Teaching a System Dynamics Approach
(in a variety of “educational” settings)

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Teaching a system dynamics approach

ABSTRACT

The system dynamics approach has long been viewed as a powerful framework for building understanding and improving performance in dynamic systems. However, anecdotal evidence suggests that there may be challenges for would-be practitioners in developing facility with “best practices” necessary for effective use of the approach. One possible source of these challenges may be our approach to teaching and learning system dynamics.

In this presentation, I share one perspective on teaching and learning system dynamics. Drawing from over 35 years’ experience working in the field—in software support, in workshop design, development and delivery, in consulting, and as a university instructor—I describe elements of a learning-by-doing approach that supports the development of best practices. I show how the approach is used in a 10week undergraduate course at an Ivy League institution, and I illustrate how elements of the approach can be used to support thinking in systems in the context of a short, issue-focused workshop. Informal observations on learning outcomes in a variety of educational contexts are offered. These provide a context for focused discussion on how we might do a better job of helping people to learn how to use system dynamics approaches to think, learn, and improve their world.

Teaching a system dynamics approach

OVERVIEW

- My objectives for this session
- Some historical context
- How do people learn this stuff?
- Elements of an approach that seems to work
- A few examples
- Discussion

My objectives for this session

1. Share one perspective on teaching and learning a system dynamics approach
2. Create a space for discussion around how we might…
   - Do a better job of helping people to learn how to do this
   - Do a better job of helping people to use this stuff to think, learn, and improve their world

Some historical context

LOTS OF YEARS, LOTS OF EXPERIENCE, VERY GOOD MENTORS

- SD focus in grad school (Meadows, Meadows, Richmond, early 1980s)
- Multiple years in SD software business focusing on user support and training (Richmond, 1980s-2002)
- Independent consultant delivering workshops + projects in defense, pharma, not-for profit, national labs (collaborations with Lexidyne, Paich, others. 2003-Present)
- Semi-academic, teaching SD at Ivy League institution (2010-present)

How do people learn this stuff?

A FEW OBSERVATIONS

- Motivation for learning is often *instrumental* rather than *intrinsic*—capabilities are developed *in order to* achieve some other goal rather than simply because this stuff is extremely cool[1]
- Developing significant expertise requires deliberate practice (often at the edges of one's comfort zone)[2]
- To get good at this, you need good coaches! [2]
- You *learn* SD by *doing* SD

(1) Schank, R.C., 1995. *What we learn when we learn by doing*. Northwestern University.
(2) Ericsson, K.A., Prietula, M.J. and Cokely, E.T., 2007. The making of an expert. *Harvard business Review*, *85*(7/8), p.114.

