
Leverage Points: Places to Intervene in a System

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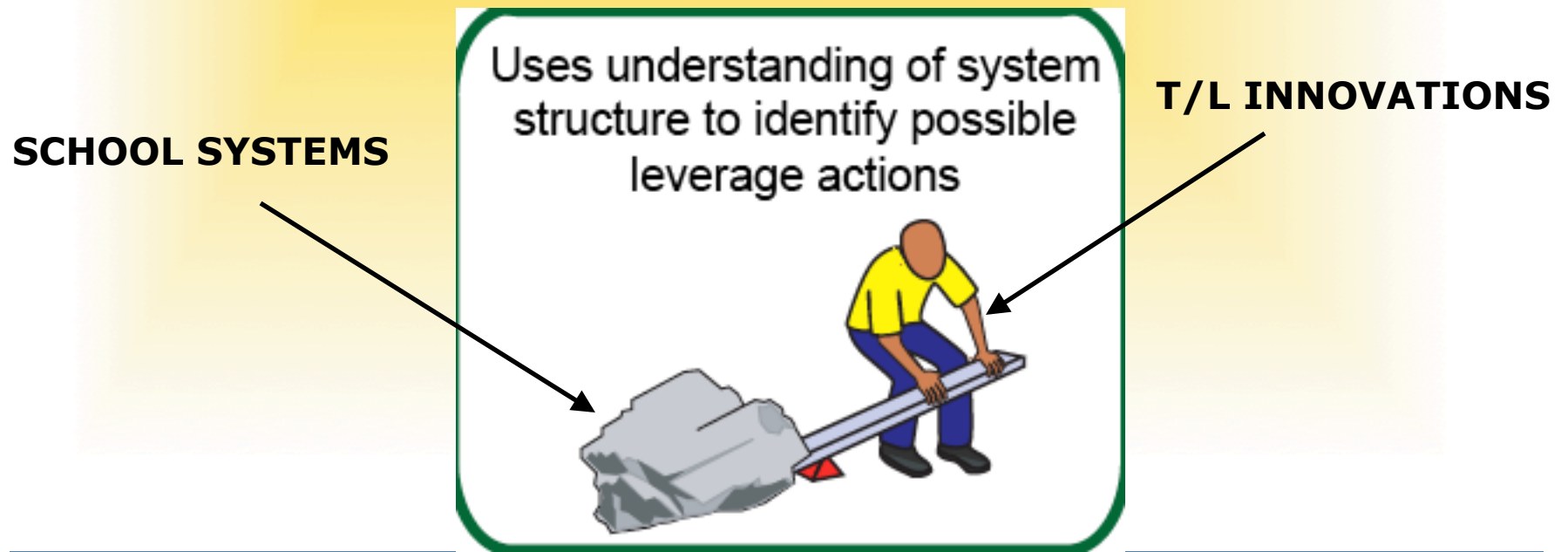
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Leveraging Power or Ideas

