Why Do Americans Stink at Math? Some of the Answer.

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On July 23, 2014, a lengthy and persuasive article appeared in the *New York Times Magazine* written by the author as an introduction to her new book by the same eye-catching name:

Why Do Americans Stink at Math?
Elizabeth Green
http://www.nytimes.com/2014/07/27/magazine/why-do-americans-stink-at-math.html

Ms. Green's basic premise is that somehow Japanese classrooms modified their style from the purportedly traditional approach of rote response and memorization of meaningless algorithms to the American style of teaching mathematics following the National Council of Teachers of Mathematics (NCTM) *Standards*. Unfortunately, her article - and, presumably, book - represent so much education industry misinformation that it almost cries out for clarification/correction. Herein is an attempt toward that end. It is far from complete but I will try to cover the high points. In summary, Ms. Green has referenced much of the same source material as mentioned herein but a deeper look at those sources leads to quite a different interpretation of the past and, more importantly, implications for trying to improve performance in mathematics in many American precollegiate schools. For the record, there are many American precollegiate schools with exemplary mathematics performance.

For clarification, "the *NCTM Standards*" will (as is common) represent the NCTM philosophy since there is no single document by that name. Officially, the original was the *Curriculum and Evaluation Standards for School Mathematics* in 1989 and rewritten as *Principles and Standards for School Mathematics* in 2000 supplemented by the *Curriculum Focal Points* in 2006. The *Focal Points* were in response to widespread negative reaction to the nebulous nature of the misnamed *Standards* and added much-needed specificity. That lack of specificity was deliberate and the *Focal Points* are seldom mentioned in *NCTM Standards* discussions because the actual philosophy is pedagogical, not grade-level - or even appropriately sequential - mathematics content oriented.

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> "Takeshi Matsuyama was an elementary-school teacher, but like a small number of instructors in Japan, he taught not just young children but also college students who wanted to become teachers. At the university-affiliated elementary school where Matsuyama taught, he turned his classroom into a kind of laboratory, concocting and trying out new teaching ideas. When [Akihiko] Takahashi met him, Matsuyama was in the middle of his boldest experiment yet — revolutionizing the way students learned math by radically changing the way teachers taught it."

Early in the article we already see the heart of the problem yet to be fully realized in Japan but overwhelmingly dominant in the US and the best general answer to the very title of the article: The rise of professional education as a separate academic entity as opposed to a strong interest of many bright people with general interests at the elementary level and specialized interests in the upper grades. In the era of my mother's education, a particularly strong elementary and high school academic experience followed by one year of "normal school" prepared much more effective elementary school teachers than those of our current teacher factories parroting the myths-of-the-era. Whole Language Learning (that means phonics-free reading "instruction") and Bilingual Education (that means Spanish only at first and gradually transitioning to English without ever getting there) are a couple of such examples that have been thoroughly debunked but remain undead. I will concentrate here on math ed efforts with an even longer history and just as undead.

In Ms Green's article, note the absence of mathematics expertise or contributions from math-based academic areas such as engineering or the hard sciences. Even representation from math-requiring so-called trades that need computationally competent novices to train in their expertise is missing. No, it is nothing but "received wisdom", more appropriate in religion than education.

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> "Instead of having students memorize and then practice endless lists of equations — which Takahashi remembered from his own days in school..."

This "having students memorize and then practice endless lists of equations" is one of the most often propped up mathematics education "strawmen". That was not my education more than a half-century ago in rural Iowa and it was not Takahashi's. Decades ago, 1954 Field's Medalist (think Nobel Prize for mathematics) Kunihiko Kodaira oversaw (wrote?) superb precollegiate mathematics books for Japanese students that reflect none of that yet the same indefensible practices get repeated as historical fact year-after-year, decade-after decade. Regrettably, it is used as justification for NOT developing a certain level of automaticity and accuracy with elementary number facts very early in the school years (little kids eat that stuff up and 5-10 minutes a day on a regular basis is plenty to accomplish the goal). Such automaticity is critical to nearly all of what follows in mathematics. Are the standard algorithms of arithmetic difficult? They are not! Organized work and accurate elementary number facts makes teaching, computing, and understanding of them a natural transition. No big deal. The same is true for the arithmetic of ordinary fractions. Explaining "why" is a little harder but not that much and the real problems are lack of competence with elementary number facts and pervasive lack of teacher competence. If a student has to spend too much time thinking about and too often getting the little computations wrong, the big ones get branded as impossibly hard. If the teacher has problems with these (too often the case), we have an entirely different problem that is almost insurmountable in a "self-contained" classroom.

