The Math Wars and Hofstede's Dimensions of Culture

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Abstract

In the 1990s, the mathematics curriculum in the US became the object of intense conflicts known as "the Math Wars." We will examine this conflict, some of its historical roots and continuing consequences, and we will consider a cultural interpretation of these battles.

Introduction

In 1997 I was appointed to the California State Mathematics Framework Revision Committee. The committee consisted of 22 people, with a wide variety of experiences and points of view, but overall representing a high level of professionalism and concern for the public good. However, the committee was bitterly divided between "reformist" and "traditionalist" camps. The result was to replace thoughtful discussion with acrimony and invective. Each side repeatedly showed its unwillingness to listen seriously to the other side. The 1997 California Mathematics Framework became a trophy to be carried off by the victors rather than a product of broad-based collaboration. This was my introduction to the "math wars," in which California played, and continues to play, a role of leadership and importance for the entire nation.

Ever since that difficult summer, I have tried to understand what the math wars were really about. Unexpectedly, I found some useful clues in the Geert Hofstede's pioneering work, *Dimensions of Culture: Software of the Mind*.

This paper, then, has three parts. The first part briefly describes the history of the math wars, especially in California. The second part introduces Hofstede's dimensions of culture and their relation to education. The third part is an attempt to use Hofstede's work to gain insight into the math wars.

Part 1. Some History

The roots of the math wars are old and can be traced back many decades. In the years of the Eisenhower presidency (1953-1960), US K-12 education was based mainly on programs and attitudes that went back to before the war. However, changes were afoot. The Advanced Placement (AP) program of the College Board, the Conant Report (urging consolidation of small high schools so that more varied and advanced course offerings could be supported), and the shock of Sputnik (October, 1957) all prompted hard looks at the K-12 curriculum. At the same time, Brown vs. the Board of Education led to a Supreme Court decision (1954) which led to decades of struggle centered about overcoming inequalities in public education.

Of these factors, Sputnik had the most immediate effect on US mathematics education. Backed by generous NSF support, k-12 teachers took mathematics courses, and teams of writers, led by university mathematics educators, produced new k-12 mathematics materials. The School Mathematics Study Group (SMSG), was perhaps the best known of these groups and came to be identified in the public mind with "the new math." SMSG produced a widely used series of

mathematics texts that were mathematically correct if pedagogically naïve. SMSG emphasized abstract concepts and played down routine practice with basic algorithms, for example, presenting number bases other than ten and by introducing set theory in elementary grades.

SMSG was not the only innovative program of the day. Of special note are *The Math Workshop* for grades K-6, based on varied learning experiences involving a rich view of mathematics, and *The Mason Mathematics Program*, which introduced (very successfully) arithmetic with negative integers and fractions as well as algebraic equations to kindergarten students.

By the end of the 1960s, disillusionment with the new math was widespread, perhaps due in part to the rather wooden pedagogy of SMSG and its heavy handed use of sets, but also no doubt to the fact that the new math had come from sources far removed from many local school districts. Parents and teachers, who had not themselves studied set theory, often had trouble understanding the SMSG program, a situation satirized by Tom Lehrer, whose song, *The New Math*, stated, "It's so simple, so very simple, that only a child can do it." In reaction to the new math, a movement known as "back to basics" took hold in the 1970s .

If some of aspects of new math were extreme, so was the back to basics movement, which emphasized rote learning and memorization in grade school arithmetic to the virtual exclusion of anything else. Evidently, the false dichotomy between conceptual understanding and computational skills was well established by that time.

The pendulum swung back in the other direction in the 1980s, though slowly at first. Reacting to the limitations of back to basics, the National Council of Teachers of Mathematics (NCTM) in 1980 issued *An Agenda for Action*, which urged that mathematics instruction focus on problem solving rather than on basic skills. It argued that the need for basic skills would be obviated by ready access to calculators for all students. *An Agenda for Action* also urged the abandonment of the traditional high school mathematics courses in algebra, geometry, and trigonometry and the introduction of material such as discrete mathematics, all of which was, in some high schools, combined into courses called "integrated mathematics." This swing of the pendulum was powerfully reinforced in several ways during the 1980s.

•Fears arising from economic "stagflation" led to a report by the National Commission on Excellence in Education entitled, "*A Nation at Risk*" (1983), which claimed that "The educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future. . ."