Design considerations

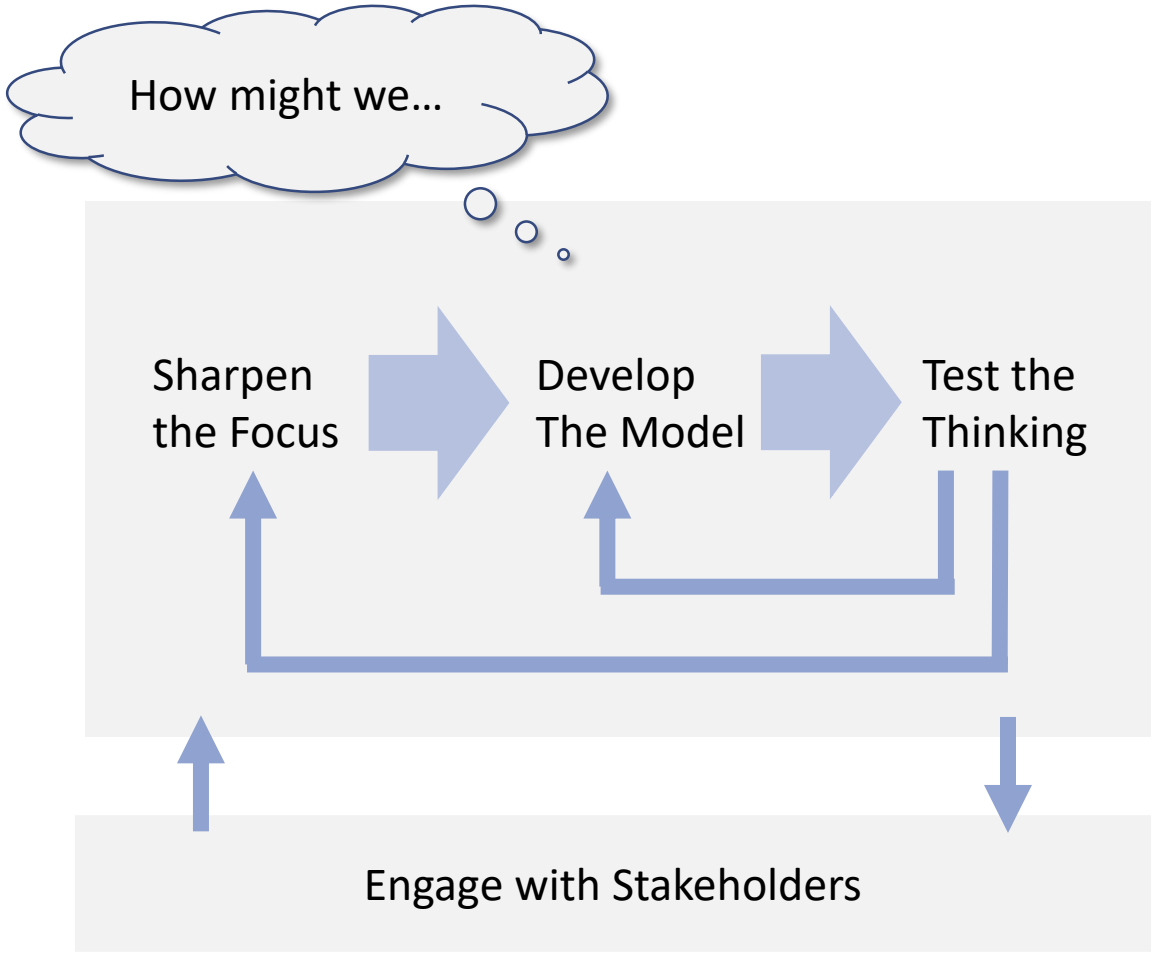
FOR WORKSHOPS, COURSES, CONSULTING ENGAGEMENTS, ETC.

- What goal(s) are being sought by the learner/client?
- What SD approaches/tools/techniques can be applied to help the learner/client achieve their goals?
- How might we create and take advantage of opportunities for hands-on, deliberate practice?
- What coaching strategies are likely to be most effective?

Elements of an approach that seems to work

MINDSET, PROCESSES, PRACTICAL SKILLS

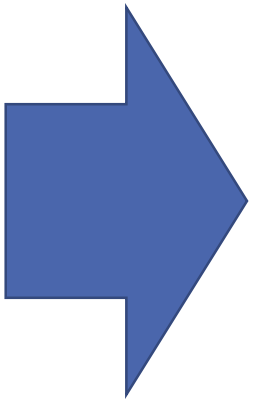
- A design approach
- A set of practical skills
  - Dynamic thinking
  - Operational thinking
  - Expanding the boundary of inquiry
  - Feedback thinking
  - Seeking an evidence basis
- Productive processes for engaging stakeholders



Sources:
Peterson, S. (2010) Systems Thinking for Anyone: Practices to Consider. In J. Richmond, et al (Ed.), *Tracing Connections: Voices of Systems Thinkers* (pp. 31-51). ISBN 978-0-9704921-2-8
https://hbr.org/2008/02/make-better-decisions (accessed 2016-07-15)

Shifts in teaching emphases

- Lectures
- Readings
- Theory
- Exams
- Teacher
- Curriculum-driven (direct skill instruction)



- Hands-on
- Screencasts
- Short Case Studies
- Individualized Projects
- Co-creator
- Just-in-time; just-what's needed (JITJWN)

A few quick examples

- College context: 10-week Ivy League undergraduate course
- Public health context: Access and affordability of care

10-week Ivy League undergraduate course

WHAT'S POSSIBLE IN AN INTRODUCTORY COURSE WITH LESS-QUANTITATIVE STUDENTS?

