

The system dynamics K12 experience in Door County, WI

with

Implications for SD adoption within the Firm

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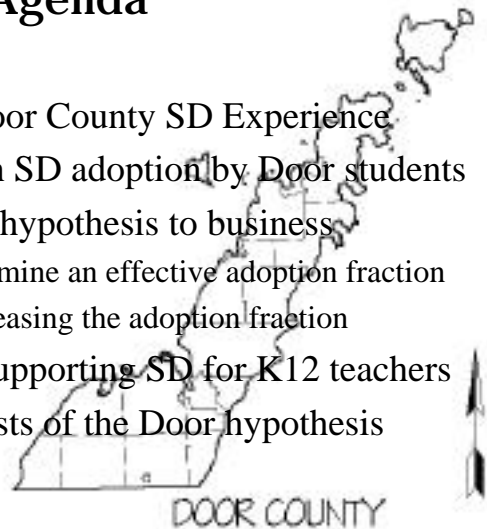
June, 2002

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Agenda

- Overview of the Door County SD Experience
- Hypothesis for high SD adoption by Door students
- Applying the Door hypothesis to business
 - Simulation to determine an effective adoption fraction
 - Guidelines for increasing the adoption fraction
- Other reasons for supporting SD for K12 teachers
- Proposed further tests of the Door hypothesis



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1st Door County SD Course Overview

- 1999-2000 academic year – 8 adult students & 5 HS students
 - 8 adult students: 4 HS teachers & 4 community members
 - 5 HS sophomores fall & 1 HS sophomore spring
- Classes held 1 weekday evening & Saturday mornings
 - Separate classes and curriculum for sophomores and adults (fall), and for teachers and non-teachers (spring), but with overlapping reading discussion time between classes.
- Major curriculum resources used, among others...
 - Forrester's *Principles of Systems* (**the sophomores really liked it!**)
 - 1st draft of Sterman's *Business Dynamics*
 - Alfeld & Graham's *Introduction to Urban Dynamics*
 - Trinity College's *ST&DM Courses 1 & 2*
- Graduate credit for teachers, HS elective credit for sophomores

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HS teachers: Jim, Don & Carl
(Steve missing)

Larry John
Roy Pat



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Saturday Morning Reading and Application Discussion Circle
(In the Fall, held in the hour between the Adult's and HS Students' classes)

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Four course students attended the ST&DM in K12 Education Conference in Skamania, WA (Summer, 2000)



- Steve, HS teacher
- Rob, HS student
- Larry, University of WI. Professor
- Roy, Non-profit Executive Director

Rob, one of the HS sophomores, having studied Jay Forrester's *Principles of Systems*, and having read several of his papers, was thrilled to meet Professor Forrester at Skamania Lodge

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**High School Social Studies Teacher Don Ziegelbauer (top left)
and eight of the thirty high school students
who've taken his SD course(s) in the two years since the first class**

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Some student initiatives in the 25 months since the course ended

- HS introductory & intermediate SD courses
 - 30 HS students / 3 classes
 - Student models in ecology, epidemics, local landfill issue, terrorism, drug trafficking, etc.
 - **Budget cutback Fall 2002!**
- Teachers using SD in teaching HS economics, current affairs, history & agribusiness
- Teacher-taught seminar for other Door County teachers
- Trinity Course 1 for other teachers, summer 2001
- Use of systems in courses at UWGB – now a new course focused on systems & sustainability
- Many presentations on SD
 - HS social studies teachers conference in Milwaukee
 - Other school districts
 - Other schools and districts
 - Local Rotary Club
 - Governor's Wisconsin Educational Technology Conferences in Madison and Green Bay
 - Sustaining Educational Change conference at UWGB

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-Observation & Question-

Seven of the eight adults (teachers & non-teachers) who took the Door County SD classes, continue, over two years later, to think about problems in stock/flow and feedback terms, and to either teach, or encourage SD use, in their schools, community, and work.