Speaking of "the standard algorithms of arithmetic", Ms. Green's article can be interpreted in support of the widely discussed *Common Core State Standards in Mathematics* (hereafter *CCSS-M*). To avoid the controversy that the NCTM addressed (and then ignored) with its *Focal Points*,

the authors of the *CCSS-M* incorporated an interesting ploy that needs more exposure, a deliberate bait-and-switch on "the standard algorithms" of elementary arithmetic. Professional math educators have long argued that there is no such thing (because of trivial differences that do exist within the standard ones), and that's what calculators are for anyway so who cares? Such a cavalier attitude often receives an appropriate reaction from concerned observers from parents to university mathematics professors. A familiar example of how different algorithms can be is (for the initiated) the Lattice Method for multiplication that some math curricula present and almost require. The *CCSS-M* writers "dodged that bullet" by requiring competence with the standard algorithms. Problem? They use words (always too many words and insufficient numerical examples!) without specifying what "the standard algorithms" means. As it turns out, the words mean nothing at all. A careful, if somewhat cynical, reading of this explanatory paper by a couple of well-known math ed experts informs us that all algorithms based on place-value numeration (base 10 to most people) fall within the purview of the definitive article "the" provided plenty of place-value "understanding" is developed with it.
"Standard Algorithms in the Common Core State Standards" by Karen Fuson and Sybilla Beckmann.
http://www.mathedleadership.org/docs/resources/journals/NCSMJournal_ST_Algorithms_Fuson_Beckmann.pdf

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> "Matsuyama taught his college students to encourage passionate discussions among children so they would come to uncover math's procedures, properties and proofs for themselves."

Nice as such words sound, the idea is genuinely absurd. Mathematics developed incrementally over millennia by geniuses, not by a group of ordinary students passionately discussing the procedures, properties, and proofs of mathematics that they have been able to discover independently. Fibonacci is famous not only because of his familiar sequence but for having brought Hindu-Arabic numeration (base 10 because we have 10 fingers) to European businessmen with the ease of the standard computational algorithms. Newton (the inventor of calculus and so much else) famously said, "If I have been able to see further, it was only because I stood on the shoulders of giants." Professional mathematics educators continue to insist on "discovery", often called "constructivist", pedagogy that forces students to invent their own algorithms rather than be taught the standard ones. The very antithesis of Newton's quote.

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> "One day, for example, the young students would derive the formula for finding the area of a rectangle; the next, they would use what they learned to do the same for parallelograms. Taught this new way, math itself seemed transformed. It was not dull misery but challenging, stimulating and even fun."

In contrast to his former description, this is excellent teaching - let me emphasize TEACHING - and there is nothing new about it; in fact, "time immemorial" comes to mind. Clearly, this sequence is not the blind leading the blind but a carefully structured setting where the students do recognize, “discover” if you wish, the formulas along with a solid understanding of why they work. Continue a little longer and students “discover” why the formula for the area of a triangle is what it is. Moreover...

> “Takahashi quickly became a convert. He discovered that these ideas came from reformers in the United States, and he dedicated himself to learning to teach like an American.”

This happens to be good teaching no matter where it’s from but it is not teaching “like an American” of our so-called reform math era (New-New Math, Rainforest Math, fuzzy math, and lots of other names, unfortunately not of 4-letters). The totally misleading part is the idea that this was something new in Japan! Associated with the 1995 *TIMSS* (*Third International Mathematics and Science Study*), UCLA’s Jim Stigler conducted a video series of math classes in several countries being tested including the US and Japan. Consequently, it has already been documented that that style of teaching was the way of life in Japanese schools 20 years ago. The tapes are a delight to watch; an extension, for example, of a lesson that had been pursued the day before where, if the students “saw it”, there was an almost trivial solution to the new setting but, if not, there were more crude and laborious solutions available. The instructor would give a limited time, 10 minutes maybe, for students to explore their solutions and then collectively discuss them. Does this work? Does this always work? Are there more efficient solutions? And the like. By the end of the class, all students were aware of the best approach(s) and why they worked. Not, “All solutions are equally valued”, nor the instructor learning along with his students as is often advocated in the US; the instructor was in complete command. Although the classes were warm and a little noisy, they were focused on the topic and the instructor was clearly in charge, a “Sage on the Stage”, even if the stage might have been anywhere in the room. Why that was not Mr. Takahashi’s experience I have no idea, and maybe it was not, but my guess is he has learned the US education industry’s rhetoric rather than Japan’s historic reality. NYU’s Alan Siegel provided a nice summary of these videotapes:
http://www.cs.nyu.edu/faculty/siegel/ST11.pdf

