# Re-grow Your City:
# A NetLogo Curriculum Unit on Regional Development

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**Abstract:** This poster presents the design of an agent-based modeling activity for teaching regional development and social policy at the undergraduate level. Taking a Constructionist view of learning and design, it allows students to learn about the relationship between the emergence of particular socio-economic neighborhoods and the infrastructural design of cities, by 're-growing' their own city.

## Mechanisms and Constructionism

Despite decades of social sciences *research* using agent-based modeling, its use in social sciences *education* is understudied. This poster presents a curriculum unit using agent-agent-based modeling to support a mechanism-to-dynamic-focused, Constructionist approach to teaching social policy at the undergraduate level. In particular, this policy focuses on Regional Development, and on how social policies and infrastructural decisions can affect the socio-economic emergence of a city's neighborhoods. Epstein (1999) famously said about agent-based modeling in social sciences that, "If you didn't grow it, you didn't explain it." By deploying a NetLogo model, the unit allows students to change the infrastructural and zoning design of their city and to 're-grow' their own city.

College students struggle with understanding how social policies and urban planning affect the racial and socio-economic composition of a city's neighborhoods. This should be cause for alarm, because if even highly educated citizens are unable to reason cogently about the relationship between policy intervention and outcome, we run a serious risk of political inertia. Experimental research on policy learning suggests that knowledge and beliefs about policy issues are correlated, and that a mechanistic approach to explaining policy issues can strengthen both understanding of an issue, and support of policies to address it (Clark, Ranney & Felipe, 2013). This suggests that taking a mechanism-focused approach to teaching about the relationship between social policies and their outcomes may be productive in a social policy educational context. However, another line of research focusing on learners' reasoning about complex systems (e.g. Wilensky & Resnick, 1999) suggests that even if learners understand each of the individual mechanisms of a system, they may still struggle with understanding the dynamic system-level outcomes. As a remedy, agent-based modeling has been used as educational tools for at least two decades, offering learners a 'tool-to-think-with' to cognitively offload their knowledge about individual mechanisms, and let the model show how they dynamically interact. Agent-based modeling has been used for education in STEM (Wilensky & Resnick, 1995; Jacobson & Wilensky, 2006). The present unit extends design and research experience from this work to education in social sciences.

Use of agent-based modeling in education has typically taken a Constructionist approach to learning and to the design of learning activities. Constructionism holds that learning happens best when learners construct external, shared, and personally meaningful artifacts (Harel & Papert, 1991; Papert, 1980). This unit implements these design principles by encouraging groups of students to redesign a city that they are already familiar with. Further, by drawing on a familiar city, students may activate educationally productive epistemological resources relating to their personal experiences there.

## Description of Activity

The curriculum unit is served through WISE (Linn, Clark, & Slotta, 2003), and the simulation activity is designed and run in NetLogo. Students in groups of 2-3 are first asked to decide on a policy outcome ('commute times', 'quality of education', 'access to leisure areas', or 'pollution'). They are then asked to first explain what they aim to do with this policy outcome (e.g., 'reduce commute time across the entire population', or 'increase quality of education for bottom 20% income bracket'). They are then asked to hypothesize how they will do this, and to articulate some design principles for achieving their social policy outcomes. Once this is done, the NetLogo model is downloaded, and the simulation activity begins.

Students must first re-zone their city and ensure that there is housing and workplaces for all citizens in their city. They can zone five different kinds of areas: Dense Urban Area, Medium Urban Area, Light Suburban Area, Subsidized Housing, and Industrial Zones which contain workplaces. Further, they can designate zones for public parks, and they can build highways and railroads. Once they have finished re-designing their city, they let the city "grow". This causes new citizens to move to the city. These citizens have an income drawn randomly from a distribution similar to that of the US. Each person finds a job in one of the Industrial Zones, and then decides where to live based on three principles: 1) it must be affordable relative to their income, 2) it

 

should be close to their spending limit, and 3) it should provide a fast commute to their workplace. In other words: people want to live in a place they can afford, and will then weight the quality of the neighborhood against how convenient it is for their commute. Whenever someone moves into a neighborhood, house prices in that neighborhood and surrounding neighborhoods are adjusted so that the more high-income people move in, the higher the housing prices, and vice versa. This in turn affects who can afford to live there, and thereby affects who move in as more citizens populate the city.

After the city is fully populated, students must investigate how well they did, and reflect on what happened. The model provides two different ways for students to do so: Students can spatially visualize the different outcomes on the map (Figure 1) or they can see bar charts of the distribution of the outcomes per income decile (Figure 2).

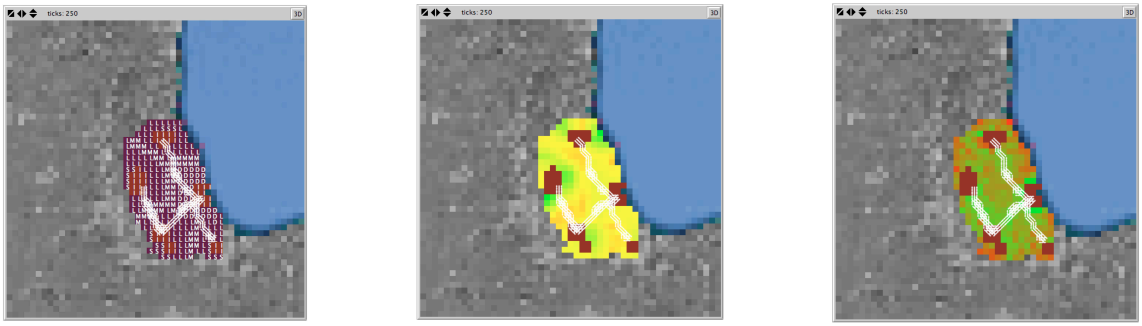

Figure 1: (Left) The designed city, (center) avg. incomes by area, (right) and avg. commute times by area.

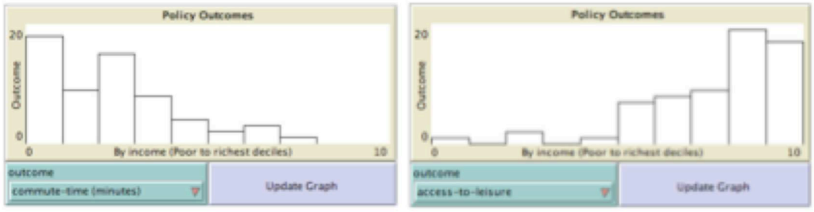


Figure 2: Customizable bar charts per income decile. (Left) Commute time, (right) access to leisure areas.

Students are then encouraged to discuss whether they think they could improve on their designs, and if they choose so, iterate over their designed city until they have re-grown their city in a way they feel meaningfully meets their policy outcome goals, and makes the city a better place to live in. Finally students present their re-grown cities to other groups in the class, accounting for their goals, their outcomes, and their policy and design strategies for achieving them.

## Contributions and Relevance

We believe that agent-based modeling in social sciences education is understudied, and under-designed-for. Agent-based modeling already has a decades long tradition in social sciences research and STEM education, with a focus on mechanism-to-aggregate-outcome explanations of phenomena, and taking a Constructionist approach that enables learners to draw on multiple epistemological resources and connect informal, personal experiences with more formal domain representations. Our curriculum unit draws on this work, but pushes it in a new, exciting direction: Toward social sciences educational contexts.

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