Quantitative Literacy: A Means for Bridging the Chasm of the Two Cultures

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Abstract

Quantitative literacy (QL), a relatively new literacy, has the potential to bridge the gap between the literary and scientific cultures. The chasm of the two cultures refers to the gulf and increased polarization between scientists (science) and literary intellectuals or literati (arts). Snow (1959) drew attention to the divide of *The Two Cultures* and attributed the gap to the inability of scientists and literati to communicate effectively with each other due to deficient knowledge of each others' discipline. Re-education or less specialization in education, according to Snow would facilitate communication between the cultures and promote citizenship, as QL cultivates the authentic application of scientific and mathematical cultural practices (measurement, interpretation, quantitative expression, assertions, reasoning, estimation, analysis, problem solving, etc.) across the arts, humanities, and culture.

QL highlights the natural inter-relatedness of the two cultures and serves as a potential bridge in the gap. In addition QL across the arts would provide measurable, yet unobtrusive component of the arts; a pedagogical component that requires no formal training; and a language understood by both literati and scientists. The development of QL has emerged as a task for higher education, mainly because of higher education's emphasis on scholarship and research, model tools in re-education. QL provides an alternative approach to interdisciplinary instruction in higher education and cross curricular projects at the elementary school level. Whereas elementary schools seek to integrate the arts into the sciences, QL draws attention to the sciences and mathematics that inherently exist in the arts. Consequently, QL decreases compartmentalization, enhances meaning in context, and promotes the underpinnings of communication between the two cultures and citizenship.

Introduction

In his 1959 Rede Lecture on *The Two Cultures and the Scientific Revolution,* C. P. Snow bemoaned the mounting chasm between the culture of "literary intellectuals (literati)" and the culture of "scientists" (Snow 1959). Furthermore, "he noted with incredulity that during the 1930s the literary intellectuals, while no one was looking, took to referring to themselves as 'the intellectuals,' as though there were no others" (Brockman 1995, ii). Snow attributed the distinction between the two cultures to their mutual indifference and the inability of the two non-communicating groups to understand each other (Leavis and Yudkin 1962). The scientifically and. the literary-inclined have been unable to communicate effectively with each other due to deficient knowledge of and interest in each others' discipline (Barash 2005). Nonetheless, Snow advocated the need for bridging the gap between the two cultures as a means for ensuring

effective citizenship and global progress. He believed, for instance that both effective political policymaking pertaining to industrial countries and the reduction of the gulf between the rich and poor countries of the world required the combined expertise of both scientists and literati. Snow suggested that one way to bridge the scientist – literati gap was to foster communication through re-education.

Re-education can be implemented in a variety of ways. The approach to re-education that I propose involves quantitative literacy (QL). I believe that the heightening of quantitative literacy in education would serve as a process capable of reducing the existing gulf between scientists and the literati because it would serve as a means of increasing communication between the two cultures.

This paper will make the case for QL and re-education by first outlining the various components of QL and then demonstrating how its components enhance communication between the two cultures. That will be followed by an explanation of the function of QL in re-education. Then the processes involved in the development and implementation of QL will be discussed in the context of higher education versus. K12 schools. Finally, QL will be defined and its broader impact on society in general highlighted.

Components of QL

According to Wolfe and Haynes (1997). the components of QL include measurement, information or data collection, reason, assertion, interpretation, estimation, analysis, description, persuasion, intuition, recognition of underlying trends, evaluation of risk and uncertainty, prediction, decision making, having a feel for numbers, revelation of patterns, observation, and

quantitative expression These elements of QL are attributes one would associate with and expect of science and mathematics. One would not ordinarily associate these QL elements with the arts. However, less obvious or unnoticed is that these traits or elements of scientific and mathematical cultural practices are also innately embedded in the underpinnings of the arts. For example logic and reasoning in language and communication; ratio and rhythm in music; scale, proportion, and geometry in art; recognition of patterns in history and political science; and assertions in philosophy and classics (Steen 1999).

QL is a common set of skills used in both the culture of math and science as well as the culture of the arts. Whereas the culture of math and science requires the emphasis and purposeful teaching and development of the QL abilities, the culture of the arts does not require that level of attentiveness to QL. In essence, QL is a common language spoken by both the scientists and the literati, the only difference being that it is a language spoken loud and clear in the sciences but spoken at a mere whisper in the arts, for example, ratio when used as a concept of probability in a risk analysis and ratio when used as a vital component in an artistic creation or a musical rendition.

