Weaving participatory modelling into an introductory system dynamics class

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2022 International System Dynamics Conference

Extended abstract

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Abstract

In the system dynamics field there is a rich literature on participatory system dynamics / group model building and a rich literature on teaching students system dynamics. However, these two have not yet been combined and there is a lack of insights on using participatory system dynamics in a teaching context. This paper starts to close this gap by reporting two examples of participatory system dynamics teaching. It discusses the purposes of such kind of teaching, relating it to the different purposes of (i) teaching participatory modelling as such vs. (ii) using a participatory process to teach system dynamics concepts.

Introduction

There is little information available to others who teach system dynamics about how participatory elements can be included into an introductory system dynamics class. Thus, this paper aims to elucidate how participatory elements can be brought into SD teaching and with which purpose in mind. It presents two concrete examples of how we can familiarise students with participatory modelling and how we can use participatory modelling in teaching. It also discusses the purpose of participatory teaching, relating it to the learning objectives concerning model content vs. system dynamics insights vs. participatory modelling.

The next sections present literature related to teaching SD, the two sessions that use participatory modelling and their context. Subsequently, I will discuss the insights and limitations from such teaching.

The two teaching sessions

The two examples are part of my 'Systems Thinking and System Dynamics' class. This is an introductory system dynamics class, which I teach over 10 week in weekly sessions of a duration of about three hours. The sessions in weeks five and eight are taught by team members. The students of the class are primarily from three different master programmes: energy system modelling, behaviour change and psychology as well as policy. Conceptually, the class draws from teaching of David Lane, George Richardson and Peter Milling's former SD team at the University of Mannheim. The learning objectives of this elective class are to learn to think systemically, seeing issues in interrelation, understanding the relationship of structure and behaviour, conceptualising problems, causal loop diagramming, formal model building and analysis and some model testing. The participatory part has a further objective, this is to broaden the students' skills in dealing with stakeholders, which is important for their future work or research. Objectives are addressed through exploring models, copying models and adding structure (voluntary) for qualitative and quantitative models as well as modelling problems with known structure and dynamics and modelling personally chosen problems qualitatively, but roughly 30% of students chose to quantitatively model their chosen problem. The learning objectives and structure thus bear strong similarity with Richardson's (2014b) 'canonical sequence' of phases in introductory SD modelling.

In the teaching lectures, exercises and discussion are mixed. In week two and week six, I bring in participatory elements: In week students I build a first causal loop diagram (CLD) in a participatory way with my students and in week six we have an explicit focus on participatory modelling.

Week two: first CLD

In week two, I present my students with the case of Mississippi River flooding.[1] After a short introduction of the context, I ask the students to tell me concepts, i.e. variables that are important to describe the issue and that are related to the issue. We aim for 'good' variable names and I explain some recommendations for variable names as we go along. It is not uncommon particularly in the beginning that I need to ask the students for improvements to variable names or sometimes make my own suggestion and ask whether they agree. After about 12 variables have been elicited, I stop the variable identification and we start to identify connections between them. This way we build a causal loop diagram (CLD) of the Mississippi river flooding issue. We identify link polarities as well as loop polarities as loops emerge.

Week six: participatory modelling of urban dynamics

In week six, we focus on Urban Dynamics and build a simplified qualitative stock and flow diagram of Alfeld and Graham's (1976; see also Richardson, 2014a) simplified urban dynamics model. Again, I first explain the context of a pattern of urban growth and decay in relation to an urban regeneration case in London before we go into variable elicitation and structure elicitation.[2] In this example, I don't let the students come up with their own variables, but I give them group identities and prescribe the variables that their group is supposed to put forward in a round robin variable elicitation session. Information on the groups, their sub-tasks and variables is available in the supplementary materials. The purpose of prescribing the variables is to come up with the variables and structure that is underlying the urban dynamics model. This is important because the section not only serves the purpose of learning about participatory modelling but also of an introduction to the core mechanisms of the Urban Dynamics model. After variable elicitation with behaviour-over-time graphs and voting on variables that my groups consider particularly important for the issue, we elicit the causal links between them. I also integrate some further information on participatory modelling into this class, e.g. information about important scripts (Scriptapedia Wikibooks contributors, no year) as well as about the roles in group model building (Richardson & Andersen, 1995).

Adaptations to the class size and for virtual or hybrid lectures

The sessions can be adapted to different class sizes and in-person vs. online or hybrid settings. While in session two I don't control for equal participation and take variables from those who are offering one, a more formal elicitation process could be added. In week six, the process includes this more formal elicitation.

When translating this setting to virtual teaching, I don't let the students draw behaviour-over-time graphs but only let them elicit variables, which I then directly place on a shared screen. Of course, it would also be possible to let the groups develop behaviour-over-time graphs in breakout groups. In a hybrid setting, it has been useful to group the online participants into their own group.

Insights

These teaching settings have been useful not only to teach participatory system dynamics, but to also teach important system dynamics concepts as well as familiarise the students with important model content and structure. Week two particularly focused on teaching SD concepts plus participatory process and week six focused on participatory process plus important model content and structure.

The participatory process has also been helpful to facilitate an easy start into SD, e.g. by showing how a model of only a few variables gets built as well as what its important sub-structures are.

While there exist records of the resulting models, insights into the process are limited to the author's recollection plus recordings of online and hybrid sessions from two years. In addition, the two examples here are just examples of the many different possible ways of how participatory elements can be included into and can support SD teaching.

Endnotes

[1] A previous version of the slides that I use to present evidence on flooding were developed by Brad Morrison. I have also added elements from Michael Deegan's (2007) PhD work that focuses on flood mitigation.

[2] This is an example developed by me, but using an existing model. The teaching case can be adapted to other cities than London or even for different models than the small Urban Dynamics model.

Acknowledgements

I thank the members from my peer mentoring group for very valuable feedback.

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