While we are on the subject of the traditional Japanese approach, Stigler’s tapes provided concrete evidence of how far off US math ed “reformers” are missing the right idea… One of the very active projects on teaching mathematics the NCTM way was UCLA’s well-funded Mathematics Renaissance. With all of the publicity surrounding the 1995 *TIMSS*, some states - even a few large school districts - contracted with Stigler’s group to do video studies of their own programs for comparison with the Japanese, German, and “ordinary” US schools. There was a conviction of math reformers that they were doing things “the Japanese way” (of course, not Takahashi’s recollection thereof!) and Mathematics Renaissance had enough federal money to have them study and compare some Mathematics Renaissance classrooms with the Japanese. The report was enlightening for those with their eyes open (not the reformers, unfortunately). The December [1997] issue of the *Communicator* of the California Mathematics Council (think California chapter of the NCTM) had an article by two of its leaders, Nanette Seago and Judy Mumme, entitled "Mathematics Renaissance *TIMSS* Study" that describes the project. Instead of coming closer to emulating the high performing Japanese, the Mathematics Renaissance program had been encouraging a pedagogical philosophy that was even further from the Japanese model than were typical U.S. classrooms.

> "The amount of time that teachers engage in teacher/demonstration was analyzed. Japanese lessons not only contain more Teacher Talk/Demonstration than the other three groups, but more time is devoted to it when it does occur. In the case of Mathematics Renaissance lessons, such segments never occurred. There are dramatic differences between the percent of lessons in which Teacher Talk/Demonstration occur, 64% of the Japanese lessons and 0% Renaissance lessons."

Other evidence that Stigler's tapes showed about Japan's classrooms (along with his 1993 book with Harold Stevenson, "The Learning Gap") was that calculators were never seen in Asian elementary (K-5?) school classrooms and routine calculations were performed routinely and accurately. Perhaps Mr. Takahashi has been able to fix that "problem" in Japanese schools to emulate our own "success"?

That was an exemplary model of NCTM-style classrooms but the math reform philosophy had been strong well before that. In fact, the 1989 NCTM Standards represented more of an official confirmation of efforts that had been underway for more than a decade so even the 1995 *TIMSS* was not comparing traditional "direct instruction" American mathematics classrooms (curricula and pedagogy) with schools of other nations, many of those schools were already well on their way and the infamous Math Wars had begun. Many of the controversial curricula were not striving for automaticity of the number facts and instead of teaching the traditional algorithms of arithmetic "my group" was (and is!) expected to explain our method to "your group" with the justification mathematically tenuous at best. Better to be told (even though many forget they were ever told!) than the blind leading the blind. Those videotapes were helpful in that regard as well. Stigler and Hiebert described the situation of genuine mathematical support of the process under study strikingly, or may be shockingly, similar to the percents at the Mathematics Renaissance schools, 0% of the US schools spent time on mathematically supportable proof. James W. Stigler and James Hiebert, Phi Delta Kappan 79, No. 1 (September 1997) 14-21:

> "One feature on which the team members focused was deductive reasoning, a form of mathematical activity that they considered central for students' engagement in important mathematics. They defined deductive reasoning as the reasoning needed to draw logical conclusions from premises. Mathematical proofs are the most familiar form of such reasoning. Deductive reasoning, as defined by the Math Group, was not common. Only one-fourth of the 90 lessons contained instances of it. As it turned out, these instances were found in 62% of the Japanese lessons, 21% of the German lessons, and 0% of the U.S. lessons."

