Creating the Quilt of Quantitative Literacy

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As our society becomes more information dependent, and as technology becomes a part of everyday life there is an increased need for citizens to be quantitatively literate. We are bombarded daily by tables, charts, numbers, and graphs. We make financial and health care decisions based on statistics.

Despite the increasing importance of quantitative literacy to the citizenry, seventy-five percent of higher education math enrollments are in classes that are considered high-school level; and less than ten percent of college math enrollments are above the AP calculus level (Steen, 2002). The presence of under-prepared undergraduate students is supported by a National Assessment of Educational Progress (NAEP) study that states that the average math performance of seventeen-year-olds has increased just one percent in twenty-five years and still remains at the "basic" level (NCES, 1997).

Low levels of math performance are also apparent at the local and state levels. According to Michele Johnson, President of Pierce College Fort Steilacoom in Lakewood, Washington, sixty-five percent of recent high school graduates who attend Pierce College need at least one developmental course and eighty-eight percent of these need at least one developmental math course (personal conversation, November 2002). Figure 1 on the next page, from the *Report of the June 2002 Think Tank, Recommendations, Actions, The Washington Center for Improving the Quality of Undergraduate Education,* clearly shows the weakness of Washington State students in mathematics. It also shows the racial disparity that exists where success in mathematics is concerned. Approximately ten percent of African American students passed the tenth grade Washington Assessment of Student Learning (WASL) math component compared to more than 40% of white students. Both scores are dismal but the racial disparity is shocking.

Another aspect of the deficiency in quantitative reasoning skills cannot be ignored: quantitative reasoning skills are often the door to economic access. Students who receive a bachelor degree that requires at least one quarter of calculus (e.g. architecture, business, engineering, computer science) earn significantly higher average starting salaries than students who earn a bachelor degree in a major that does not require higher-level math (English, anthropology, or sociology). Is this fair? No, but it *is* fact. Robert Moses (2001) spoke profoundly on the impact of poor math skills on African Americans in his book *Radical Equations, Civil Rights from Mississippi to the Algebra Project:*

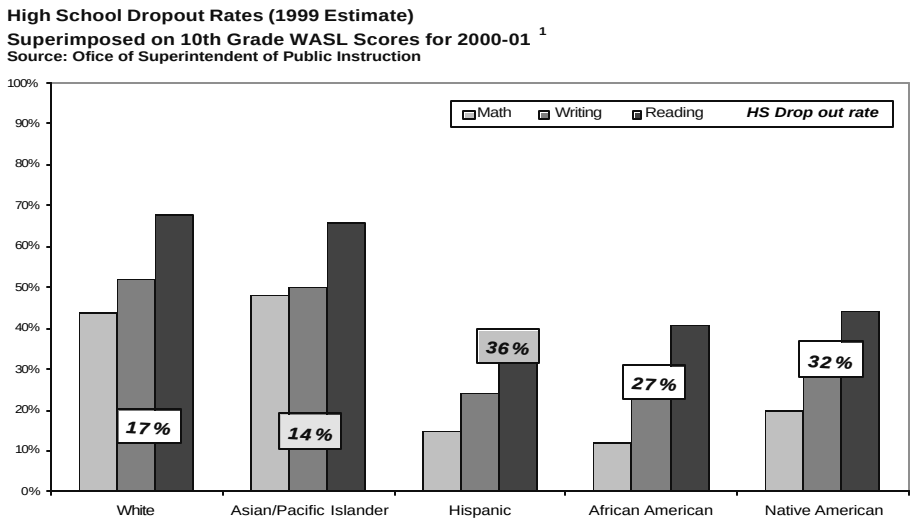
> "What is central now is the need for economic access; the political process has been opened…but economic access, taking advantage of new technologies and economic opportunity demands as much effort as political struggle required in the 1960s . . . Math illiteracy is not unique to Blacks the way the denial of the right to vote in Mississippi was. But it affects Blacks and other minorities much, much more intensely, making them the designated serfs of the information age . . ."

Despite the importance of quantitative literacy to our lives, both to understand our data-filled society, and as an avenue for economic access, mathematics is usually explained through the foggy window of a mathematics class disconnecting the math from the students' real-life experiences and interests. While we would be the first to argue that more student-centered, context-based math classes are a good idea, they are not a panacea.

