



Teaching Math Classically With Andrew Elizalde

Lesson 1: The State of Mathematics in America

Outline:

The State of Math Education in America

- Where are we right now in our mathematics education?
- How did we get here?
- What are the current explanations?

Where are we right now in our mathematics education in US?

- “Among 30 developed countries, the United States is ranked 25th in math, 21st in science. But when the comparison is restricted to the top 5% of students, the United States is ranked last” – Karl Weber, *Waiting for “Superman”*: How we can save America’s failing public schools.

How did we get here?

- Through cycles and cycles of reform reflecting the climate of public opinion, driven by elites outside the classroom.

Timeline

- 1905 – Carnegie Foundation established for advancement of teaching.
 - The need for a quantifiable unit to measure achievement – the Carnegie Unit: a single one-hour meeting, on each of five days per week for a total of 24 weeks per year.
- A minimum of these credits were then needed to enter universities
- Schools and universities still use this “period” system to this day Early 20th century – Administrative progressives arbitrating various reforms
 - Progressivism = students should test ideas by active experimentation. Learning is rooted in the questions of learners that arise through experiencing the world.
 - Inequalities in economic and social circumstances began to show.
- 1954 – Supreme court: *Brown v Board of Education*
 - Who is education for in America?
 - Campaign for equality, justice and desegregation
- 1957 – Deepening of the Cold War causes shift in values, departing from progressivism.
 - Back to basics approach with rigor and discipline
 - Education focused on being competitive



- “The solution, these reformists contended, was much more emphasis on focus on science, mathematics, and foreign languages and other traditional liberal arts. They wanted rigor, a demanding adult world of discipline and high cognitive expectations for the mostly dull and disorderly young of the nation.” – Tinkering towards Utopia
- Late 1970 to early 1980: The focus on the basics continued, with a focus on hard work and international competitiveness.
 - Forms of assessment of progress were established – standardized tests
 - State mandated minimum competency testing = drill and kill approach to teaching basics
 - Inattention to complex thinking – students just needed to perform well on these standard assessments.
- Late 1980 to late 1990 – Discourse focused on international competitiveness as measured through test scores.
 - The United States was found to not be competitive with other nations – general mediocrity.
 - The back to basics approach was not translating to stellar performance on standardized tests nor economic competitiveness.
- Mid 1990s to 2013 - India and China growing and education improving (The Global Education Reform Movement), while there was stagnancy in US.
 - Since 1971 we doubled amount of money we spent per child in public education, but performance remains flat
 - Nothing to show for the cycles of reform efforts in the United States.

How are people explaining the current mediocrity?

- **Problems in the way the material is taught**
 - *An Excess of Shallow Content*
 - Teachers make decisions on what to cover and what to omit based on a variety of factors, such as what is on the test, or what they deem can be pushed to future teachers, or simply their comfort level with the text.
 - This makes transitions from one level to another difficult as it is impossible for teachers to know what has been omitted by previous teachers, causing great gaps in education
 - When core curriculums exist, they become somewhat of a checklist to be gotten through.
 - Reforms in curriculums seem to be ways to “teacher-proof” the subject.
 - The mathematics textbook is dull, spiritless and unoriginal, “insufferably dull”
 - Conscious decisions are often made to include a huge breadth of topics that cannot be gotten through in a semester, due to the desire for the textbook to be marketable.



- “Intriguingly, fragmentation of US teacher’s mathematical knowledge coincides with fragmentation of mathematics curriculum and teaching in the US found by others researchers as major explanations for unsatisfactory mathematics learning in the United States. From my perspective, however, this fragmentation and coherence are effects, not causes... what caused the coherence of the Chinese teacher’s knowledge, in fact, is the mathematics substance of their knowledge.”
– Ma, *Knowing and Teaching Elementary Mathematics*
- **A curriculum that has repetition and review, but lacks enrichment and extension.**
 - *The Problem of a fragmented curriculum*
 - The curriculum is not cohesive or cumulative,
 - There are too few opportunities for reintegration and resynthesis, rather there is a list of topics to learn and revisit in a seemingly haphazard way where topics increase in complexity but not in relationships with other topics.
 - Students might even be distracted by old concepts while they learn new ones.
 - In Pierre van Hiele & Dina Van Hiele-Geldof 1950s research on high school geometry, they found high school students unprepared for the course because they had not had the opportunity to advance to the right stage of mathematical thinking from previous classes.
 - “The practical error is not to load the memory of the student with a mass of undigested knowledge, but to force upon him so much that he has rejected all. It has been the error of distracting and enfeebling the mind by an unmeaning profusion of subjects; of implying that a smattering in a dozen branches of study is not shallowness, which it really is, but enlargement, which it is not” -Newman, *The Idea of a University*

What does it mean to do mathematics?

- *What is mathematical aptitude?*
- *Mathematics is seen as a set of skills and algorithms to be memorized and learnt quickly and efficiently, with very little use in real life. If we are unaware of one of the highest values of learning mathematics – that is, learning critical thinking – we resort to weak justifications of usefulness and focus on individual pieces.*
 - The modular, piecemeal approach to teaching encourages quick teaching and moving on.
 - Students are under challenged as teachers subscribe to an ability-based model rather than an effort-based model.
 - The ability- based model that affords excuses, overvalues efficiency, minimizes errors,



- The effort-based model rewards effort, hard work and considers errors a part of learning process
- Mathematical aptitude is measured by the speed of which sets of problems are done and the number of mistakes in them
- Mathematical exercises are a series of rapid insights rather than problems to wrestle with.
 - If a mathematics problem is solvable, it should be solvable within 10 minutes
 - The longest students are expected to spend on a mathematical problem in an AP Calculus test is 15 minutes
 - Andrew Wiles spent 7 years proving Fermat's Last Theorem
- Students are taught to do math, but are given efficient bites instead of full meals. How are they expected to learn to love math?
 - "Young children in the United States are becoming literate in a literal sense; that is, they are mastering the rules of reading and writing, even as they are learning their addition and multiplication tables, what is missing are not the decoding skills, but two other facets, the capacity to read for understanding and the desire to read at all." – Gardner, *The Unschooled Mind*
- The teaching of mathematics is now mechanical, perhaps reflective of the Industrial Revolution.
- Word problems and story problems as decoding exercises rather than a chance to think meaningfully about the problem and the tools at the student's disposal.
 - Word problems also seem to be weak attempts at justifying the usefulness of mathematics

Takeaways

- Be aware of the goal of mathematics – to promote critical thinking
 - Mathematics teach students to evaluate what they know and don't know, what
- methods they have
 - Students should be allowed to grapple with the material - teaching through problem solving, with tools.
 - The curriculums should be revised to give the students the skills they need in a cumulative way, presenting the toolbox as a whole
 - A deep content knowledge is crucial for any teacher who seeks to require their own pedagogy
 - Teachers should devote themselves to developing their own individual pedagogies and philosophies – what does it look like to educate a child?