US students' poor showing on Second International Mathematics Study (1977-1981) reinforced the sense of urgency in "*A Nation at Risk*."

•New results from the study of human cognition suggested that students needed far more than drill and practice in basic skills to develop the higher order thinking skills needed for effective use of mathematics. From this work there arose a psychological theory known as "constructivism," (not related to the constructivist movement in mathematics) which was based on the idea that each person must construct each mathematical concept for him/her self, and that such concept formation can be fostered by the use of manipulatives.

•Despite (or perhaps because of) increasing rates of high school attendance and graduation, the numbers of students failing high school mathematics courses was woefully high and rising. These rates were even more alarming for African American and Hispanic students. The existing mathematics curriculum was seen as reinforcing the privileged social position of white males. In particular, as the

percentage of high school age people actually in high school grew, the percentage of failures in algebra and geometry grew alarmingly. Integrated mathematics courses were seen as offering a way to brake that trend.

•Calculator manufacturers, eyeing lucrative markets in public education, supported the idea of "calculators on demand." Expressing skepticism about this made one a Luddite, as did pointing out that calculator companies play a role in education analogous to that of the pharmaceutical industry in health.

California acted on *An Agenda for Action*, embodying its recommendations in the 1985 state mathematics framework. It was a major departure. California played a unique role here, because, like Texas, it has a system of statewide textbook adoption. The US market for school mathematics books is very lucrative and very competitive. No publisher can afford to write off California. In the ensuing mathematics textbook adoption, none of the books submitted was judged as meeting California's requirements, so the state temporarily acquiesced in using books that it rated as less than satisfactory, while warning publishers that the next adoption would not be as forgiving. In the meantime, teachers were encouraged to write "replacement units" to use where textbook coverage was inadequate. Supporters of *An Agenda for Action* were encouraged to see its recommendations put into action, though complete implementation would have to await the publication of new materials. In 1989 the NCTM published its *Standards for Teaching Mathematics*, which had the effect of supporting nationally the changes being implemented in California. In California itself, those changes were further reinforced by the 1992 mathematics framework, which made little mention of mathematics *per se* and was largely about methods of teaching. It endorsed the use of calculators and computers, emphasized "higher order thinking skills" in place of paper and pencil computation, and instruction through the use of small groups for discovery exercises. In 1994 the California State Board of Education approved new mathematics texts, which were aligned with the state mathematics framework.

But even as "reform" in mathematics education appeared to be accepted, opposition to it was coalescing. Many replacement units in California were poorly written and had little mathematical content. At the same time, the state educational leadership was embarrassed, first by the failure of a reading program based on "whole language" and the avoidance of phonics, and then by an abysmal state testing program (CLAS) in English and mathematics. These programs had mobilized Christian right leaders to political action. They and their followers were skeptical about the reform movement in mathematics, and they soon found common cause with parents and teachers in school districts with high expectations, such as those near leading university campuses. They were able to enlist the support of many mathematicians on those campuses.

The new mathematics textbooks seemed to justify the skepticism. They were elegantly printed, with elaborate use of full color and busy page layouts, but in some cases it was hard even for mathematicians to identify just what mathematics was being covered. Algorithms for basic arithmetic operations with integers and fractions were, in some cases, omitted altogether, as were definitions of basic terms, such as "fraction." To the extent that mathematics was presented, it was usually in the context of problem situations, with little or no attention given to mathematics *per se*. Students were asked to write about mathematics, but there was little emphasis on mastery of any mathematics. Anything that might pose a difficulty for some students, such as long division, long multiplication, or work with fractions, was played down.

Skepticism also greeted constructivism as a useful model of learning. At face value, it is obvious that each person must create for him/her self each concept. It is also clear that people learn not only from explanations but also by using their various senses. However, it is not clear that anyone knows what activities best foster concept formation in different individuals or that careful explanation is not one of the most useful ways to help people learn. If one insists on basing all mathematics instruction on manipulatives, then it is impossible to teach any mathematics requiring higher levels of abstraction, which is to say, most of mathematics.

Finally, the reform curriculum repeated a key mistake of the new math; it was implemented for the most part not as a result of local initiatives but in reaction to directives from above. This "top-down" curriculum change ignored the wishes of many parents and teachers at the local level.