Relevant to the Mathematics Renaissance situation described earlier, one of the precepts of US-style "reform math" is avoidance of direct teaching ("lecturing" is a dirty concept if not a dirty word). Although still far short of the Japanese instructional quality, ordinary US classrooms were observed doing better than the Mathematics Renaissance classrooms:

> "Although it is true that Japanese teachers give students time to struggle with challenging problems, they often follow this up with direct explanations and summaries of what the students have learned. This is why Japanese teachers were coded as engaging in more

> direct lecturing than either German or U.S. teachers. Although the time devoted to lecturing was minimal in all three countries, 71% of Japanese lessons contained at least some lecturing, compared with only about 15% of German and U.S. lessons. Japanese teachers also control the direction of the lesson in subtle ways, such as creating conditions in the classroom that will govern the kinds of solution methods students are likely to invent. For example, to begin a lesson, they often select problems that can be solved by modifying methods that were developed during the previous lesson."

Don't miss the clear necessity of well-qualified classroom leadership.

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Back to Takahashi's mistaken description of what was developing in Japan (exemplary teaching was already there!):

> "Over the next 12 years, as the Japanese educational system embraced this more vibrant approach to math,"

There is some historical fact in his description of moving toward the NCTM model of the blind leading the blind (instead of top-quality mathematics classrooms as documented). This was due to the growing professional mathematics education (as opposed to the discipline of mathematics) influence in Japan but well before the end of the 2000s falling performance for university preparedness and international comparisons had created quite a stir - their own Math Wars:
http://www.nippon.com/en/in-depth/a00601/

> "This time protest would come from universities. And rather than educational researchers or arts instructors, it was the math and science instructors who were speaking out."

Specific implications for current Japanese classrooms can be seen in an interesting, if little-known, late 2000s study of careful observation of representative middle schools in Japan conducted by Linfield College. The study indicate that these classrooms are highly reminiscent of my own precollegiate experience and the way we usually conduct university-level courses; announcement and summary : http://www.linfield.edu/linfield-news/students-and-prof-examine-why-japan-outsmarts-u-s-in-math-scores/

> "Students sit in rows and are expected to listen quietly. Teachers rely on direct instruction rather than investigative mathematics, but although they ask few questions, the questions they do ask are useful in guiding student understanding."

Given the heavy reliance on calculators in the early grades and graphing calculators later on in American-style "reform math" (coinciding with downplaying of competence with the standard algorithms of elementary school mathematics), the following is enlightening:

> The biggest surprise was a shocking lack of technology in Japanese classrooms. "Not a single student pulled out a calculator during class," Drickey said. There were no overhead projectors, televisions, computers or laptops.

> "But lack of reliance on technology may lead to higher scores for Japanese students," she said. "The ability to think mathematically, without the aid of an outside source, could help students process mathematical problems more accurately and efficiently."

Unfortunately, I do not have an easy referral reference to the full school-by school data but I will provide it on request.

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> "It wasn't the first time that Americans had dreamed up a better way to teach math and then failed to implement it. The same pattern played out in the 1960s, when schools gripped by a post-Sputnik inferiority complex unveiled an ambitious "new math," only to find, a few years later, that nothing actually changed."

There are several levels of misconception involved here. Perhaps the most important is that the New Math of the late 50s and 60s was incomparable with "reform math" embodied in the *NCTM Standards*. I was in college and a young high school mathematics teacher (inner suburb of Chicago) so well aware of that reform movement and its practicality or lack thereof in a real-world school. I was well aware of, and liked, the iconic curricula of the School Mathematics Study Group (universally abbreviated SMSG) but it never could have worked at my high school. A large part of the problem was that reported "inferiority complex" had convinced some mathematics education leaders (who were then highly mathematically competent) that US mathematics needed more formality, almost the antithesis of "my group has decided" of the modern "constructivist" era. In fact, some of the New Math curricula was TOO formal for almost every high school student, not just the teachers who were generally mathematically competent (for the mathematically initiated, think Bourbaki). An example of that would be Max Beberman's curriculum of the University of Illinois Committee on School Mathematics (UICSM). It purported to be "discovery learning" but it was only in the sense of (again, for the mathematically initiated) the "Moore Method" of R. L. Moore.

SMSG was workable at some places and did have positive influences on curricular development but from its inception it could not have work generally. Interestingly, the seminal meeting for SMSG was held at Stanford University and the "god" of discovery learning in problem solving situations, George Polya, (his *How to Solve It* books are, by some, almost taken as divine writing) was in residence and strongly encouraged to participate. He wanted nothing to do with the project because he was sure it was a failed effort before it ever started. Great for a select few and a train-wreck in the making for the masses in ordinary classrooms with ordinary students and ordinary instructors.