Positional advantage; power to act effectively



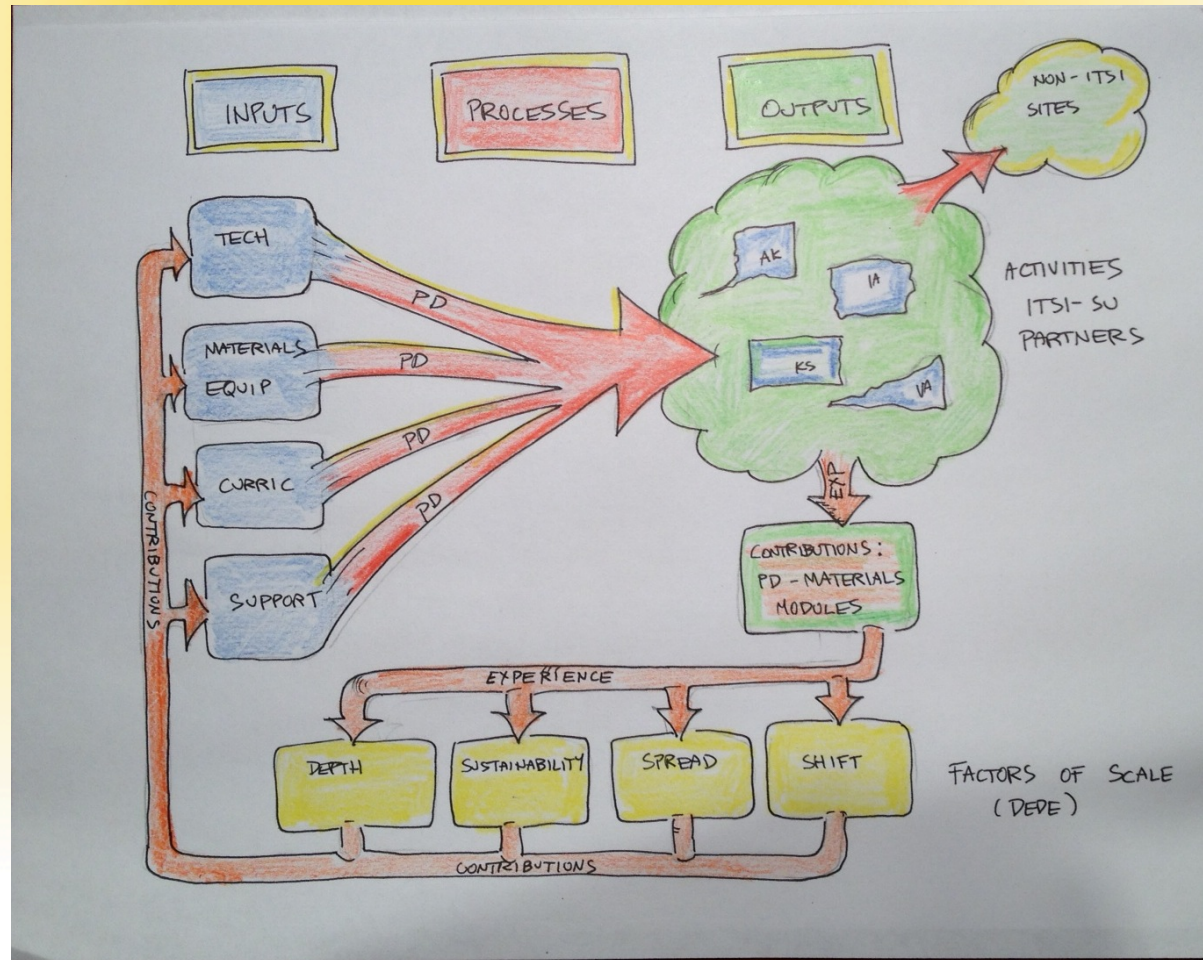
ITSI-SU Project

Innovative Technology in Science Inquiry Scale Up

- ❑ ITEST (NSF), Concord Consortium
- ❑ Alaska, Iowa, Virginia, Kansas state cohorts >250 teachers Year 3/5
- ❑ Web-based science simulations, probeware, modeling for gr. K-12 students
- ❑ Teacher online community
- ❑ Online assessment systems



My fuzzy logic model: ITSI-SU



Systems Levers

Small Movement: Large Effects

12 Systems Levers: Donella Meadows

- Numbers
 - Buffers
 - Stock and Flow Structures
 - **Delays**
 - Balancing Feedback Loops
 - **Reinforcing Feedback Loops**
 - **Information Flows**
 - Rules, Incentives
 - Self-Organization
 - Goals/Purpose of system
 - **Paradigms**
 - Transcending paradigms
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Lever: Delays

- Delays are critical relative to the rate of change in the stocks the feedback loop is controlling: You're looking for oscillations, as any system will have
 - Too short a delay: overreaction
 - Too long a delay: sustained or exploding oscillations
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Delays: Too Short

- ❑ Too short a delay: overreaction
 - ❑ Example: all the kids are doing online science and using probes immediately, their test scores rise immediately) what's wrong with this data?
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Delays: Too Long

- ❑ Too long a delay: sustained or exploding oscillations
 - ❑ Feedback that is irrelevant or useless
 - ❑ Example: typically school system feedback occurs only as a function of standardized test results; is there anything the intervention can do to shift this focus?
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ITSI Delay: Classroom

- ❑ Student content knowledge: Teachers have students take online assessments pre/post before each unit. For the research purposes of the grant, sent back to CC.
 - ❑ Not analyzed until after several months, then reported to PI, or following year.
 - ❑ Leverage point: If feedback were immediate (within days), teachers would refine instruction and implementation designs the next time (e.g. INK-12 immediate laptop response 4th grade math)
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ITSI Delay: Regional

- ❑ Local/regional adoption: In a district, the response and feedback of implementation e.g. Anchorage: (how many teacher Yr 1, Yr 2, Yr 3) grows; as a function of hearing about earlier cohorts
 - ❑ Hypothetical: district adoption into a pay-service model; they want to see results in their language: standardized science exam scores, but by the time these will be analyzed, reported, and tied to ITSI classroom activities (2-10 contact days/year), will be irrelevant, too late after project funding.
 - ❑ Leverage point: difficult to enact b/c funding timeline, needs several years of repeated practice
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Lever: Reinforcing Feedback Loops

- A reinforcing feedback loop is self-reinforcing: the more it works, the more it gains power to work some more, driving system behavior in one direction, either positively or negatively
- more people have flu, the more will get infected, more will get the flu and infect more
- the more money you have, the more you'll make, you invest more, you make more
- more the polar ice cap melts, the less reflected albedo decreases, less radiant energy reflected back, more heat retained, more ice melts