The coalition opposed to "reform" mathematics thus had plenty to work with. They soon gained allies in the state legislature and even the Governor, Pete Wilson, who liked to be known as "the education governor." After public hearings in 1995 and 1996, and it was decided to reform the California Mathematics Framework in 1997, two years ahead of the normal schedule. Also, reacting to the lack of specific mathematical content in the existing math framework, the state legislature passed a law requiring the creation of California mathematics content standards, to be incorporated into the new framework. The California math wars were raging.

The State Board of Education, appointed by the Republican governor, was opposed to reform mathematics. The executive officer of the State Board, who actually runs the California Department of Education, is the California Superintendent of Education, an elected officer. This post was then held by Delaine Easton, a Democrat, who tried to remain neutral in this controversy, in particular in naming the membership of the 1997 Mathematics Framework Revision Committee.

Late in 1996, Superintendent Eastin, following tradition, received recommendations from the State Curriculum Commission, which had recommended approval of the reform texts, on the membership of the 1997 mathematics framework revision committee, and she forwarded these recommendations to the State Board of Education. However, the Board, departing from tradition, revised the membership to be less oriented toward reform, putting on it, among others, two former presidents of the Mathematical Association of America.[1] The changes were vigorously protested, but the protests were rebuffed by the Board. Governor Wilson, promptly appointed an additional anti-reform Board Member, Marian Joseph.

The first business of the framework committee was to elect its chair, a post to which the reform committee members expected to name Calvin Moore, former chair of the mathematics department at UC Berkeley then working in the UC Office of the President. However, the anti-reform group nominated and elected Deborah Tepper Haimo, former President of the Mathematical Association of America (and benefactor of the annual Haimo award for excellence in mathematics teaching) who was then at UC San Diego.

The committee bickered through the long, hot Sacramento summer, eventually completing a compromise framework which pleased nobody and, of course, did not include the standards, which had not been finished at that point. The committee that wrote the standards had no overlapping membership with the Framework Revision Committee, even though the standards were to be

[1] The writer, too, was put onto the committee by the Board in the change.

incorporated into the Framework. No significant communication between the two groups took place. Furthermore, the framework was to be completed by a deadline well in advance of the deadline for the standards. The committee that wrote the standards was more reform minded than the Board of Education and therefore postponed submitting the standards to the Board until the last possible day, in hope that there would be no time to modify them. However, the Board belatedly brought in four anti-reform mathematicians from Stanford and had them revise the standards and then revise the framework as needed to harmonize with the standards they had just revised. The hard feelings resulting from those tumultuous years have still not gone away.

The math wars did not end in 1997 and indeed continue today. Many important national groups, notably the NCTM, and the National Science Foundation, continue to support reform mathematics curricula. However, California has not changed its stance significantly, and California's role as a textbook adoption state continues to give it weight beyond its population size, which is large and growing in any case. Anti-reform groups continue to lobby against reform mathematics nationally, often earning the ire of their opponents with hardball political tactics. As I continue to ponder the question of what the math wars are really about, I have found some clues in the work of Geert Hofstede.

Part 2. Hofstede's Dimensions of Culture

Geert Hofstede, Professor Emeritus of Organizational Anthropology and International Management at Maastricht University, The Netherlands, has studied cultural comparisons since the 1960s, when he founded and managed the Personnel Research Department of IBM Europe. A survey on attitudes of thousands of IBM employees around the world showed, not surprisingly, important differences between countries. Hofstede analyzed these results and thus constructed his landmark dimensions of culture, statistically defined constructs, each based on a cluster of survey questions, that go far toward accounting for the observed differences. Based on the meaning of the questions in each cluster, he named the dimensions of culture: power distance, individualism-collectivism, masculinity-femininity, uncertainty avoidance, and long- and short-term orientation. (The last of these was not found in the original survey but is based on later work.)

Other studies, some of which were designed as replications or extensions of Hofstede's work, have validated the dimensions of culture described here. The relative positions of nations with regard to dimensions of culture appear to be quite stable over time, though uncertainty avoidance tends to grow in nations at war. It remains to be seen, of course, to what extent that stability will persist as mass migration and international media expand.

