The state of System Dynamics education:
Accumulating better practitioners

Panel Discussion

Inspired by the System Dynamics Competence Framework for Teaching SD by Martin Schaffernicht and Stefan Groesser (published in the SD Review)

Overview

• Motivation

• Survey: https://cardiff.onlinesurveys.ac.uk/survey-of-sd-teaching-practices

  Preliminary survey results

• Panel-group discussion
  – Sally Brailsford
  – Siôn Cave
  – Jim Duggan
  – Hisham Tariq
## Respondents

<table>
<thead>
<tr>
<th>Trainer expertise vs. proportion of main job using SD</th>
<th>0 to &lt;25%</th>
<th>25 to &lt;50%</th>
<th>50 to &lt;75%</th>
<th>75 to 100%</th>
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<tbody>
<tr>
<td>Competent (C)</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Proficient (P)</td>
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<td>5%</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>Expert (E)</td>
<td>37%</td>
<td>21%</td>
<td>16%</td>
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<tr>
<td>Master (M)</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
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- Most have >10 years experience of using and teaching SD
Preliminary survey results

Top Tips

✓ *Always* have a working model
✓ Use stocks and flows with data and time-charts – don’t focus only on the qualitative structure
✓ Hands-on examples
✓ Use your *own* case studies and examples vs. *Use simple* examples not from specialist field of the learners

✓ Start with simple models
✓ Explanation is key – ensure the basic principals are fully understood
✓ Take it slowly and be prepared for students to find it difficult - *reassurance*
✓ Get students to identify the key structure from a stock and flow format

✓ Model the issue not the data!
✓ Include teaching on data – how to populate the model (sources, quality, quant & qual)

✓ Audience background essential for orienting training
✓ Assess current ability and start there; “*when in doubt, bias towards the basics*”
### Skills develop in stages

<table>
<thead>
<tr>
<th>Skills</th>
<th>Complexity Level (cl)</th>
<th>Competence Development Stages</th>
<th># of Learning Outcomes</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Beginner</td>
<td>Advanced Beginner</td>
</tr>
<tr>
<td>Policy evaluation and design</td>
<td>cl3</td>
<td>2</td>
<td>4</td>
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<tr>
<td></td>
<td>cl2</td>
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<td>4</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
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<tr>
<td>System dynamics language</td>
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**Total numbers of outcomes**

<table>
<thead>
<tr>
<th></th>
<th>Beginner</th>
<th>Advanced Beginner</th>
<th>Competent</th>
<th>Proficient</th>
<th>Total</th>
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<tbody>
<tr>
<td>cl3</td>
<td>15</td>
<td>140</td>
<td>84</td>
<td>26</td>
<td>265</td>
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</table>
Skills

• Language
  – Bookwork and formal definitions
  – Vs. analogies, real world examples, stating with simulation
  – Vs. not covered specifically just trainer consistently using terms

• Dynamic reasoning
  – “Follow the causal logic”
  – Emphasis of over time
  – Case studies / examples then formal definitions
  – Simple, small models for experimentation

• Model analysis
  – Divide and conquer
  – Use differences as the learning route (differences between real world and model)
  – Case studies / examples
  – NOT using causal loop diagrams
  – Coursework adapting an existing model
Skills

• Project initialisation
  – Is SD the right tool?
  – Careful requirements definition
  – Focus on structure in case studies – not building from scratch
  – Beyond the scope of Beginner/Adv. Beginner?
    Or covered elsewhere (general OR modelling approach)
  {Flagged as needing room for improvement}

• Model creation
  – Focus on ‘observable’ variables
  – Live model building \(\rightarrow\) never be further than 30mins away from a working model
  – Extend rather than create from scratch
    Or create a model together for students to develop themselves
  – Low focus on equations \(\rightarrow\) structure focus (and tools to view it nicely)
Skills

- Model validation
  - Devise steady state and then add
  - *Inseparable* from creation teaching
  - Case studies and encouraging use of *reference models* when building
  - Coverage can be limited by teaching method and limits of licensed software (free versions)
  - Bookwork → Sterman

- Policy evaluation and design
  - Not covered by several respondents
  - Demonstrate good *and* bad outcomes
  - Model *without* policy implications first... then introduce these decisions
  - Group work → trial solutions on a *running* model

- Long thin teaching
Competency Weightings

(Preliminary survey results)

(D) Project initialisation
(E) Model creation
(C) Model analysis
(B) Dynamic reasoning
(G) Policy evaluation and design

(A) Language