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Systems Thinking

When a system is broken:

- Improving all its users is not the solution.
- Improving the system is the answer.
- Trying to improve all the users of a system doesn’t work.
Systems Thinking

In a well designed system:

- Good users of the system making a good effort achieve great results.

In a broken system:

- Great users making a great effort achieve only good results.
- Good users making a good effort achieve poor results.
Our Current System of Education

- High levels of student failure and wide variance in teacher performance reveal a poor system.
- We must transform our system of education.
Two Examples of Systems

Two examples:

- First, an apocryphal story.
- Then, a real example.
A Fictional Example

At a town hall meeting the problem of a local intersection was discussed.
Dangerous Intersection

As the town had grown, an increasing number of accidents were occurring at this intersection.
Best Predictor of Success

The local driving school proposed that for $1000 a driver, they could increase the quality of the drivers and only let the best ones drive.
Driving safety was a high town priority so the town agreed to the expense.

They spent a lot of money, and raised the average quality of drivers.
Taxes went up.
People started leaving town to avoid taxes.
As did those who lost their driving licenses.
And the intersection still wasn’t safe.
The town was in decline.
A Radical Proposal

With the town on the edge of collapse, a radical proposal was made.
So Any Reasonable Driver Succeeds

A traffic light would make the intersection safe for any good driver making a reasonable effort.
Systemic Change
So Any Driver Can Succeed

With a good system, most people succeed with a reasonable effort.

Improving systems is cheaper, easier and yields better results than improving its users.
U.S. car companies lost market share to Japanese companies due to quality and price.

Many believed that American workers could not produce the same quality, at the same price, as Japanese workers.

But, it was later shown that Japanese cars were designed with half the parts as American cars.
This was part of an overall more effective system of designing and producing cars.

It was not the workers, it was the quality of the system.

Now, that Lean Thinking has been adopted in the U.S., quality and price are competitive.
W. Edwards Deming

The Japanese had adopted the philosophy of an American in designing their system of production: W. Edwards Deming.

His philosophy was only adopted in the U.S. after transforming Japan.

Fundamental to his philosophy is to never blame the workers for poor quality, that is always the result of management.
Deming Quotes

“The worker is not the problem. The problem is at the top! Management!”

“…don’t blame the singers (workers) if the song is written poorly (the system is the problem); instead, rewrite the music (fix the system).”
Good Books for Systems Thinking

1. Lean Thinking
   - James P. Womack and Daniel T. Jones

2. Out of the Crisis
   - W. Edwards Deming

3. Thinking in Systems
   - Donella H. Meadows
      - Edited by Diane Wright, Sustainability Institute
Good Books for Systems Thinking

- The Structure of Scientific Revolutions
- The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail
- The Fifth Discipline: The Art & Practice of the Learning Organization

These books provide insights into systems thinking and are highly recommended for anyone interested in understanding complex systems and organizational dynamics.
Every system must address a need.

When needs change, systems must change.
The Current System

- In the past, there were jobs for people who did not learn science or math.

- Those jobs are shrinking in number.

- Science and math courses were used for selecting pathways for students, not elevating all students.
PSI-PMI

PSI-PMI was designed to address the need that:

Societies must improve STEM achievement as an issue of social justice and international competitiveness.
Science and Mathematics

Many 21st century jobs require prerequisite learning in science and mathematics:

Science  Medicine
Technology  Computer Science
Engineering  Agricultural Science
Mathematics  Veterinary Science, Mining, etc.

Employment in these fields is strong and growing.
Science and Mathematics

Many other 21\textsuperscript{st} century jobs are linked to the analytical thinking of science and mathematics:

Business
Finance
Urban Planning
Design

Investment Banking
Law
Corporate Planning
Architecture, etc.
The Current System

- Too small a percentage of students are successful in math and science.
- Traditional approaches towards curriculum, pedagogy and assessment have failed many.
- The teaching of these subjects has screened students out, not welcomed them in.

This is no longer acceptable.
The System must be Transformed

The current system of education was addressed to a different need.

Pushing on it harder:
- Stresses students and teachers,
- Doesn’t improve student learning or test results

Like forcing a key in the wrong lock; turning it harder breaks the key, but doesn’t open the lock
A new system of education.

The results have been dramatic and show that it is practical to transform education rapidly.

As a results these programs are spreading.
The PSI-PMI System of Education

- Rigor and Stress Are Decoupled

- Student learning and enjoyment rise.

- Teacher satisfaction and effectiveness improve.
The PSI-PMI System of Education

- Mathematics and science become demystified.
- All students see their basic human character.
- They are no longer the exclusive domain of those who succeed despite the old system of teaching and learning – the “elite”.
The PSI-PMI System of Education

Integrates: Pedagogy
Curriculum
Assessment
Teacher Development
The PSI-PMI System of Education

Converges: The Written Curriculum
The Taught Curriculum
The Assessed Curriculum
The Learned Curriculum
Structure of Classroom Learning

- Topics each have direct instruction and about six formative assessment questions.

- Units are comprised of Topics

- Courses are comprised of Units

- Education is the sequence of K-16 courses
The Teacher’s Role Shifts

To teaching: communicating, engaging and motivating students.

Away from “lesson planning”.

No more individually designed assessments or lesson plans.
Teacher Created Digital Courses

- Creating these courses is complex and time consuming - beyond the capacity of a single teacher.

- Teams of teachers create digital courses.

- The artisan model of lone teachers handcrafting lessons and assessments is obsolete.
Curriculum Coherence

- Vertical alignment: each year builds the foundation for the next year
- Horizontal alignment: what is learned in math is used in science; examples from science are used in math
- No dead-ends: Only what is used is retained by students. If it won’t be used again, don’t teach it.
PSI HS Science Sequence – Minimum

9th Grade
- Physics
- Algebra

10th Grade
- Chem
- Geom.

11th Grade
- Biology
- Algebra II & Trig

12th Grade
PSI HS Science Sequence – Minimum

9th Grade: Physics

10th Grade: Chem

11th Grade: Biology

12th Grade: Algebra, Geom., Algebra II & Trig
PSI HS Science Sequence – with APs

9th Grade

Physics

Algebra

Geom.

10th Grade

Chem

AP Physics

Geom.

Pre Calculus

11th Grade

Biology

AP Chem

Algebra II

12th Grade

AP Bio

AP Calc