Teaching Humanities using Systems Tools

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CLE Conference
July 1, 2018
Our Workshop Plan

• Frame the context within which we can all be inspired....

• Share with you (briefly) some of our best experiences using Systems Tools in our classrooms

• Focus on giving you hands-on opportunities to brainstorm, in small groups, places you might want to use one or more tools

• Provide guidance/resources to help you continue the learning process after the workshop

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Defining The “Humanities”:

(Stanford University Humanities Center
http://shc.stanford.edu/what-are-the-humanities)

• A DEFINITION: “the study of how people process and document the human experience...to understand and record our world.”

• OPERATIONALLY: “Using a variety of tools and perspectives (including history, arts, music, religion, language, philosophy), we organize and structure those experiences “to feel a sense of connection to those who have come before us, as well as to our contemporaries.”

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System Dynamics Adds Value:

• By connecting *patterns* of behavior with systemic “*structures*” that allow us to see and test our ability to manage “wholes.”

• See Jay Forrester’s 1971 paper, “The Counterintuitive Behavior of Social Systems,” that highlights recurring examples of ineffectual (and even counterproductive) policies fostered by inadequate mental models.

• Systems Humanists Want to Do Better! Jay’s call has special meaning for the humanities (and the social sciences) in that our challenge/responsibility is to foster citizens who feel confident and empowered to manage the social systems within which they live and work.

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A “How To” Blueprint of Sorts...

Learning through System Dynamics as Preparation for the 21st Century

by
Jay W. Forrester
Professor
Sloan School of Management
Massachusetts Institute of Technology

Keynote Address for Systems Thinking and Dynamic Modeling Conference for K-12 Education
June 27-29, 1994 at Concord Academy Concord, MA, USA

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DEVELOPING PERSONAL SKILLS
Basis for Clear Thought and Communication
Building Courage
Personal Philosophy
Seeing Interrelatedness
“Renaissance Man,” Unifying Knowledge, Mobility

OUTLOOK AND PERSONALITY
Confidence in Creating the Future
Authoritarian vs. Innovative Personality
Mental Models and Computer Models

UNDERSTANDING THE NATURE OF SYSTEMS
Cause and Effect Not Closely Related in Time or Space
Low-Leverage Policies
High Leverage Policies, Often Wrongly Applied
We Cause Our Own Problems
Drift to Low Performance, Collapse of Goals
Long-Term vs Short-Term Goals

ACHIEVING THE BENEFITS OF A SYSTEMS EDUCATION
Experience and Participation
The Deeper Lessons
Systems Thinking vs System Dynamics
Revision of Road Maps
On Teaching Systems

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DEVELOPING PERSONAL SKILLS

Learning a New Language

- Basis for Clear Thought and Communication
- Building Courage
- Personal Philosophy
- Seeing Interrelatedness
- “Renaissance Man,” Unifying Knowledge, Mobility
A Systems-Based Humanities Education

DEVELOPING PERSONAL SKILLS

Learning a New Language

OUTLOOK AND PERSONALITY

Fostering Personal Empowerment

- Confidence in Creating the Future
- Authoritarian vs. Innovative Personality
- Mental Models and Computer Models

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A Systems-Based Humanities Education

DEVELOPING PERSONAL SKILLS

Learning a New Language

OUTLOOK AND PERSONALITY

Fostering Personal Empowerment

UNDERSTANDING THE NATURE OF SYSTEMS

Applying Principles of Systems to Social Problems

- Cause and Effect Not Closely Related in Time or Space
- Low-Leverage Policies
- High Leverage Policies, Often Wrongly Applied
- We Cause Our Own Problems
- Drift to Low Performance,
- Collapse of Goals Long-Term vs Short-Term Goals

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A Systems-Based Humanities Education

DEVELOPING PERSONAL SKILLS
Learning a New Language

ACHIEVING THE BENEFITS OF A SYSTEMS EDUCATION
Finding Problems To Solve

- Experience and Participation
- The Deeper Lessons
- Systems Thinking vs System Dynamics
- Revision of Road Maps
- On Teaching Systems

OUTLOOK AND PERSONALITY
Fostering Personal Empowerment

And iterative...Learning Begets Questions, New Learning...

UNDERSTANDING THE NATURE OF SYSTEMS
Applying Principles of Systems to Social Problems

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Toolset for Systems Thinking

By understanding structures we can be CREATIVE and TRANSFORMATIVE, and change underlying causes.

Operating at the Event level, we REACT and RESPOND.

Recognizing Patterns allows us to be PROACTIVE and ADAPTIVE.
Influence
12. As we affect the system, should we revisit the original issue definition?
11. Can we demonstrate that other policies represent low leverage?
10. How do we best use these insights to communicate with others to advocate those effective policies?
9. Do we understand leverage well enough to design effective policies?