Intro to Language & Process

- Reference behavior
- Causal loops
- Stocks and flows

Case-based approach to building testing, and debugging models

(Cases supported by screencasts, short quizzes)

- Infectious diseases
- Conceptualization
- Pharmacokinetics
- Predator-prey, Romeo and Juliet
- Promotion chain
- Qat-water dynamics in Yemen
- Youth violence

Project focus

- Model
- Analysis
- Poster
- Extended Abstract

Capstone event: poster symposium

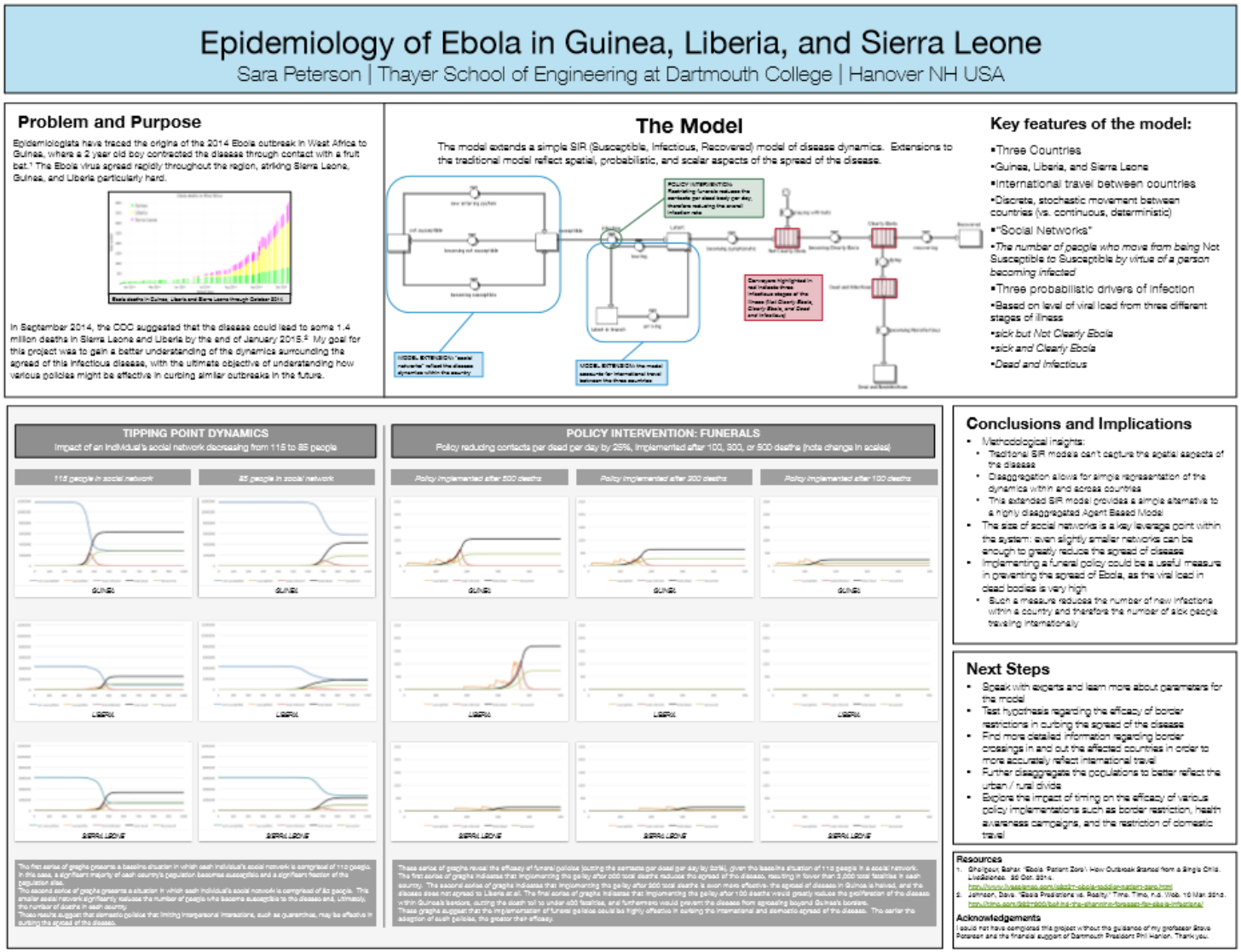
10-week Ivy League undergraduate course

STUDENT PROJECTS FROM 2018 COURSE

- Gentrification and Bus Ridership Decline in Los Angeles
- Chronic Pain Management and the Opioid Epidemic
- Improving AYUDA's Efforts and Knowledge of Type 1 Diabetes in the Dominican Republic
- Modeling Gentrification and Homelessness in an Urban Center
- Optimizing Pollution Tax Policies in Rural China
- The Internet Divide Between Rural and Urban Areas (A Vermont Case Study)
- Impact of Dairy Migrant Workers in the Upper Valley
- Alzheimer's Disease Population Dynamics in the United States
- Bush, Hussein, and Coupled Cognitive Biases in the Lead-Up to the Iraq War
- Deconstructing Social Entrepreneurship : Exploring Impact and Efficiency Across Strategies
- Exploring Migration Dynamics in Puerto Rico
- How Might Consumer Choice Precipitate an Electricity Death Spiral?
- Retribution vs. Rehabilitation for Drug-Related Crimes in the United States
- Startup growth dynamics
- Business Dynamics at Poona Indian Restaurant
- Mass Incarceration and the Prison Industrial Complex
- Increasing Female Participation in Software Engineering through Technological Artifacts
- Towards Environmental Justice: Balancing Greenspace and Gentrification
- Measuring the Benefits and Risks of the Hard Alcohol Ban at Dartmouth
- Hosting the Olympics: opportunity or catastrophe?
- The Political Economy of Reproduction: Motherhood in the United States
- Addressing the New Hampshire Housing Crisis
- High-Risk HPV Transmission in College-Aged Women

10-week Ivy League undergraduate course

WHAT'S POSSIBLE IN AN INTRODUCTORY COURSE?



10-week Ivy League undergraduate course

STUDENT OBSERVATIONS ON STUDENT OUTCOMES

- On inverted classroom:

  I think learning through screencasts instead of lectures was really effective, since we each got to watch at our own pace and re-watch some areas that may have needed clarification. Similarly, using class time as practical hands-on time was really great.

- On workload:

  This course had the heaviest workload of all of my courses, but not in a bad way. There were just a lot of deliverables between the in-class projects (which I never finished in class) and the quizzes. I'm glad that these came in with less frequency as the term went on.

- On individualized project and symposium:

  I think the final project was great--I loved picking my own topic and being able to break it down and use STELLA to explain my impression of the system behind the problem. The symposium is a great way to share, because it is a much more lively environment then in-class presentations, which can get repetitive.

Access and affordability of care

CONVERSATIONAL APPROACHES IN BRIEF FACILITATED SESSION

- 1.5 day session held at a place whose name you'd recognize
- ~10 experts brought in from academe, host institution, health systems, not-for-profits, and school systems
- Multiple "back bench" participants from host institution

Disclaimer:

Funding for the workshop was made possible by the Centers for Disease Control and Prevention and ChangeLab Solutions under Cooperative Agreement Number 6NU38OT000141-04-03. The views expressed in written workshop materials or publications and by the speakers and moderators do not necessarily reflect the official policies of the Department of Health and Human Services, nor does the mention of trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

Access and affordability of care

CONVERSATIONAL APPROACHES IN BRIEF FACILITATED SESSION

- Objective: come to clearer and shared understanding of how to improve accessibility and affordability of care
- Strategy:
  - Help participants develop initial level of facility with stock-flow mapping
  - Facilitation team charged with doing heavy lifting of map creation/revision
  - Participants charged with critiquing/improving map
  - Revised map served as basis for policy-focused discussion during day 2 of session