There was a more fundamental problem with the "need for" the New Math, however; inadequate mathematics instruction was not the reason for the "inferiority complex". In fact, long before newly educated math-based scientists were having an influence, the US had long since left the USSR and the rest of the world in the dust. Those same "poorly math educated" scientists and technicians had proved that there was no reason for a feeling of inferiority. I'm glad that the NSF (National Science Foundation) spent a lot of money educating me - and I would like to see more of the same for mathematically talented students now - but Sputnik only provided the political impetus, not a genuine necessity. From a one-room country school through a small Iowa high school, I got the mathematics knowledge base that I needed and so did several others in my small class. Moreover, that situation was highly representative of the nation. We were getting a much higher percentage of students genuinely prepared for (I hate the term) STEM careers. Too much drill-and-kill arithmetic in the early years? Certainly, and I hated it, but there were plenty of word problems that were motivating and the right seeds had been planted. In those terrible bubble-in-your-answer state tests (the Iowa Tests of Basic Skills), I consistently busted the top in spite of those awful teachers and awful math curricula. Sarcasm switch off - a modest reform would have been reasonable but the attempt for a revolution was unwarranted.

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> “The unschooled may have been more capable of complex math than people who were specifically taught it, but in the context of school, they were stymied by math they already knew. Studies of children in Brazil, who helped support their families by roaming the streets selling roasted peanuts and coconuts, showed that the children routinely solved complex problems in their heads to calculate a bill or make change.”

Why are we not surprised? These infamous street urchins of Recife in mathematics education literature being recycled yet again?! How long has it been now, a couple decades at least, maybe three? If it weren’t for schools (and too many don’t have access to good ones) these kids would be both illiterate and innumerate. Able to sell seashells by the seashore and get the money right? Certainly. Math-based career opportunity because of this street experience? Well...

> “When cognitive scientists presented the children with the very same problem,…”

What real cognitive scientists would do is try to somehow measure future potential because of this unusual street experience. My guess is that a well-run (lots are NOT) HeadStart experience followed by a good elementary school math program would be much better academic preparation than a decade or more trying to scratch out a living on the streets of Recife.

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> “Lampert tells the story of how one of her fifth-grade classes learned fractions. One day, a student made a "conjecture" that reflected a common misconception among children. The fraction 5/6, the student argued, goes on the same place on the number line as 5/12. For the rest of the class period, the student listened as a lineup of peers detailed all the reasons the two numbers couldn't possibly be equivalent, even though they had the same numerator.”

What a ridiculous waste of zero-sum math time, especially in 5th grade with a 3rd, or at most 4th, grade concept. Take 5 or 10 minutes, if necessary, clearly review the concept and move on!

> “A few days later, when Lampert gave a quiz on the topic ("Prove that 3/12 = 1/4 ," for example), the student could confidently declare why: "Three sections of the 12 go into

each fourth."

Confidently declared or no, as a stand-alone statement, it is pure nonsense - the number 12 doesn't have "sections" although it is easy to read into it what he meant. Calling it a "proof" is ridiculous but it is informative. It probably means that Ms. Lampert never understood "sophomore geometry" or any other mathematical proof. It amazes me that the last generation or two of professional mathematics education has been able to do what a couple of millennia was not able to do; kill the greatest gift of the ancient Greeks to modern thought, semi-formal deductive logic. Sin has many forms. As we saw from the Stigler and Hiebert observations, the Japanese schools knew better and know better.

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> "With the Common Core, teachers are once more being asked to unlearn an old approach and learn an entirely new one, essentially on their own. Training is still weak and infrequent, and principals — who are no more skilled at math than their teachers — remain unprepared to offer support."

This is all true and it is an insurmountable problem. These people are "in the pipeline", often with tenure but at the very least with an implied "property right" having served for years with glowing evaluations. Their mathematics competence will never be at the level needed to conduct such an environment effectively; it is very hard to "carry it off" well with good mathematics skills and teaching talent let alone a lifetime of (understandable) math avoidance. The part that is not understandable is how we have long since ignored mathematics competence among teachers and administrators. Beyond that insurmountable problem is the surmountable one that professional math ed refuses to face, independent and objective assessments of (borrowing a term from medicine) efficacy and toxicity; i.e., potentially negative side effects. Math ed "research" and education "research", in general, does not come close to reputable standards of research. The medical admonition, "First Do No Harm", needs to be addressed and it has not been for the *CCSS-M*.