Understanding
8. Can we identify places (leverage points) in the structure where the behavior can be readily affected?
7. Do these structures generate the historical behaviors?
6. Are there delays in material or information flows that are important?
5. What reinforcing and stabilizing feedback loops control the flows?

Knowledge
4. How do we predict those elements will behave in the future? What do we “hope” or “fear”?
3. What stocks and associated flows are likely to be important? (Revisit “Past Behavior”?)
2. How has the system “behaved” in the past? Does this help to select or refine the issue?
1. What system is of interest to us & which “problem” concerns us?
First Step in Systems Thinking:

World’s Population Increasing Exponentially

The Iceberg Model

World Population (in billions)

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Event Thinking:

Stock Market Plummets 416 Points
February 27, 2007
OR Systems Thinking:

Stock Markets Show Upward Trend

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Starting with BOTGs - Systemic Patterns

Growth

Decline

Stasis

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Where do these appear in the Humanities?

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Your Own BOTG

In your group:

• Brainstorm: What’s a meaningful issue?
• Build BOTG(s)
• Prepare to share BOTG with a 1-3 sentence story.
• Discussion: What next?
Behavior-over-time Graphs

• Provide a common language to share thinking and knowledge.

• Tell stories about meaningful patterns of change.

• Help frame questions about what structures may be causing these behaviors.

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Moving To The Structural Layer

Patterns grow out of structures.
Patterns grow out of structures.

By understanding structures we can be CREATIVE and TRANSFORMATIVE, and change underlying causes.
Feedback loops are elements connected in a closed loop, and each element causes a change in the elements next to it.
Reinforcing Feedback

- “Things are getting out of control!”
- “I can’t keep up!”
- “We are really on a roll now!”
- “It’s spreading like wild fire!”

Anne LaVigne and Alan Ticotsky
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Balancing Feedback

Anne LaVigne and Alan Ticotsky

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- “We are experiencing some subtle ups and downs.”
- “I can sense that things are beginning to settle down.”
- “We seem to be achieving balance and stability.”
- “Our system is close to reaching our goals.”
Exercise:

- Identify each pair as a reinforcing or balancing feedback loop.
- Draw the feedback loop.
- Write a sentence or two explaining how the loop operates.
Feedback Exercise

• Susceptible individuals // number of new infections
• Fatigue // sleep.
• Savings account balance // interest
• Success // confidence
• Population // deaths
• Population // births
• 1980s: U.S. arms // Soviet arms
• Government intervention // quality of life

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Neolithic Era

Reasons effective for feedback loops

- Dramatic Change
- Clear variables
- Clear connections

• BONUS: Counterintuitive trends
Neolithic Era

Human population began increasing in the Neolithic era. Why?

Variable #1: Total Human Population
Variable #2: Individual Human Life Expectancy

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# Neolithic Era

Models need to include main variable.

<table>
<thead>
<tr>
<th>Mo</th>
<th>Number of humans</th>
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</thead>
</table>

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Neolithic Era

One change was people began farming

Number of humans

Time spent farming

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Neolithic Era

As humans increase, time farming increases

Number of humans

Time spent farming

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Neolithic Era

Time spent farming increases the # of crops

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Neolithic Era

Growing more crops increases food supply

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Neolithic Era

A stable food supply allows for more births
Neolithic Era

This complete a reinforcing loops

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Neolithic Era

What if we add domesticated animals

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Neolithic Era

Livestock can be used for directly for food

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Livestock can be used to help farm

Number of humans

Number of Births

Time spent farming

Domestic Animals

Food Supply

Amount of Crops
Neolithic Era

Variable #1: Total Human Population
Variable #2: Individual Human Life Expectancy

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Neolithic Era

Livestock also exposed humans to more disease
Neolithic Era

New diseases lead to more deaths

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Neolithic Era

Balancing loop increases the number of deaths

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Neolithic Era

Permanent settlements lead to population density

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Neolithic Era

This leads to more exposure to disease
Feedback Loop: Rising Population and Declining Longevity:

Feedback Loop Names:
1) How population increases food (main loop)
2) variables that cause average life span to decrease (main loop)
3) # of birth creates more space
4) Treadness increases/changes Illness
5) Effects of food surplus
6) how Domestic Animals can help w/
7) Job variation and causes/effects of that
8) How protection impacts population

Juliana Winita (Author's Name)
Student Work

Population and Life Span Loop

Farming Food Loop
- Number of crops
- Number of livestock
- Amount of food in food supply
- Disease
- Hygiene

Food into Humans Loop
- Number of births
- Human population
- Living close together

Skiddlylooping Loop
- Unhealthy people

Unhealthy People Loop
- Animal disease

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The Language of Stocks and Flows

Stocks and Flows are the “Nouns” and “Verbs” of Systems Thinking

Stocks are accumulations of “stuff” (Nouns).