In our direct and anecdotal experience, this adoption fraction seems much higher than in most SD training efforts.

What caused this higher adoption fraction?

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Hypothesis for cause of high adoption

- Self selection into the course
- Customized curriculum re-tailored during the course to maintain student interest
- Sustained learning focused on compelling problems
- Curriculum focus on the SD paradigm and process
- Continued collaboration among students taking a self- paced self-study course together
- Teachers and non-teachers sharing SD applications and perspectives (most important, the KEYSTONE)

On reflection, we think these, in combination, had much to do with causing our high adoption.

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Applying the Door Hypothesis to Business

Q: What is the SD adoption fraction required to get past the tipping point for effective SD adoption dynamics at a business firm location?

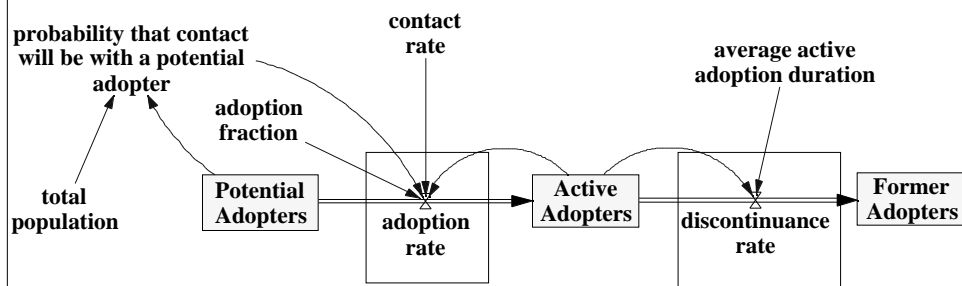
A: Simulate to find the adoption fraction

Q: At a business firm location, how can we increase the SD adoption fraction?

A: Apply the Door Hypothesis?

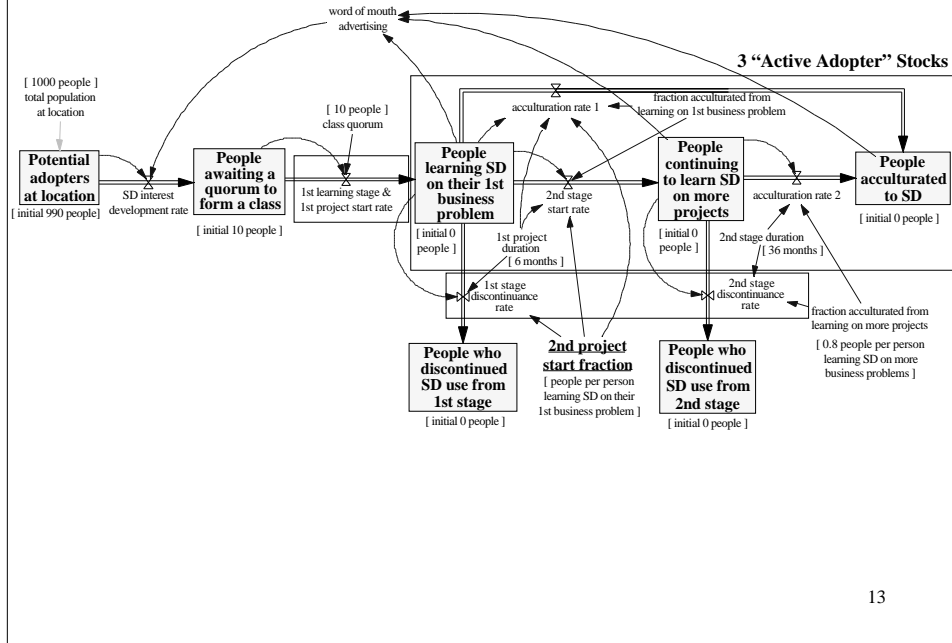
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Generic Innovation Diffusion Model from Sterman... What must be true for an epidemic to occur?