> "Textbooks, once again, have received only surface adjustments, despite the shiny Common Core labels that decorate their covers. "To have a vendor say their product is Common Core is close to meaningless," says Phil Daro, an author of the math standards."

This is entirely accurate and it will remain so. As opposed to genuinely good standards (the California Mathematics Content Standards are great example), there is so much pedagogical fuzz deliberately embedded in the *CCSS-M* that such an evaluation is inherently, and inconsistently, subjective. Unfortunately, Mr. Daro himself is representative of the inherent problem of math education in the US. In spite of his long history of leading NCTM-style mathematics education reform in California and across the nation, his degree is a bachelors degree in English, not mathematics, not even a math-based academic discipline. That situation is pervasive throughout the professional education behemoth. Moreover, he comes with heavy baggage as the primary author of the mathematics portion of an earlier effort to reform education standards, The "New Standards Project", and as the principal author of its associated assessments, the *New Standards Mathematics Reference Exams* (*NSMRE*). Using the full data of the Pittsburgh Public Schools, Stanford's Jim Milgram and myself confirmed that the alleged enlightened results of the *NSMRE* were completely meaningless; worse, misinforming. Using exactly the same cohort of students, 4th grade in 2001 with the *NSMRE* and 5th grade in 2002 with the *PSSA*, the regular state exam for Pennsylvania, the highly touted - and NSF funded - math program of Pittsburgh was shown to be no more effective, especially with minority children from with low socioeconomic and low education level backgrounds, than other attempts have been there and elsewhere. Indeed, the data followed by on-site visitation, confirmed our suspicions; the objectively-assessed more successful schools had developed ways to compensate for the program or, in the best case, the school had purchased an entirely different math curriculum (much more traditional in nature) to be used whenever the MPs (Math Police) were out of sight.

What about the *NSMRE* versus systemwide exams? This traditionally low-performing cohort of students who, in 4th grade, had performed collectively a little above the national norm for ALL students were shown to really have been no better educated mathematically than the ugly pre-suppositions would have suggested. One year later, using the same *CCSS-M* friendly curricula and pedagogy, some 60% of these students were performing in mathematics Below Basic or Far Below Basic; life's handwriting already on the wall. (Data available on request.)

Not only was Mr. Daro's influence very strong in writing the *CCSS-M* (along with lead writers Jason Zimba and William McCallum), his New Standards Project experience does not bode well for the new-shiny assessments to go with the *CCSS-M*, especially those states with exams being prepared by SBAC, the Smarter Balanced Assessment Consortium. He is also in charge of the mathematics assessment therein. Not only does his instrumental involvement with the *NSMRE* offer reasonable concern, he was also actively involved in the other forerunner of these "new" assessments, the *MARS Balanced Assessments*. In spite of lots of NSF and Noyce Foundation money, these exams are just as "off-the-wall" as are the *NSMRE*.

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> "Guiding the student through the exercise <snip> without understanding why. This can make for even poorer math students. "In the hands of unprepared teachers," Lampert says, "alternative algorithms are worse than just teaching them standard algorithms."

Addressing another observation of Magdalene Lampert, her reasonable assessment of this limitation of so-called discovery or constructivist pedagogy should not go unnoticed. In fact, I have observed several elementary school math classes doing exactly that; elaborately developed student small-group activities where students were to "discover" some important mathematical underpinning. Problem? I was the only person in the room, teacher included, who understood the activity. The activity took place including expensive "manipulatives", was completed and recorded as instructed, and neatly put away. Math lesson over with nothing accomplished except for babysitting.

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> "By 1995, when American researchers videotaped eighth-grade classrooms in the United States and Japan, Japanese schools had overwhelmingly traded the old "I, We, You"

> script for "You, Y'all, We." (American schools, meanwhile didn't look much different than they did before the reforms.) Japanese students had changed too. Participating in class, they spoke more often than Americans and had more to say."

