By Kate Shuster and Ximena Giesemann

CREATE JUST SYSTEMS

Antiracist educators focus on the complexity of systems, particularly those in schools. The curriculum invites students to examine how policies and practices operate to impede or advance human potential. Antiracist schools dismantle inequitable systems and create new ones.

Changing unjust systems requires that people can see and understand systems. In addition, change-makers — whether school leaders, classroom teachers, or students — need to feel confident in their ability to have an impact. In practice that confidence requires a feeling of self-efficacy rooted in an understanding of the major characteristics and functions of just and unjust systems.

WHAT IS SYSTEMS THINKING?

Systems thinking is the ability to "visualize the interconnections and relationships between parts of a system."[1] When learners engaged in systems thinking see a pond, they see a system at work. They note that all elements in the pond (e.g., snails, lily pads, gravel, fish, water) are interconnected and interact to form the pond as a whole. They notice patterns as the pond responds to external influences. For example, learners might see that summertime sunshine makes the pond prone to algae blooms, and that this excess of algae in turn kills fish. Learners might then plant tall trees around the pond, minimizing sunlight and algae blooms and keeping the fish alive.

Teaching learners to see and understand systems is essential to make systemic change possible.

Systems thinking is especially important in the context of racism. Learners who examine racism through the lens of systems thinking can see racism as both an individual phenomenon (for example, through individual acts of prejudice) and one that manifests at the levels of institutions and cultural belief systems. They see its deeply embedded and systemic nature.[2] Conversely, students who do not recognize the systemic nature of racism may primarily view racism as a thing of the past, occurring in the present day only via individual acts of discrimination or bias.[3] This failure to recognize racism as a systemic issue is dangerous and can reinforce and perpetuate racism.[4,5,6] To understand the true nature of racism, learners must engage in systems thinking.

1 Orgill, M., York, S., & MacKellar, J. (2019). Introduction to systems thinking for the chemistry education community. *Journal of Chemical Education, 96,* 2720-2729.

2 Van Ausdale, D., & Feagin, J. R. (2001). *The First R: How Children Learn Race and Racism.* Rowman & Littlefield.

3 Schmidt, S. (2005) More than men in white sheets: Seven concepts critical to the teaching of racism as systemic inequality, *Equity & Excellence in Education, 38*(2), 110-122.

4 Feagin, J., & Bennefield, Z. (2014). Systemic racism and U.S. health care. *Social Science & Medicine, 103,* 7-14.

5 Williams, D., & Mohammed, S. (2013). Racism and Health I: Pathways and Scientific Evidence. *American Behavioral Scientist, 57*(8), 1152-1173.

6 Woodson, A. (2017). "There Ain't No White People Here": Master Narratives of the Civil Rights Movement in the Stories of Urban Youth. *Urban Education, 52*(3), 316-342.

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THE BENEFITS OF SYSTEMS THINKING

There are many demonstrable benefits to using systems thinking in educational contexts. Educators who integrate systems thinking into their practice, both by teaching about systems and examining schools as systems, report improvements in their own practice and in learner-level outcomes such as retention and application of knowledge.[7,8,9] Learners who develop systems thinking develop better abilities to take perspectives, integrate complex ideas, and think across disciplines. They also ask better questions,[10] learn content more deeply,[11] and participate more actively in learning through critical investigation.[12] Pedagogy that encourages systems thinking increases learners' retention of material[13] and problem-solving abilities.[14] A wide body of literature shows that systems thinking builds holistic understanding of complex, real-world problems including climate change,[15,16] healthcare inequities,[17] and poverty.[18] Fortunately, research suggests that learners as young as elementary students can develop systems thinking skills.[19]

DEVELOPING CRITICAL SELF-EFFICACY

Learners who do not see systems at work are unable to change them. They may take valuable individual actions (for example, bringing reusable bags to a grocery store), but not those likely to resolve a large and persistent problem such as global warming. In fact, when such learners encounter major, large-scale injustices such as poverty or racism, they may feel unable to make any real, positive change because they do not see systems at work. In psychological terms, we say that learners in these circumstances lack perceived self-efficacy for change.