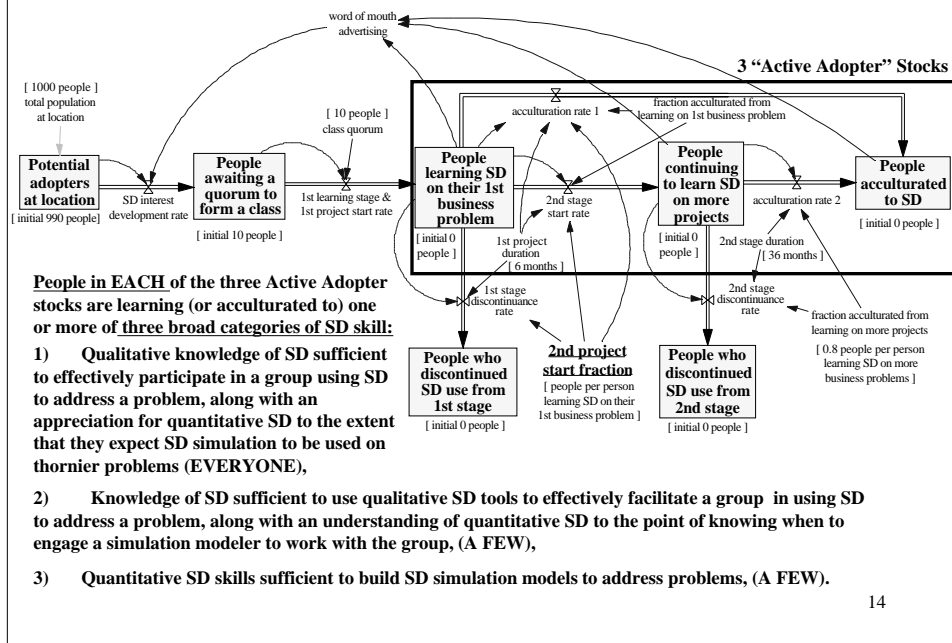


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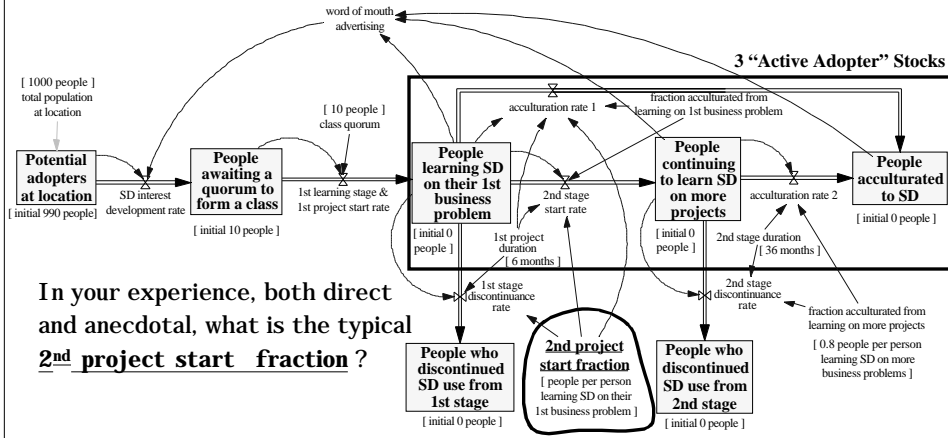
Draft of an innovation diffusion model for a business location



This model DOES NOT differentiate qualitative & quantitative SD skills!



Questions to answer before running the simulation

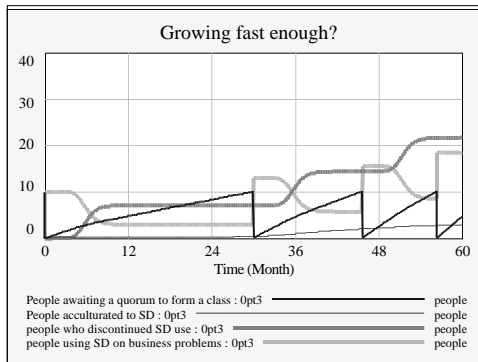


In your experience, both direct and anecdotal, what is the typical **2nd project start fraction**?