We believe that the key to developing a quantitatively literate citizenry is to show students the relevance of math in their content classes and throughout the curriculum. By bringing mathematics into content areas, students become aware of the importance of thinking quantitatively and can begin to lift the veil of fear that many of them wear around mathematics. While taking more math classes remains one of the doors to economic access, taking more math classes does not, necessarily, lead to quantitative literacy. Knowing how to do calculus does not make a person quantitatively literate. They may know more formulas and procedures, and hopefully understand some important concepts; but are they more able to function as a citizen? Do they understand the "richness" that quantitative literacy can provide them? Lynn Arthur Steen (2002) suggests not:

> "Much of this (mathematical) richness occurs when patterns amenable to quantitative or logical analysis arise in other subjects - in history or agriculture, in carpentry or economics. For students to develop mathematical habits of mind, they need to see and do mathematics everywhere, not just in math class. As writing is now accepted as part of the entire curriculum, so should math."

Figure 1



The benefits of quantitative literacy are broader than being able to balance your checkbook or knowing which size of detergent is the best buy. Quantitative literacy is a way of thinking and reasoning that cuts across all disciplines. It is the historian analyzing a document for authenticity, or the attorney carefully structuring an argument, or the social worker calculating the mileage he or she traveled to see a client, or the college administrator evaluating the cost/benefit of canceling a class. As information becomes more readily available the need to understand and evaluate that information becomes greater. Quantitative literacy is needed in everyday life as well as in the workplace. Should a menopausal woman use hormone replacement therapy? What are the risks of investing in the stock market? Can I understand my financial consultant when she or he explains how bonds work? What does a "yes" vote on a ballot initiative really mean? In a cooperative article written by the quantitative literacy design team in the book *Mathematics and Democracy, the case for Quantitative Literacy* (Steen, Ed., 2001), the case for a quantitatively literate society is well stated:

> "Quantitatively literate citizens need to know more than formulas and equations. They need a predisposition to look at the world through mathematical eyes, to see the benefits (and risks) of thinking quantitatively about commonplace issues, and to approach complex problems with confidence in the value of careful reasoning. Quantitative literacy empowers people by giving them tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently. These are skills required to thrive in the modern world."

Because of our belief that a quantitatively literate citizenry is critical to a democracy and because of our belief that mathematics is best taught in context, our National Numeracy Network project team will spend the 2003-2004 school year mentoring individual faculty to increase the quantitative reasoning in their courses. We will work with individual faculty to increase their awareness of quantitative reasoning and to identify quantitative reasoning opportunities in their courses. We will help them to develop materials and assessments that will enhance the quantitative reasoning that is naturally present in the course content and help them to locate and use quantitative reasoning resources. Toward the end of the year, the mentored faculty members will be trained to mentor a new group of faculty for the 2004-2005 school year. This year, the mentored faculty members come from a variety of disciplines including psychology, early childhood education, anthropology, and criminal justice. Each of these faculty members has a different vision of how quantitative reasoning can and should be incorporated into their courses. These differences were highlighted at a workshop we conducted for Pierce College faculty in May 2003. Three different psychology instructors came up with three different ways to increase the amount of quantitative reasoning in their classes: one faculty member wanted to incorporate a more rigorous treatment of statistics, another wanted to assess students' ability to read tables and graphs, and the third wanted students to be able to chart behavior patterns that would lead to the identification of syndromes. Despite the differences between these approaches, each is a valid way of incorporating more quantitative reasoning into a psychology class.

There is no set path to developing a quantitatively literate citizenry. Nor is there a pre-determined approach to incorporating quantitative reasoning into non-math classes. In fact, the very definition of quantitative literacy is in its formative stages and is dynamic. Despite these complicating issues, the need for a quantitatively literate citizenry is apparent and the time is right for the journey to begin. The road to a quantitatively literate citizenry has been set before us by the rush of the information age. As educators, we have a unique role in shaping the future of our nation. It is our challenge and our responsibility to guide our students to a future that ensures that all people will have the competence and the confidence to fully participate in this great experiment called democracy.

References

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