Power Distance: Inequality in Society

Power distance is an index of social inequality. Consider the workplace. In a low power distance situation, subordinates feel free to address superiors; in a high power distance situation, that is not so. In a low power distance workplace, facilities like bathrooms, eating places, and parking lots are shared equally; that is not so in a high power distance workplace.

Individualism-Collectivism

Individualism-collectivism is an index of the importance of the individual relative to his or her group. Most people are born into extended families whose interest prevails over that of its individual members to such an extent that "I" is nearly meaningless compared to "we." For those people, the

extended family is the source of identity and protection and is owed lifelong loyalty. To go against one's extended family is unthinkable. Numerically far fewer people are born into nuclear families and treated as individuals. Where the child in the collective situation is expected to play or work with others in his extended family, the child in the individualist society learns to choose his/her friends based on personal preference. Such individualist children are taught to stand on their own feet and to make their own way in life.

Masculine-Feminine

Rigidity of gender roles varies greatly. Societies with very rigid gender roles are called masculine, whereas those with more fluid and equal gender roles, especially in which men take on roles that other societies restrict to women, are called feminine. The Scandinavian countries have among the most feminine societies, with paternity (as well as maternity) leave for young parents, for example. In masculine societies, men focus on fighting life's battles outside the home and are expected to be competitive and tough, while women are to be nurturing. In feminine societies, both kinds of roles are played by both sexes.

Uncertainty Avoidance

This dimension is an indication of the way a society views the unknown. In a society with high uncertainty avoidance, "what is different is dangerous," whereas in a society with low uncertainty avoidance, what is different is viewed with interest and curiosity. Broadly speaking, uncertainty avoidance corresponds to intolerance of ambiguity, and generalized anxiety (as contrasted with fear of a particular danger). Societies with high uncertainty avoidance tend to rely on rules, written or not, to guide behavior, whereas societies with low uncertainty avoidance expect people to be able to work out for themselves how to handle unexpected situations as they arise.

Long- and Short-Term Orientation

Hofstede came upon this cultural dimension only after considering aspects of Chinese culture that did not arise in the survey he originally studied. This dimension deals with deferred versus immediate gratification. For example, thrift and persistence are virtues associated with long-term orientation. In the US, preoccupation with quarterly financial statements is an example of short-term orientation. China's push to absorb Taiwan, in contrast, is an example of long-term orientation. They have pursued that goal for half a century and appear willing to continue to pursue it for decades more.

Cultural Dimensions and Schooling

Hofstede's comments about the relationship between cultural dimensions and education are of particular interest here. The following are quoted from Hofstede.

On power distance and schools

In the large power distance situation the parent –child inequality is perpetuated by a teacher – student inequality which caters to the need for dependence well established in the student's mind. Teachers are treated with respect (older teachers even more than younger ones); students may have to stand up when they enter. The educational process is teacher-centered; teachers outline the intellectual paths to be followed. In the classroom there is supposed to be a strict order with the teacher initiating all communication. Students in class speak up only when invited to; teachers are never publicly contradicted or criticized and are treated with deference even outside school. . . .

In the small power distance situation teachers are supposed to treat the students as basic equals and expect to be treated as equals by the students. Younger teachers are more equal, and therefore usually more liked than older ones. The educational process is student-centered, with a premium on student initiative; students are expected to find their own intellectual paths. Students make uninvited interventions in class, they are supposed to ask questions when they do not understand something. They argue with teachers, express disagreement and criticisms in front of the teachers, and show no particular respect to teachers outside school. When a child misbehaves parents often side with the child against the teacher. The educational process is rather impersonal; what is transferred comprises 'truths' or 'facts' which exist independently of this particular teacher. Effective learning in such a system depends very much on whether the supposed two-way communication between students and teacher is, indeed, established. The entire system is based on the students' well-developed need for independence; the quality of learning is to a considerable extent determined by the excellence of the students."

Corporal punishment at school, at least for children of pre-pubertal age, is much more acceptable in a large power distance culture than in its opposite. It accentuates and symbolizes the inequality between teacher and student and is often considered good for the development of the child's character. In a small power distance society it will readily be classified as child abuse and may be a reason for parents to complain to the police.