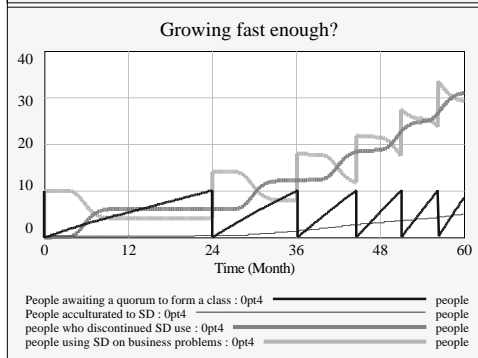
In a business location with effective “self-selection” SD adoption dynamics...

- * How long after the start of the 1st class will the 2nd class start?
- * What fraction of the employees in the business location...
 - will be using SD on business problems at 5 years?
 - will be acculturated to SD at 5 years?
 - will have tried & discontinued SD use during the first 5 years?

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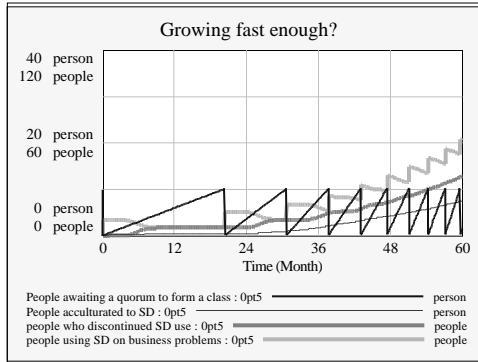


2nd Project Start Fraction = 0.3
 (business location with 1000 people)
 Time until quorum reached for 2nd class = 30 months
 18 people using SD on business problems after five years
 3 people acculturated to SD after five years
 22 people discontinued SD use in first five years

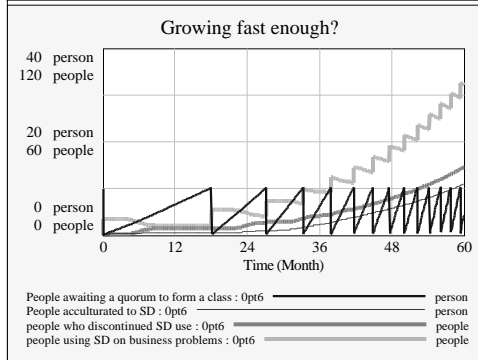


2nd Project Start Fraction = 0.4
 (business location with 1000 people)
 Time until quorum reached for 2nd class = 24 months
 29 people using SD on business problems after five years
 5 people acculturated to SD after five years
 31 people discontinued SD use in first five years

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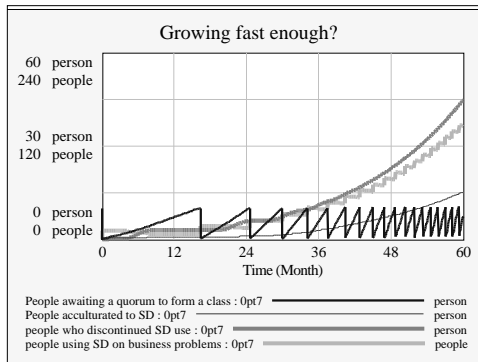


2nd Project Start Fraction = 0.5
 (business location with 1000 people)
Time until quorum reached for 2nd class = 20 months
62 people using SD on business problems after five years
7 persons acculturated to SD after five years
38 people discontinued SD use in first five years