Access and affordability of care

SOME OUTCOMES FROM FACILITATED SESSION

Short-term…

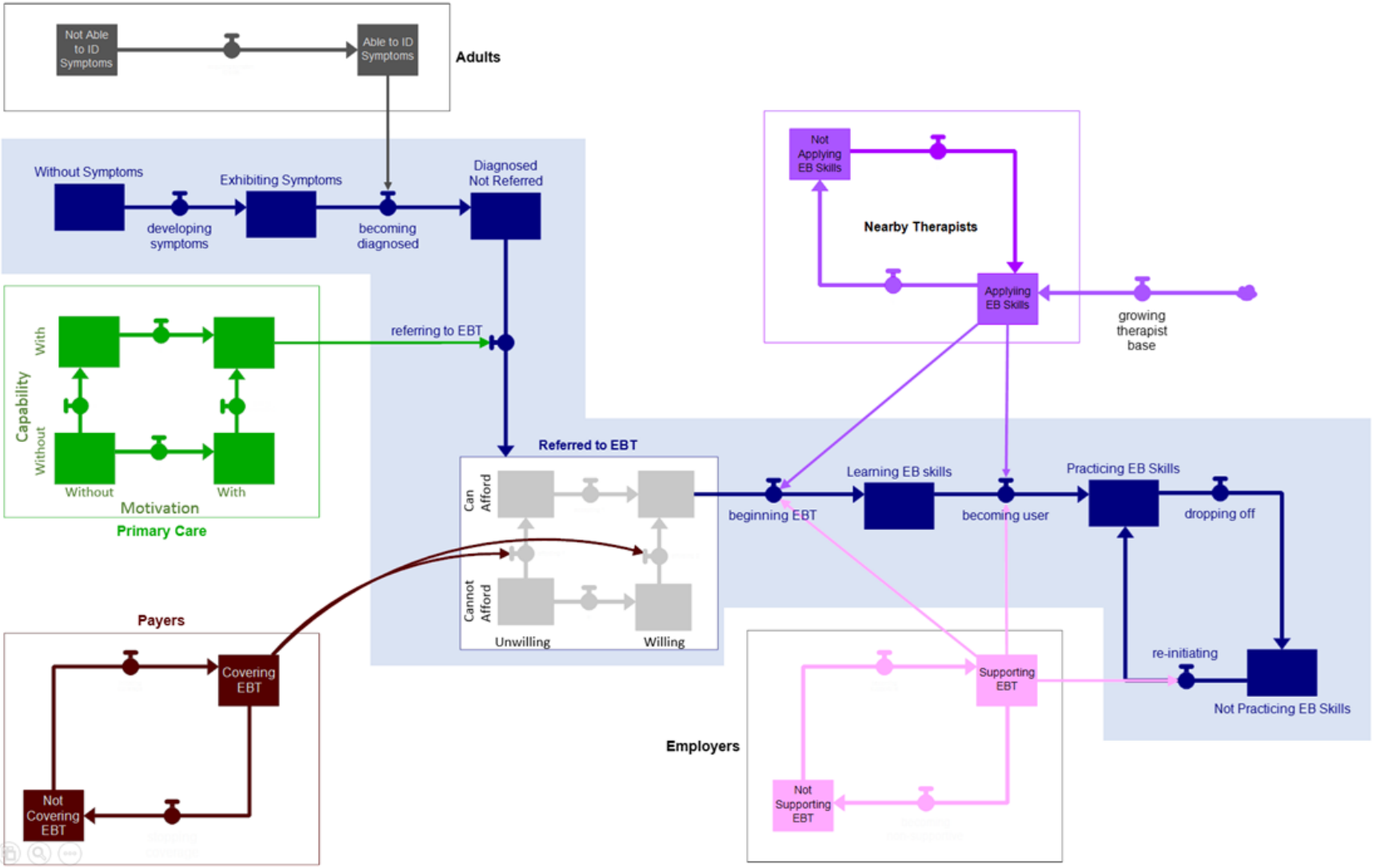
1. Ownership of map effectively transferred from facilitators to clients during workshop
2. Post-workshop, client team worked *on its own* to revise map
3. Map in use to help identify high-impact areas for improving access and affordability

Longer-term…

1. Map expected to play essential role in development of "children's mental health research agenda"
2. Continued collaboration with external participants

Access and affordability of care

"FINAL" MAP



Common outcomes from facilitated sessions

ANECDOTAL, BASED ON >125 SESSIONS IN THE CURRENT MILLENNIUM

1. Significant progress in understanding and improving problem performance
2. Enthusiasm for the toolset and approach
3. Initial level of practical skills in “best practices”
4. (Typically) follow-on opportunities

Discussion