On Individualism-Collectivism and Schools

The relationship between the individual and the group which has been established in a child's consciousness during its early years in the family is further developed and reinforced at school. This is very visible in classroom behavior. In the context of development assistance it often happens that teachers from a more individualist culture move to a more collectivist environment. A typical complaint from such teachers is that students do not speak up in class, not even when the teacher puts a question to the class. For the student who conceives of him/herself as part of a group, it is illogical to speak up without being sanctioned by the group to do so. If the teacher wants students to speak up, she or he should address a particular student personally.

Collectivist students will also hesitate to speak up in larger groups without a teacher present, especially if these are partly composed of relative strangers; out-group members. This hesitation decreases in smaller groups. Personally I obtained broad participation when teaching a collectivist class by asking students to turn around in their seats so that groups of three were formed. I asked the students to discuss a question for five minutes, and to decide who would report their joint answer to the class. Through this device students had an opportunity to develop a group answer and felt comfortable when speaking up before the class because they acted as the small group's representative. I also noticed that in subsequent exercises the students arranged for the spokespersons to rotate. Taking turns in group activities is a habit which exists in many collectivist cultures.

The desirability of having students speak up in class is more strongly felt in individualist than in collectivist cultures. Because most collectivist cultures also maintain large power distances, their education tends to be teacher-centered with little two-way communication.

In the collectivist society in-group-out-group distinctions springing from the family sphere will continue at school, so that students from different ethnic or clan backgrounds often form subgroups in class. In an individualist society the assignment of joint tasks leads more easily to the formation of

new groups than in the collectivist society. In the latter, students from the same ethnic of family background as the teacher or other school officials will expect preferential treatment on this basis. In an individualist society this would be considered nepotism and intensely immoral, but in a collectivist environment it is immoral *not* to treat one's ingroup members better than others.

In the collectivist classroom the virtues of harmony and the maintenance of 'face' reign supreme. Confrontations and conflicts should be avoided, or at least formulated so as not to hurt anyone; even students should not lose face if this can be avoided. Shaming, that is invoking the group's honor, is an effective way of correcting offenders: they will be put in order by their in-group members. At all times the teacher is dealing with the student as part of an in-group, never as an isolated individual.

In the individualist classroom, of course, students expect to be treated as individuals and impartially, regardless of their background. Group formation among students is much more *ad hoc*, according to the task, or to particular friendships and skills. Confrontations and open discussion of conflicts is often considered salutary, and face-consciousness is weak or nonexistent.

The *purpose* of education is perceived differently between the individualist and the collectivist society. In the former it aims at preparing the *individual* for a place in a society of other individuals. This means learning to cope with new, unknown, unforeseen situations. There is basically a positive attitude towards what is new. The purpose of learning is less to know how to do, as to know *how to learn*. The assumption is that learning in life never ends; even after school and university it will continue, for example through recycling courses. The individualist society in its schools tries to provide the skills necessary for 'modern man'. In the collectivist society there is a stress on adaptation to the skills and virtues necessary to be an acceptable group member. This leads to a premium on the products of *tradition*. Learning is more often seen as a one-time process, reserved for the young only, who have to learn *how to do* things in order to participate in society.

The role of diplomas or certificates as a result of successful completion of study is also different between the two poles of the individualism-collectivism dimension. In the individualist society the diploma not only improves the holder's economic worth but also his or her self-respect: it provides a sense of achievement. In the collectivist society a diploma is an honor to the holder and his or her in-group which entitles the holder to associate with members of higher status groups; for example to obtain a more attractive marriage partner. It is to a certain extent a 'ticket to ride'. The social acceptance that comes with the diploma is more important than the individual self-respect that comes with mastering a subject, so that in collectivist societies the temptation is stronger to obtain diplomas in some irregular way, such as on the black market.

On Masculinity-Femininity in Schools

A Dutch management consultant taught part of a course for Indonesian middle managers from all over the archipelago. In the discussion following one of his presentations, a Javanese participant made a particularly lucid comment, and the teacher praised him openly. The Javanese responded, "You embarrass me. Among us, parents never praise their children face to face."

This anecdote illustrates two things. First, it demonstrates how strong, at least in Indonesia, is the transfer of behavior models from the family to the school situation, the teacher being identified with the father. Second, it expresses the virtue of modesty in the Javanese culture to an extent that even surprised the Dutchman. . . . The Dutch consultant said that even some of the other Indonesians were surprised at the Javanes's feelings. A Batak from the island of Sumatra said that now he understood

why his Javanese boss never praised him, even when he himself felt that praise should have been due. In feminine cultures, teachers will rather praise weaker students, to encourage them, than openly praise good students. Awards for excellence, whether for students or for teachers, are not popular; in fact *excellence* is a masculine word.