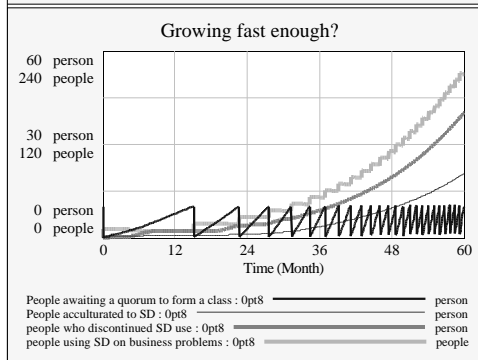


2nd Project Start Fraction = 0.6
 (business location with 1000 people)
Time until quorum reached for 2nd class = 18 months
97 people using SD on business problems after five years
11 persons acculturated to SD after five years
43 people discontinued SD use in first five years

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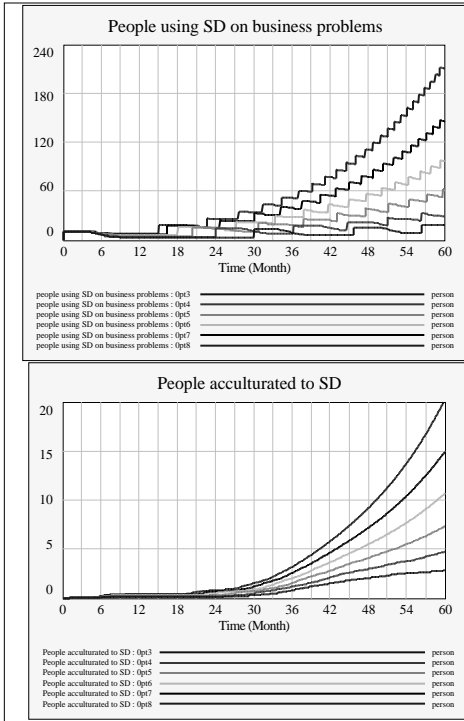


2nd Project Start Fraction = 0.7
 (business location with 1000 people)
Time until quorum reached for 2nd class = 16 months
145 people using SD on business problems after five years
15 persons acculturated to SD after five years
46 persons who discontinued SD use in first five years



2nd Project Start Fraction = 0.8
 (business location with 1000 people)
Time until quorum reached for 2nd class = 15 months
210 people using SD on business problems after five years
20 persons acculturated to SD after five years
40 persons who discontinued SD use in first five years

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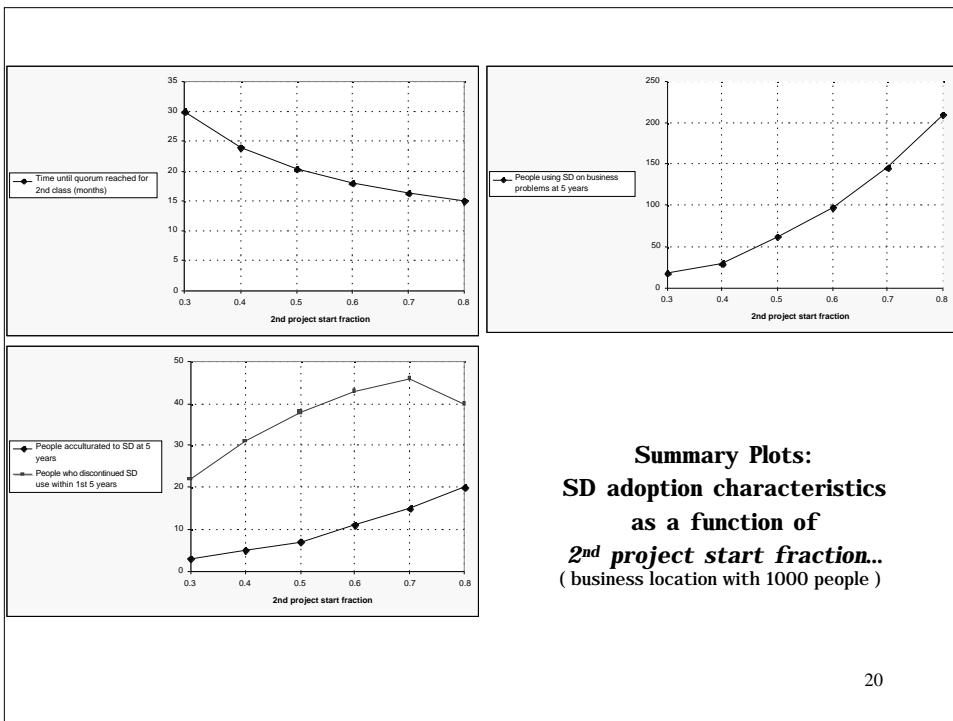
**Sensitivity to variation in
2nd project start fraction
from 0.3 to 0.8**

(business location with 1000 people)

Question...