Accurate as this may be, we seem to have a chronological problem. 1995 is almost two decades ago and the NCTM Standards had only been out for 6 years (1st edition in 1989) so the reported pervasive influence in Japan could not yet have had that influence. As the videotapes of the Japanese classrooms confirmed, their highly competent mathematics practices were already well ingrained and videotapes of a decade earlier would not have been all that different. One of the observations about the Japanese classrooms in comparison with the American ones in this "spoke more often" comment is that the Japanese classrooms were generally focused on the problem at hand, noisy for the sake of mathematics not for the sake of noisy. Seldom is that the norm in US classrooms but, if conditions are right, it is a delightful learning environment. In fact, I experienced it in one of my own high school classes, a senior-level class that the math teacher had been able to persuade the powers-that-be to offer for a few of us (5 or possibly 6) with strong math-based backgrounds as an introduction to university-level mathematics where we were all headed the following year. It was great. Joshing each other, including the instructor, helped keep the atmosphere relaxed but it was never malicious and always focused on the mathematics we were studying. Don't try that with 30-some students, many ill-prepared for the class and most of them required to be there against their will, and "led" by a teacher also ill-prepared for the class.

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> "Finland, meanwhile, made the shift by carving out time for teachers to spend learning. There, as in Japan, teachers teach for 600 or fewer hours each school year, leaving them ample time to prepare, revise and learn."

A little-known truth is that Finland's highly publicized jump to near the top-in-the-world math performance was only by education industry smoke-and-mirrors. Finland's performance on the *TIMSS* (now "Trends" because of its strong reputation but "Third" was in 1995) did not jump dramatically as casual observers would conclude from all of the publicity. No, it was based on using an entirely different international assessment. *PISA* (*Programme for International Student Assessment*) is an exam prepared by the Freudenthal Institute with lots of US math ed "insight" directing the process and it is an invalid indicator of mathematics competence. The fact is that Finland's actual mathematics competence has not improved. Updated *TIMSS* results exist and confirms that Finland's performance, as of 2011, remains so-so, very comparable to that of the US and far behind those Asian nations:
http://timss.bc.edu/TIMSS2011/index.html
http://timss.bc.edu/TIMSS2011/downloads/T11_UserGuide.pdf
Chapter 2, P 23 for 4th grade (Singapore still on top, Finland slightly behind US)
Chapter 3, P 57 for 8th-grade (Korea on top followed closely by Singapore, Finland slightly ahead of US)
Note: Although still high, officials in Japan were chafing at not being 1st or 2nd.

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> "Of all the lessons Japan has to offer the United States, the most important might be the belief in patience and the possibility of change. Japan, after all, was able to shift a country full of teachers to a new approach."

Rest assured, it is not the most important lesson - it is not even close. By far the most important is what Japan, Korea, Singapore, and lots of other high-performing nations have - something that used to be a given in the US but we have long since lost - mathematics competence of the teaching faculty, especially at the elementary level. In spite of its so-so performance, even Finland is considerably better off than we are in that regard; most countries are. Not only does the published research of the professional education industry fail to meet general academic standards, candidates for teaching are, generally speaking, poorly prepared coming in to college and weakly educated while there with grade inflation in professional education courses at a ridiculous level. Objective assessments of prospective teachers (primarily through the SAT and ACT) and those pursuing higher degrees, often in education administration, (primarily through the GRE) are consistently in the lowest quartile of college students. By contrast, prospective teachers in Japan are consistently in the top quartile and many from the top 10%. Jim Stigler (of the *TIMSS* video project and *The Learning Gap*) reported about an education PhD candidate from Japan that he met at a well-known university who was here in the US for a very enlightening reason: On completion of her preservice education to become an elementary school teacher in Japan, she had failed the rigorous competency exam required to become a teacher (think bar exam in the US). Rather than wait the mandatory year and do the prerequisite "cramming" to take the test again, she accepted an offer to pursue a PhD in education here in the US.

> "The other shift Americans will have to make extends beyond just math. Across all school subjects, teachers receive a pale imitation of the preparation, support and tools they need. And across all subjects, the neglect shows in students' work. In addition to misunderstanding math, American students also, on average, write weakly, read poorly, think unscientifically and grasp history only superficially. Examining nearly 3,000 teachers in six school districts, the Bill & Melinda Gates Foundation recently found that nearly two-thirds scored less than "proficient" in the areas of "intellectual challenge" and "classroom discourse." Odds-defying individual teachers can be found in every state, but the overall picture is of a profession struggling to make the best of an impossible hand."