. . . In masculine countries students try to make themselves visible in class and compete openly with each other (unless collectivist norms put a limit to this). . . . In feminine countries assertive behavior and attempts at excelling are easily ridiculed. Gert Jan remembers being told by a classmate when he was fourteen, We know you are smart–but you don't have to show it all the time.

Failing in school is a disaster in a masculine culture.. . .Failure in school in a feminine culture is a relatively minor incident.

Criteria for evaluating both teachers and students differ between masculine and feminine cultures. On the masculine side teachers' brilliance and academic reputation and students' academic performance are the dominant factors. On the feminine side teachers' friendliness and social skills and students' social adaptation play a bigger role.

On uncertainty avoidance in schooling

The International Teachers Program (ITP) around 1980 was a summer refresher course for teachers in management subjects. In a class of fifty there might be twenty or more different nationalities. Such a class offered excellent opportunities to watch the different learning habits of the students (who were teachers themselves at other times) and the different expectations they had of the behavior of those who taught them.

One dilemma which Geert experienced when teaching in the ITP was choosing the proper amount of structure to be put into the various activities. Most Germans, for example, favored structured learning situations with precise objectives, detailed assignments, and strict timetables. They liked situations in which there was one correct answer that they could find. They expected to be rewarded for accuracy. These preferences are typical for stronger uncertainty avoidance countries. Most British participants, on the other hand, despised too much structure. They liked open-ended learning situations with vague objectives, broad assignments, and no timetables at all. The suggestion that there could be only one correct answer was taboo with them. They expected to be rewarded for originality. Their expectations are typical for countries with weak uncertainty avoidance.

Students from strong uncertainty avoidance countries expect their teachers to be the experts who have all the answers. Teachers who use cryptic academic language are respected; some of the great gurus from these countries write such difficult prose that one needs commentaries by more ordinary creatures explaining what the guru really meant. "German students are brought up in the belief that anything which is easy enough for them to understand is dubious and probably unscientific.". . . A Ph.D. candidate who finds him- or her-self in conflict with a thesis adviser on an important issue has the choice of changing his or her mind or finding another adviser. Intellectual disagreement in academic matters is felt as personal disloyalty.

Students from weak uncertainty avoidance countries accept a teacher who says, "I don't know." Their respect goes to teaches who use plain language and books that explain difficult issues in ordinary terms. Intellectual disagreement in academic matters in these cultures can be seen as a stimulating exercise, and we now of thesis advisers whose evaluation of a Ph.D. candidate is positively related to the candidate's amount of well-argued disagreement with the professor's position.

In similar situations, students in low UAI [uncertainty avoidance index] countries were more likely to attribute their achievements to their own ability, students in high UAI countries to circumstances or luck. . . .

In cultures with strong uncertainty avoidance, parents are sometimes brought in by teachers as an audience, but they are rarely consulted. . . . In countries with weak uncertainty avoidance, teachers often try to get parents involved in their children's learning process: they actively seek parents' ideas.

Long- short-term orientation

Several studies have shown that Asian more than Western students tend to attribute success to effort and failure to lack of it, so they are likely to put in more effort. Yet there is more to the performance of Asian students than hard work.

. . . the argument that Asian students simply work harder is insufficient, because then they should show an equally good performance in science as in math, which was not the case. The correlations between math performance and LTO suggest that there is something common in the mental programming dominant in the high-LTO cultures and in the mental requirement for performing well in basic mathematics.

A traditional assumption has been that Asian students focus on rote learning instead of comprehension, but the superior performance of high-LTO culture students in basic mathematics refutes this. That which Western minds interpret as rote learning may in fact be a way toward understanding.

Part 3. What do dimensions of culture have to do with the math wars?

A comparison of the hallmarks of reform and anti-reform mathematics programs (table 1) shows interesting connections with Hofstede's dimensions of culture.