**To provide effective SD adoption dynamics
at a business location,
what 2nd project start fraction is required?**

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**Summary Plots:
SD adoption characteristics
as a function of
2nd project start fraction...
(business location with 1000 people)**

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Transferring the Door Hypothesis to Business

Q: What is the SD adoption fraction required to get past the tipping point for effective SD adoption dynamics at a business firm location?



A: Simulate to find the adoption fraction

Q: At a business firm location, how can we increase the SD adoption fraction?

A: Apply the Door Hypothesis?

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Applying the Door Hypothesis as a guide to a higher adoption rate in a business location

- Ensure self selection
- Customize the curriculum, and re-tailor it during the course as needed to maintain student interest
- Sustain learning focused on compelling problems
- Focus on the SD paradigm and process
- Ensure continuing collaboration among students taking self-paced self-study courses
- Ensure sharing of a broad array of SD applications and perspectives

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Most Important!

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- Focus on the SD paradigm and process
- Ensure continuing collaboration among students taking self-paced self-study courses
- Ensure sharing of a broad array of SD applications and perspectives. **One way is to:**
 - Include K12 teachers in business peoples' SD learning process
 - Schedule sharing time, preferably once per week

Most Important!

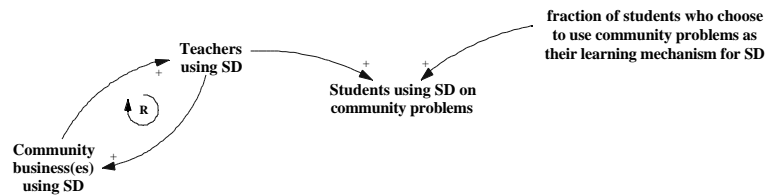
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Why use K- 12 teachers to ensure sharing of a broad array of SD applications & perspectives?

- SD learners, by observing the work & questions of other SD learners who are at their same skill level & who are using SD for **diverse purposes in diverse applications**
 - more quickly grasp the SD paradigm, process and tools
 - and thereby accelerate their own project (business problem!) work
 - thus promoting a *higher SD adoption fraction!*
- The Door County SD experience, among others, illustrates that:
 - K12 teachers using SD to address curriculum improvement problems have very different purposes* than SD used to address business problems
 - * Helping students retain or increase their curiosity, love of learning, and ability to learn on their own
 - K12 teachers' curriculum applications of SD are diverse and interdisciplinary – history, literature, current events, ecology, civics, economics, physical sciences, mathematics, etc
- Because K12 teachers are available; they are everywhere!

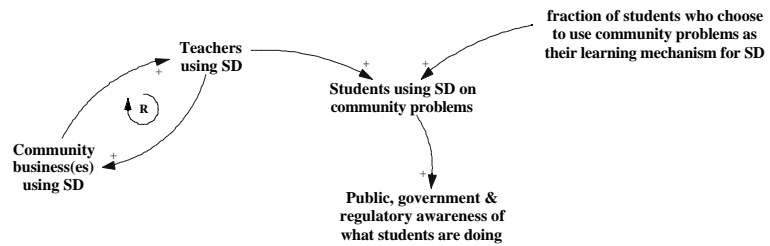
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Other reasons for supporting SD for K12 teachers