Flows are the actions (Verbs) that change the stocks.
• May be **tangible** (weighable or countable) e.g., water reserves, debt, pollution, people OR

• May be more “**soft**” and abstract (e.g., trust, anger, frustration, self-esteem)
Flows represent action (Verbs) in a system, the pathways and the rates by which “stuff” moves. They must be measured in units per time (gallons/day, people/month, tons/year, etc.,) (Normally, we label flows with -ing endings)
Stocks can ONLY change as a result of one or more Flows IN to or OUT from the Stock.
In and Out Game

NOTE: Again, these can be modified/tailored to Humanities topics
Stocks and Flows must use the same units of “stuff.”

- **Stocks and Flows**
  - **BANK ACCOUNT**:
    - Depositing
    - Withdrawing
    - ($$$/time)
  - **WATER RESERVES**:
    - Adding Reserves
    - Draining Reserves
    - (gallons/time)
  - **TOTAL POPULATION**:
    - Entering: Births & Immigration
    - Exiting: Deaths & Emigration
    - (people/time)
  - **LEVEL (OF TRUST)**:
    - Building
    - Depleting
    - (trust units/time)

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<table>
<thead>
<tr>
<th>Stock and Flow Exercise 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spending</strong></td>
</tr>
<tr>
<td>Account</td>
</tr>
<tr>
<td><strong>Business Account</strong></td>
</tr>
<tr>
<td>Income</td>
</tr>
<tr>
<td><strong>Book Withdrawals</strong></td>
</tr>
<tr>
<td>Book Returns</td>
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<tr>
<td><strong>Blood Donations</strong></td>
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<tr>
<td>Blood Bank Supply</td>
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<tr>
<td><strong>Government Deficit</strong></td>
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<tr>
<td>Total Debt</td>
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</tbody>
</table>

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Stock and Flow Exercise 2

Identify the missing “building block” and build the stock, inflow and outflow structure.

1. Groceries in the Fridge  
   Groceries Purchased
2. Cans Distributed to Needy  
   Cans on Community Foodshelf
3. Trees Harvested  
   Trees Planted

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1. Create a S/F Diagram using the Lorax (either what you used for BOTGs or something else)
2. Create a S/F diagram using the BOTG you made in your group or choose another issue.
3. Put them on chart paper and label with a description. Post them.
4. Enjoy lunch.
Roman Expansion

Previous project was a debate based on the perspective of eight historical Romans about whether military expansion was good for Rome.
Roman Expansion

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Roman Expansion

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Extensive Diagrams (lots of flows)

Public Health

Education
Moving Up the Ladder...

THE IRISH POTATO FAMINE:
Is There a "Better Story" To Be Told of Cause(s) and Effect(s)?

The Irish potato famine has been called the "last great European natural disaster." Several hundred thousand deaths from starvation and epidemics during the harsh winter of 1846-47 followed the blight that wiped out Ireland's potato crop during the summer of 1846.

The tragedy of the famine was rooted in the unique conditions that gradually developed in Ireland as a result of the introduction of the New World potato many years earlier. With the bulk of the Irish people confined to relatively small and marginally productive lands by the English, the potato, yielding enough protein from a typical garden plot to sustain a family of six and their animals, permitted population growth, which in turn, dictated more lands be devoted to the potato, allowing more population growth. On the eve of the famine, virtually all lands available to the Irish were in full production. Nonetheless, the population was finding it increasingly difficult to meet minimum calorie requirements; indeed, net population growth appears to have slowed to a stop even a bit before the famine. Thus, when the potato crop failed, the Irish were unprepared with food or land reserves with which to respond.
Moving Up the Ladder...

Historians recount that, lacking adequate food and vulnerable to disease, upwards of three-quarters of a million Irish died, while another million or more assembled their meagre belongings and, in the years between 1847 and 1853, departed Ireland (the vast majority destined for North America) to find new homes abroad.

The event, then, was largely confined to the years 1846 to 1853. But was it? Might there have been longer term causes and effects that historians have overlooked?
1. Identify the Pre-Famine STOCK and FLOW STRUCTURE. Why does the Population Grow?
2. What Happens During the Famine?
Structure...

What Should Have Happened (Line 2) Versus What DID Happen (Line 1)?

1: ACTUAL IRISH POPULATION
2: MODELED IRISH POPULATION W/O POS...
3: MODELED IRISH POPULATION

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Open STELLA)
Full Structure...
Generic Structures

Spread of Rumors (social)

- New Rumor Mongers
- RUMOR MONGERS
- People Stopping Spreading Rumors
- new rumor mongers today
- number of people you convince to stop
- number each rumor monger tells
What is next for you?

• Where can you use systems-based education in your teaching?

• What more do you need to learn?

How can we help?