In favoring memorization of basic facts and mastery of standard algorithms, traditional curricula embody teacher-centered education, whereas by de-emphasizing memory and standard algorithms (possibly asking students to invent their own algorithms) reform curricula favor student-centered education. In these respects, the reform curricula are characteristic of societies with low power distance and high scores for individualism, while the traditional approach is more typical of collective societies with high power distance. In the same vein, the reform approach, favoring exploration over direct instruction, is characteristic of societies with high individualism, low power distance, and low uncertainty avoidance, while the traditional approach, using direct instruction, is characteristic of societies with high power distance, low individualism, and high uncertainty avoidance. Again, the reform emphasis on process rather than answers is characteristic of low uncertainty avoidance, while the traditional emphasis on answers is characteristic of high uncertainty avoidance. The use of small group instruction, explicitly favored by reform advocates, accords better with collectivist and feminine cultures than does the direct instruction advocated by traditionalists. At least on the basis of the first four dimensions of culture, it appears that traditional approaches fit better with high power distance, collectivist, masculine cultures that have high uncertainty avoidance, while reform approaches fit the better with low power distance, high individualism, feminine cultures that have low uncertainty avoidance. It is not obvious on its face whether or not cultures with high long-term orientation indices would be more likely to favor a reform or a traditional approach, but the well-documented record of

success in mathematics on the part of students from Asian countries with high long-term orientation is based on relatively traditional approaches.

Of the 74 countries and regions included in Hofstede's work, the US ranks relatively low in power distance and the highest of any country surveyed on individualism. On those dimensions alone, reform curricula would appear to fit the US better than traditional ones. The US scores fairly high on masculinity, which would tend to tilt the culture toward traditional approaches, but ranks quite low in uncertainty avoidance, which accords well with reform approaches. On balance, then, it would appear that reform approaches are closer to the mainstream culture of the US than are traditional approaches. Mitigating this, however, is the fact that most US adults are the products of relatively traditional schooling.

Traditional	**Reform**
•Basic facts memorized	•Memorization de-emphasized
•Standard algorithms	•Algorithms de-emphasized
•Calculators for large jobs	•Calculators on demand
•Goal: Mastery leading to understanding	•Goal: Understanding
•Emphasis on answers	•Emphasis on process
•Teacher-centered instruction	•Student-centered instruction
•Teacher is "sage on the stage"	•Teacher is "guide on the side"
•Direct instruction	•Exploration, small group work

Table 1

The opponents of reform mathematics programs, at least in California, are a coalition, whose members are united on little beyond that issue. As described by George Lakoff in *Don't Think of An Elephant*, the Christian right has a hierarchical, authoritarian view of family led by a strong father figure. It seem that this segment of the anti-reform coalition has cultural values that has relatively high power distance, is masculine, and has high uncertainty avoidance. I am unaware of any Hofstede type studies that could verify this, but there is anecdotal evidence for it, as reported by Jackson:

> According to Tom Sallee, a UC Davis mathematics professor and co-developer of the reform-minded program, College Preparatory Mathematics (CPM), a Baptist minister in Davis went to his daughter's teacher and asked if CPM taught kids to be independent and think on their own. When the teacher replied yes, the minister pulled his daughter from the class, saying he did not want his daughter to think she could understand things on her own. According to his beliefs, knowledge is only handed down from those who are older and wiser.

The other major component of the groups opposing reform mathematics consists largely of highly educated people, a high percentage of them active in mathematics, technology, or research science. Few of these people would identify themselves with the Christian right, and indeed many of them are politically liberal. The stimulus for their activism is usually concern for their children or for the educational enterprise more broadly, which they see as being "dumbed down" by reform programs. They are, as a group, keenly aware of the "relentlessly cumulative" nature of mathematics and of the astonishing growth in the importance of mathematics in professional, economic, and intellectual life. They tend to take a long-term view of mathematics education, which leads them to see that a poor elementary school mathematics program can disadvantage youngsters for the rest of their lives. I have the feeling that they intuitively grasp Hofstede's remark that "that which Western minds interpret as rote learning may in fact be a way to understanding." An analogy with Suzuki music instruction comes to mind.

Those in favor of reform mathematics are also a coalition, but one that is not as easily described as those whom they oppose.

It seems that the math wars are indeed about the cultural values underlying and embodied in k-12 mathematics programs. I hope that recognition of this situation, together with additional work to clarify it, can lead to increased mutual understanding and, eventually, to a productive climate for improvement of k-12 mathematics.

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