Exactly my point. Moreover, expecting the professional education industry to change the status quo is like asking the leopard to change its spots. The heart of the problem is the so-called "professional" education emanating from our schools and colleges of education. It is worse than the blind leading the blind - at least the blind would try - the education industry has a strong vested interest in the status quo. No change is going to come from within and its tentacles reach into legislatures that control credentialing requirements that would have to be dramatically modified in order to effect real change. It will not happen.

Beyond the problems that impede substantial progress that were mentioned, there is another that is true in any academic area but overwhelmingly important in mathematics, adequate preparation of the students. The exciting kind of classroom of the Japanese videotapes (or of my own senior-level class that I mentioned) requires that the students all be engaged, at least mentally if not vocally. That is simply impossible in the US "ideal" - often legally mandated - heterogeneous classrooms. Mathematically weak students "turn off" very early, sometimes before the class even begins. At the other end of the spectrum, 5th graders "proving" that $4 \times 6 = 24$ by making 4 rows with 6 stars in each row, or some such, is ridiculous. It is an appropriate discussion item in 2nd or 3rd grade but it is educational idiocy that should badly irritate a well-prepared fifth-grader. Slightly more sophisticated, but still inappropriate at that level would be "proving" that $4 \times 6 = 6 \times 4$ by turning the paper 90°. Have 3rd-grade automaticity well in hand - among everybody - and move on. In US classrooms, too often that is totally unrealistic. Fortunately, at the university level (and US universities remain first-rate), we are not burdened by such ed industry insight where thousands of "research" publications allegedly "prove" that heterogeneous classrooms are best for everyone instead of the diametric opposite.

An excellent summary/admonition of what the nation should expect from all of the hoopla and funding, both private and public, trying to prop up the *CCSS-M* was given in that 1997 *Kappan* paper by Stigler and Hiebert:

> "**Beware of Simple Solutions**
> Given the high mathematics achievement of Japanese students, it is tempting to conclude that U.S. teachers should teach more like their Japanese counterparts. Although there are probably many useful ideas for U.S. classrooms in the Japanese videos, we are pessimistic that such ideas can simply be imported. Indeed, if teaching could be changed by just disseminating ideas, the record of reform in the U.S. would be more successful than it is."

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Some Relevant Background:

1988-90 Math Advisory Panel to CA's Credentialing Commission
1995 Superintendent's Math Task Force (CA first addressing the Math Wars)
1996 Invited Testimony to CA Assembly (regarding tentative education legislation)
1999 CRP (Content Report Panel for assessment of math curricula against *CA Mathematics Content Standards*)
2001 CRP (see preceding - after publishers had had legally mandated time for writing)
2002 Commissioned by Pittsburgh Public Schools to evaluate its math program (along with R. James Milgram, Philip Daro, and Uri Treisman - two critical and two supportive)
2005 CRP Interim Approval (an opportunity for publishers to resubmit)

Note: Some math curricula that did not make the California CRP approval in 1999 and/or 2001 was approved by the state in 2007 under the same *CA Mathematics Content Standards*. How come the inconsistency? Many states' standards, the *NCTM Standards*, and the *CCSS-M* include enough confounding pedagogy and lack of specificity that objective assessment of consistency is inherently impossible. The result, of course, is that all publishers point out how consistent their product is with whatever standards are in play. By contrast, the *CA Mathematics Content Standards* are quite clear in what should be considered to be grade-level compatible with them. How can a submission have been turned down in 2001 but approved in 2007 under the same standards with only cosmetic changes in content and pedagogy?

The answer has to do with the highly unusual nature of the 1999 and 2001 CA approval process that was already changing by 2005 and fully in place by 2007. The first CRP were very unusual in that degrees in mathematics education did not qualify for membership, mathematics only, and were given "trump rights" over the rest of the approval process. Even if we liked a particular curricular submission, we were obligated to reject it if it didn't pass muster against the *CA Standards*. Moreover, our decision was final. If it didn't meet the CA Standards, STOP. By 2007, there was no independent CRP assessment, only one CRP member on each evaluating sub-team of the curriculum committee at large. Democracy ruled, one person one vote, and some math curricula that did not meet CRP approval - and received a "no" vote - was approved for use in California. C'est la vie.

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