests became associated with it.

I think of curriculum reform as a continuous process which goes hand in hand with keeping in touch with the real world. This means encouraging students to solve real world problems and to give teachers the opportunity to grow in their fields and the autonomy to guide their students.

I have looked at the 6, 7, 8 grades syllabi in a New York middle school and the New York State mandated 9th, 10th and 11th grade syllabi known as the "integrated math sequence". Indeed, the topics to be covered in any particular year seem overwhelmingly many; but the overlap is great. The pressure on teachers to cover material on which students will be tested virtually prevents them from even considering any realistically paced, in-depth inquiries.

It is difficult and will require long-term collaborative efforts to influence the present school pressures and customs. I am cheered by reports on many grass roots projects at all levels that are making their little dents. I consider today's accounts of my co-panelists important implementations, mainly on the university level, of stimulating instructional principles which stress mathematics as a humanistic discipline.