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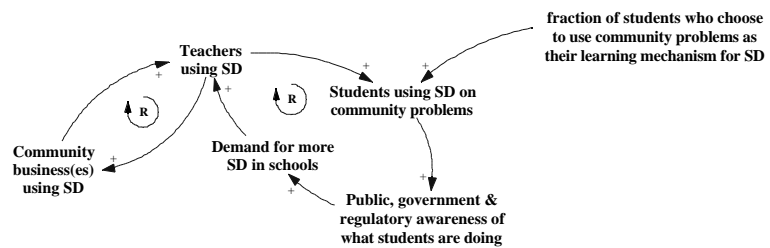
Other reasons for supporting SD for K12 teachers



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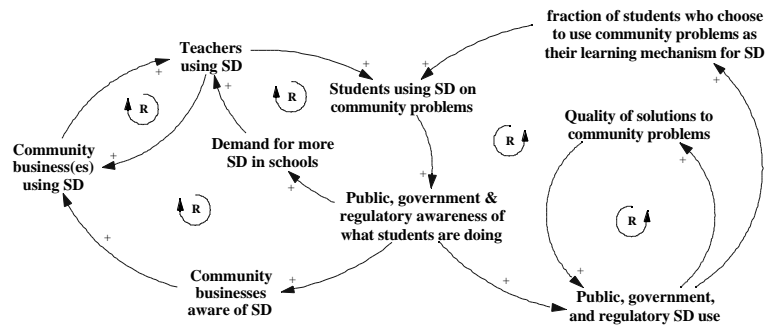
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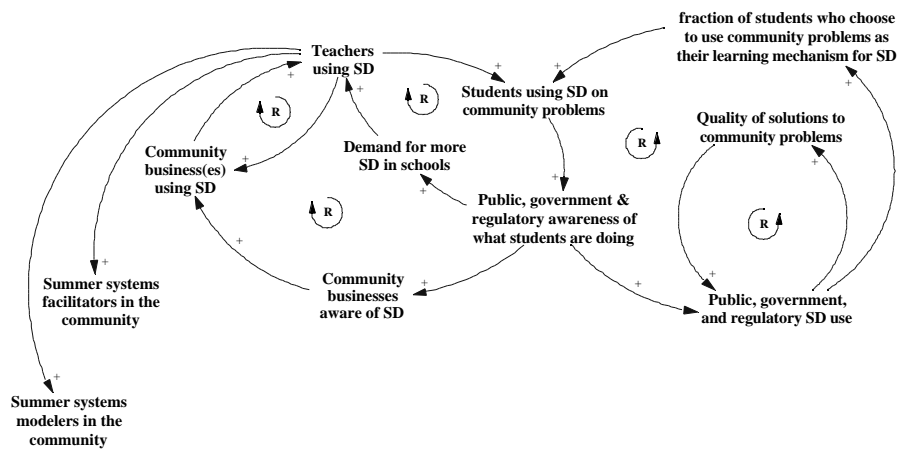
Other reasons for supporting SD for K12 teachers



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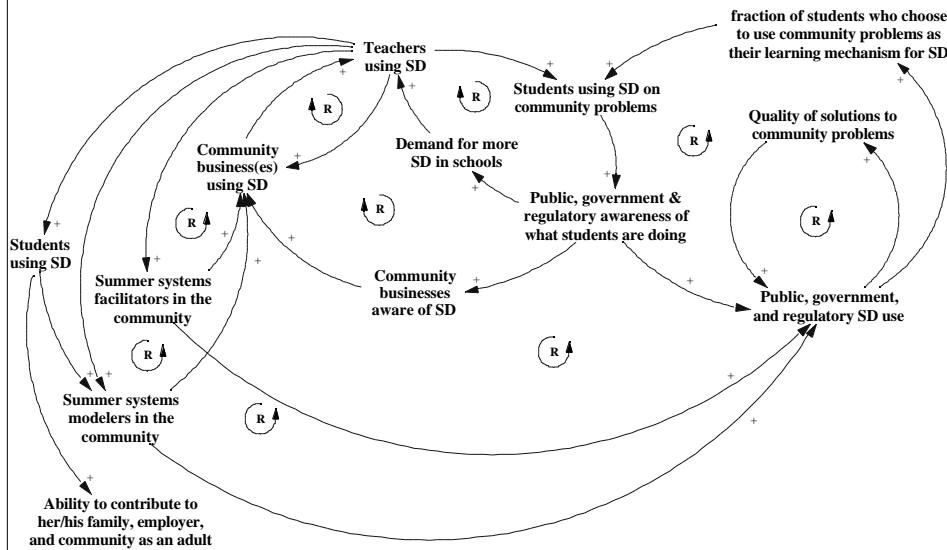
Other reasons for supporting SD for K12 teachers