The Role of QL in Communication between the Cultures

To attain the goal of communication between scientists and literati, QL, the common language, should be fostered or highly developed in both cultures. The QL components that exist in the arts ought to be encouraged to emerge. The increased and deliberate use of QL abilities in the arts could ignite and fuel the use of a common language resulting in a natural means of communication between the two cultures.

There is a need for mutually permeable relationships between the arts and sciences and QL would provide a means for permeation in both the scientific and artistic contexts. For example, Steen (1999) stated that QL is inseparable from its context as it has no context of its own. It inherits its content from its context. Consequently, the ubiquitous nature of QL provides bountiful opportunities for communicating in a multitude of contexts, for example the arts _ history, geography, culinary arts and sciences _economics, biology, agriculture. In addition, the all-pervading nature of QL also provides teachers the opportunity to teach it in multiple ways and contexts (Steen), for example, "estimating how to split a lunch bill three ways; reading and understanding nutrition labels, bus schedules, and maps; scaling recipes up and down and converting units of volume and weight; mentally estimating discounts, tips, and sales prices" (Burrill et al. 2001, 10).

The role of QL in Re-education

The re-education of teachers to incorporate QL in their instruction would *not* require teachers to learn new content but it would however require gradual "modifications" in existing pedagogy so as to include fluid and authentic ways to help students recognize, identify, use and develop QL abilities. Teachers would need to recognize those teachable moments, i.e., alertness to capitalize on an opportunity to make a QL connection while teaching. Repetition of this modified pedagogical process would provide opportunity for mastery of the QL skills for the students and mastery of the modifications to pedagogical approach for the teachers.

One major advantage for re-focusing on QL in the arts is that it would provide quantifiable assessment components in the arts without detracting from the essence of the arts. Using this pedagogical approach would both enable faculty of the arts to integrally assess the arts

authentically and alleviate the pressure on the arts faculty to quantify artistic assessment. By developing QL areas in the arts courses there would be provision for quantifiable assessment components which would not negatively impact creativity and aesthetic expression that defines the arts. Another advantage of the re-education approach is that it does not need additional formal training and faculty are free to introduce it in their courses at their own pace, using the QL skills they are most conversant with first and then gradually developing the others.

QL is paradoxically both fluid and quantifiable, making it an ideal connecting tool for joining the fluid arts and the quantified sciences. The existing demarcations across and within disciplines are man-made (Drake 1961). Nature does not make demarcations between the sciences and the arts. Nature is in a constant fluid state. Educators and textbook printers compartmentalized the various disciplines to make teaching manageable (Nietz 1964). One approach to combat these artificial demarcations in learning therefore would be to incorporate QL in a discipline as an attempt to restore natural and authentic learning. There is a need for natural solutions for closing the gap as that would make teachers more amenable to the idea (Cuban 2001).

QL Instruction: Higher Education vs. K12

Should QL be a focus at the K-12 level of education or at the higher education level? According to the Mathematical Association of America (MAA 1998), Schneider (2001) Cuban (2001), as well as Haines and Jordan (2003), the onus should be on higher education for several reasons. For example, federal mandates at the K-12 level, e.g., No Child Left Behind (NCLB) hold schools accountable for students' test scores on standardized tests and low performing schools are subject to Federal punitive measures i.e., withdrawal of needed funds. Most K-12

teachers are forced to be more concerned about standardized test scores than the various authentic processes of student learning. In addition, professional standards such as the National Council of Teachers of Mathematics (NCTM) often oscillate between extreme approaches to student learning. For example, revisions to NCTM 1989 standards did not build on the existing student learning approach. The NCTM standards in 1989 stressed thinking, problem solving, etc. whereas the 2000 version reverted to the rote learning approach to math that was common in the 1970s.

On the other hand, the academic freedom afforded higher education faculty allows for flexibility of content taught and teaching patterns. That is not to say that higher education faculty do not have to adhere to national standards in their discipline, they do, but faculty in higher education, through scholarship and research, continuously seek knowledge and instructional methods, such as QL, capable of change and positive impact on their students and the global community. In particular, the onus is on the faculty of the Schools of Education, who train future teachers and consequently impact the culture of education. Furthermore, the development of quantitative literacy (QL) has emerged as a major concern for successful liberal arts education (Mathematical Association of America [MAA], 1998; Steen 2004; Wolfe and Haynes 2002). One such liberal college, Samford University, has embarked upon a university-wide initiative to foster higher education faculty awareness of, knowledge in, and resources for incorporating QL in their instruction.

