Thinking Scientifically

An educational approach to systematizing the way we use knowledge
What’s the problem?

- Teaching is an art, not a science!
- Science is about measurement and causation, education is about context.
  - Education variables are hard to measure
  - There are too many variables to measure
  - We haven’t defined the variables to measure
  - Science provides either incomplete information or information on such a narrow domain that it is useless at best, inaccurate at worst.
Getting past the problem

- Make science relevant for teachers, not just scientists
- Demystify science and research
  - Scientific dispositions and methods
- Change teacher perceptions
  - Exposure to scientific processes and outcomes
- Move from teaching science to modeling scientific dispositions within teacher practice
Waking up

- What was the very first thing you did when you woke up this morning?

- Immediately started asking questions, collecting data, analyzing data, building conclusions.
  - What time is it? What am I doing today? What is the weather/traffic? How should I dress?
Scientific Dispositions

- We are inherently scientific beings

<table>
<thead>
<tr>
<th>Casual/informal</th>
<th>Causal/formal</th>
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</thead>
<tbody>
<tr>
<td>Scientifically haphazard</td>
<td>Scientifically methodical</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Personal/Individual</th>
<th>Scientific Method</th>
<th>Broad/Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited capacity to test</td>
<td>Observation</td>
<td>Theory based</td>
</tr>
<tr>
<td>Haphazard</td>
<td>Hypothesis/question</td>
<td>Systematic</td>
</tr>
<tr>
<td>Informal</td>
<td>Data collection</td>
<td>Formal</td>
</tr>
<tr>
<td>Responsive</td>
<td>Analysis</td>
<td>Intentional</td>
</tr>
<tr>
<td>Personal</td>
<td>Sharing</td>
<td>Communal</td>
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<tr>
<td></td>
<td>Refinement</td>
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</tbody>
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Scientific dispositions

- Scientific dispositions are about systematic process, broad definitions and outcomes
- Systematize the process and intentionally apply to practice
  - Observation
  - Hypothesis/question
  - Data collection
  - Analysis
  - Sharing
  - Refinement

Second Annual International Conference on Building the Scientific Mind, Vancouver, Canada
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Scientific dispositions

- Expand the definitions:
  - Observations and data extend beyond test scores or quantitative data and can include multiple data sources and formats
  - Hypothesis/question can be embedded in practice and personally focused
  - Analysis (systematic not necessarily complex)
  - Sharing (collegial and informal)
  - Refinement (collegial and supportive)
Scientific dispositions

- Expand the outcomes
  - Science is not about causation and certainty
  - It is about the minimization of uncertainty
  - How many planets are in the solar system?

- Research in education is not causal
  - Research informs policy and practice within current contexts, rather than constraining it across contexts.

- Research is simply one more data point
Implications

- If we view science, knowledge, and data in this manner, what are the implications for policy and practice, and how can this vision be operationalized?
Implications

- Requires that teachers be sophisticated consumers of research
  - Understanding of scientific method, data gathering methodologies, and of appropriate data analysis procedures
- Teachers must become scientifically literate
- Teachers must become systematic in their practice
  - Proceed toward a defined goal
- Teachers must become intentional in their practice
  - Teachers do what they do for a reason
Operationalizing

- Support systemic *observation*
- Build intentional reflection and *questioning*
- Increase access to *data*
- Focus on *analysis* skills
- *Share* professional knowledge
- *Refine* observations
Operationalized

- Reflective practice
  - Record *observations* of daily experiences
  - Ask *questions* about those observations

- Action research
  - Gather *data* to inform those questions
  - *Analyze* the data to answer the questions
  - *Test* your answers to refine your knowledge

- Professional Learning Communities
  - Share observations, questions, data, analyses across systems

- Systems thinking
  - Expand conception of data and data gathering networks
Building the scientific mind

- Strengthening scientific frameworks teachers use to interpret data
  - By using the scientific method to model scientific dispositions

- Democratize knowledge, increase data points
  - Open access, knowledge networks
  - Building skeptical knowledge consumers

- Applying the scientific frame across contexts
  - Content neutral (variation occurs within the frame without altering the framework)
Questions and comments

- Questions?
- Comments?
- Lengthy testimonials?