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Other reasons for supporting SD for K12 teachers



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Other reasons for supporting SD for K12 teachers

Excerpts from quotes by “Mr. Z’s” HS students

The course makes you think about things you have really never thought about.

Ben S.

My favorite part of the class was using Stella to model certain problems to see what will happen in the long run.

Greg G.

Systems Thinking taught us to look at the Big Picture, not to break everything down into little bits. The world would be a better place if more people would look at the big picture and not just what affects themselves...The most beneficial aspect of this course for me was the use of the Stella software. It is extremely useful as a tool in our everyday lives and every student should have access to it.

Scott W.

I really enjoyed this course and some of the readings we did as part of it. One such reading I enjoyed was the one by Jay Forrester that had to do with the 21st century. I really got into the deep thoughts of Jay Forrester, and the things that he was touching on in the writing that I also have thought of before and I found out that many of our thoughts are much alike.

James D.

I have used Systems Thinking at least 3 times to help me out with my personal desires, such as moving out and saving up a lump sum of cash.

Amanda M.

The systems thinking course offered by Mr. Ziegelbauer has been helpful in all aspects of life. It's helped me to look at all things not simply as occurrences that have no significance, but as patterns of an underlying structure. The course has taught me to think of everything as an interconnecting web, which affects all things. The course, as I said, gives a different view of everything, and the Stella Modeling we did was simply a way of teaching it. The modeling showed us how things are woven into each other, and because of it we now have that understanding. Because of this course, now, I've learned to appreciate the stability of the world, and I believe that a second course would be helpful in teaching me the rest of systems thinking and systems dynamics. I still have a lot of questions which couldn't be addressed in the current course.

Josiah S.

The concepts are simple, but the possibilities for application are endless.

Collin J.

Note: Blue text identifies a common theme found in many quotes.

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Summary: Why include K- 12 Teachers in Business People's SD Learning Process?

Direct business reasons: Higher SD adoption fraction at a business location.

1. The more employees who learn SD in a given time period, the more dynamic business problems are addressed in that time period as part of the employees' SD learning process (shorter term business reason).
2. Internal capacity to better address additional dynamic business problems (SD acculturation) builds more rapidly (longer term business reason).

Societal reasons: To set reinforcing feedback loops in motion that:

1. improve the community within which the business location operates (shorter term), and
2. improve society at large by increasing students' ability to contribute to her/his family, employer, and community as an adult (longer term)

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Door County is one experiment in one place

More experiments are required to better confirm the hypothesis and its implications

City offices in consulting firms with SD practices

Clients of consulting firms with SD practices

Government Offices

Manufacturing plant R&D facility, regional sales office, etc.

Suppliers to manufacturing firms

Non Governmental Organizations (NGOs) and Foundations

Higher Education

**Goal?
1 new location per year per firm now engaged in SD?**

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We've focused on a business location's use of K12 teachers to ensure sharing of a broad array of SD applications and perspectives.

The rest of the Door Hypothesis is:

- Ensure self selection
- Customize the curriculum, and re-tailor it during the course as needed to maintain student interest
- Sustain learning focused on compelling problems
- Focus on the SD paradigm and process
- Ensure continuing collaboration among students taking self-paced self-study courses

Don't forget the rest of the Door Hypothesis!

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