As part of a university-wide initiative (Owusu-Ansah, Chew, and McDaniel 2005), the definition and framework of key components of QL with assessable outcomes were developed by an interdisciplinary team of faculty to define, strengthen and assess quantitative literacy. In addition, two studies were conducted to assess the initial state of QL education as a first step

toward improving QL instruction. The results indicated that the cultivation of QL skills varies widely across disciplines from completely neglected to completely assumed (but not assessed). In addition, students exposed to QL valued it and students of varying disciplines desired to become more conversant with quantitative literacy (Owusu-Ansah, et al.). Students also expressed a preference for functional numeracy vs. pure math (Owusu-Ansah, et al. 2005; Schneider 2001).

Such an initiative promotes faculty awareness of QL, challenges or encourages faculty to embark upon its integration, and highlights the need to prepare students for the Information Age, the age of numbers (Jordan and Haines 2003; Schneider 2001). All professions are increasingly becoming number driven. For example, farmers use unit conversions to verify accuracy of drug dosages; sociologists draw inferences from data to understand human behavior; entrepreneurs project markets and costs using computer spreadsheets; lawyers use statistical evidence and arguments involving probabilities to convince jurors (Burrill et al. 2001). Essentially, just as verbal fluency gives students tools to think for themselves, to question experts, and make civic decisions, quantitative literacy does exactly the same in a world increasingly drenched in charts, graphs, and data (Cuban 2001; Hughes-Hallett 2001; Steen 1999).

We are obligated to earnestly and continuously prepare our students for this constantly changing world, seeing as a technology year is the equivalent of three months (Oblinger and Verville 1998). Projecting for the future is prudent as according to Bernstein (1998), overemphasizing the present could distort reality and lead to unwise decisions and faulty assessments.

Definition of Quantitative Literacy

Thus far this paper has provided the much needed context for QL and demonstrates the need for a workable operational definition with assessable outcomes. According to Owusu-Ansah, Chew, and McDaniel (2005) QL is defined as competence in the skills involved in the effective production, utilization and comprehension of quantitative information for the purposes of description, analysis, discovery, evaluation, reasoning, decision making, problem solving, and persuasion. Furthermore, QL involves recognizing when such skills are needed and using them appropriately and ethically. The cultivation of QL is essential for effective living skills, for informed citizenship and for personal enrichment.

Typical Attempts at Bridging the Arts and Sciences

Since the latter part of the 20th century, elementary schools have attempted to integrate the two cultures. The elementary school approach has been to use reading, writing, art, drama, music, and social studies as introductory or supplementary components of mathematics and science instruction and learning. This approach inadvertently has strengthened the role of *science and math learning* as the unit of measure for school success and the role of literary expertise as the hallmark of an intellectual. The consequence has been further widening of the gap between the two cultures, science/math and arts/humanities. QL in contrast promotes the reverse, that is, the recognition and application of typical science and math concepts in the teaching of reading, writing, music, art, drama, social studies etc., demonstrating the natural inter-relatedness of the two.

Conclusion

Re-education through the heightening of QL will make both the scientifically- and literary- inclined aware of the natural inter-relatedness of the two cultures. The amplification of QL in the arts will foster bridging of the gap between the two cultures, because it reinforces the similarities between the two disciplines. It will also cultivate a reduction in the polarization of scientists and literati because of its provision of a common language. Consequently, an increase in the communication abilities among individuals of both cultures will ensue.

C.P. Snow, physicist and novelist, was both a scientist and a literary intellectual. His knowledge of both cultures allowed him to experience first hand the advantages of inculcating both cultures and consequently, made him an advocate of bridging the gap between the two cultures. As it is not possible for many of us to be both a scientist and a literary intellectual like Snow, the heightening of quantitative literacy as the "common" language and the basis for understanding of the concepts used by both cultures or disciplines, I believe, would suffice as an adequate response to Snow's call for re-education, increased ability in effective citizenship, and a means to communicate innately across the two cultures.

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