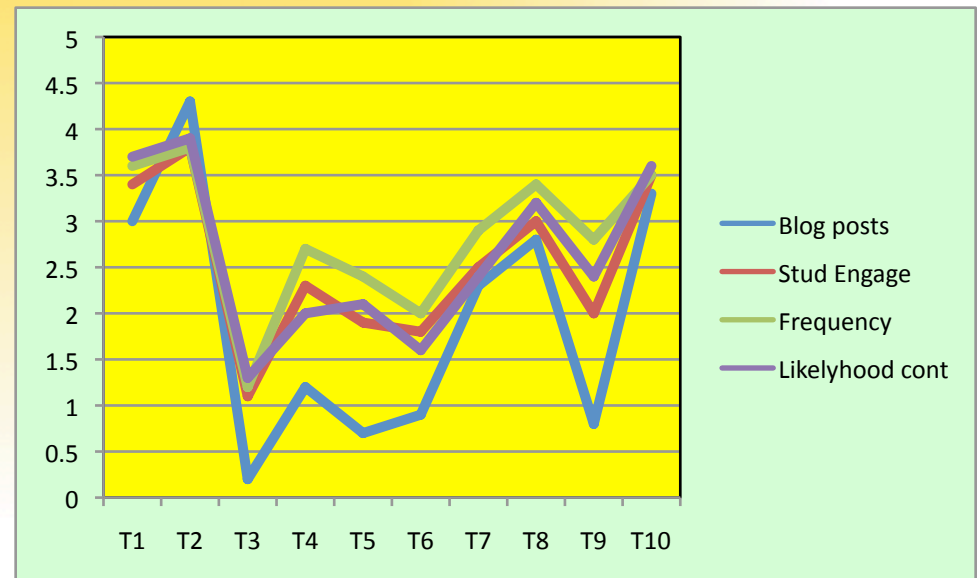
ITSI: Reinforcing Feedback Loop

- ❑ ITSI: teachers online course: 5 consecutive weeks Fall & Spring
 - ❑ Required participation, includes assignments, readings, peer review of lessons. Lesson plan posting and blog area for discussion/response
 - ❑ Required 2 posts/week, some participate more than others
 - ❑ More they blog, the more they'll receive a peer response, the more they'll blog/contribute, inevitably positioning them to implement better; the less they participate, the least likely they are to engage fully, build community, they are then left out, implement poorly
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ITSI: Reinforcing Feedback Loop

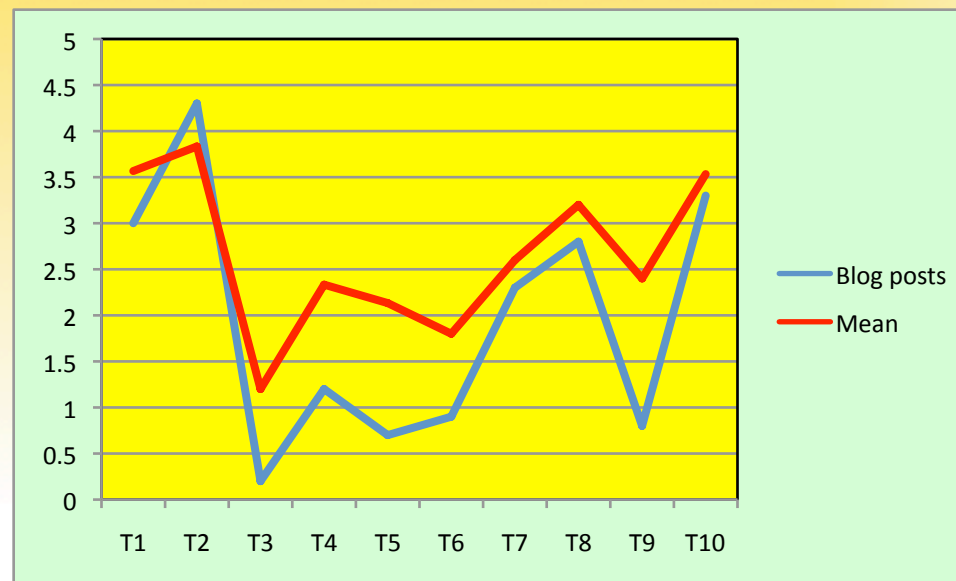
ITSI: teachers online course: 5 consecutive weeks Fall & Spring
Relationship of Frequency of blog posts to:

- Student engagement
- Frequency of ITSI activities
- likelihood to continue



ITSI: Reinforcing Feedback Loop

- Blog frequency: class dimension means



ITSI: Reinforcing Feedback Loop

- How is this useful?
 - By encouraging teachers simply to post (anything, even trivial), their overall performance might improve as a result of increased support → sense of community → increased motivation → improved classroom experiences with program → increased likelihood to continue
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Lever: Information Flows

- ❑ The structure of who does and does not have access to information
 - ❑ Missing information flows are one of the biggest causes of system malfunction
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ITSI: Information Flows

- ❑ Technical—online access, getting computer lab to work (IT/tech director or school firewall, etc.)
 - ❑ Fundamental computer comfort; this knowledge or lack of will considerably impede project advance
 - ❑ Case of school with poor access, took months, until CC visited, got online between programmer at CC and IT person; things fixed in ½ hour; Understanding this information flow helps design issues
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The Tough Levers: Paradigms

- ❑ Highly valued lever of Paradigms: how not realized or observed yet. What that might look like
 - ❑ Why deep change
 - ❑ Why not seen yet
 - ❑ What it might look like
 - ❑ Is it ok as an evaluator to expect to see this?
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