For learners to act, they must feel a sense of perceived self-efficacy rooted in an understanding of just systems. A perceived sense of self-efficacy, or one's personal sense of an ability to take action to obtain desired outcomes,[20] is consistently found to predict motivation and behavior[21,22] even more than past experiences and expected outcomes. However, while a perceived sense of self-efficacy is enough to explain behaviors or actions, it has no *per se* relationship to

7 Rizzo, D. M. (2011, June), Incorporating Systems Thinking and Sustainability within Civil and Environmental Engineering Curricula at UVM. Paper presented at 2011 ASEE Annual Conference & Exposition, Vancouver, BC. 10.18260/1-2--18134

8 Goode, G. S. (2019). *The construction of systems thinking pedagogy during a professional development institute* [Doctoral dissertation, The University of Memphis].

9 Mathews, L. G., Jones, A., Szostak, R., & Repko, A. (2008). Using systems thinking to improve interdisciplinary learning outcomes: Reflections on a pilot study in land economics. *Issues in Interdisciplinary Studies,* 73-104.

10 Lyneis, D. A. (2001). Bringing system dynamics to a school nnear you: Suggestions for introducing and sustaining system dynamics in K-12 education. *Creative Learning Exchange Newsletter, 10*(1), 1.

11 Kali, Y., Orion, N., Eylos, B.-S. (2003). Effect of knowledge integration activities on students' perception of the earth's crust as a cyclic system. *Journal of Research in Science Teaching, 40,* 545-565.

12 Richmond, B. (1993). Systems thinking: Critical thinking skills for the 1990s and beyond. *Systems Dynamics Review, 9,* 113-133.

13 Booth Sweeney, L. (2005). How is this similar to that? Recognizing parallel dynamic structures on center stage. *Creative Learning Exchange Newsletter, 14*(3), 1.

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15 Davis, J. (2010). Early childhood education for sustainability: Why it matters, what it is, and how whole centre action research and systems thinking can help. *Journal of Action Research Today in Early Childhood,* 35-44.

16 Lezak, S. B., & Thibodeau, P. H. (2016). Systems thinking and environmental concern. *Journal of Environmental Psychology, 46,* 143-153.

17 Hernández, A., Ruano, A. L., Marchal, B., San Sebastián, M., & Flores, W. (2017). Engaging with complexity to improve the health of indigenous people: a call for the use of systems thinking to tackle health inequity. *International Journal for Equity in Health, 16*(1), 1-5.

18 Briscoe, P. (2016). Global systems thinking in education to end poverty: Systems leaders with a concerted push. *International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM)), 43*(3), 5-19.

19 Evagorou, M., Korfiatis, K., Nicolaou, C., & Constantinou, C. (2009). An investigation of the potential of interactive simulations for developing system thinking skills in elementary school: A case study with fifth-graders and sixth-graders. *International Journal of Science Education, 31*(5), 655-674.

20 Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84,* 191-215.

21 Schunk, D. H. (1995). Self-efficacy, motivation, and performance. *Journal of Applied Sport Psychology, 7*(2), 112-137.

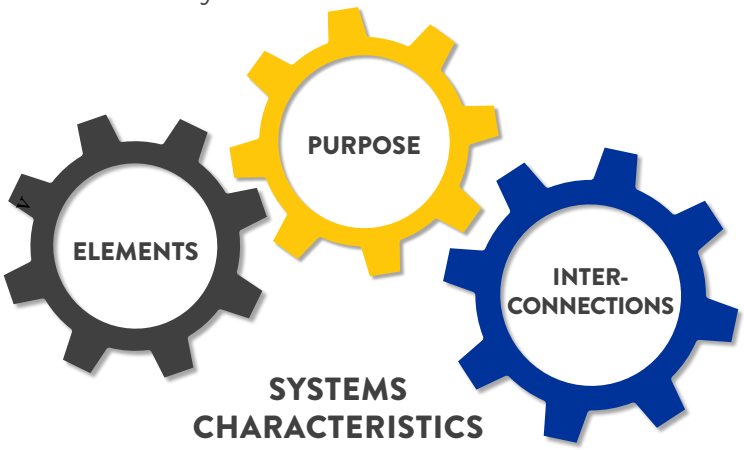
22 Sheeran, P., Maki, A., Montanaro, E., Avishai-Yitshak, A., Bryan, A., Klein, W. M., ... & Rothman, A.J. (2016). The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: A meta-analysis. *Health Psychology, 35(*11), 1178.

creating just systems. In fact, it is entirely possible that a learner could gain perceived self-efficacy to engage in destructive and unjust behavior. Creating just systems and overturning unjust systems requires critical self-efficacy, understood as the felt capacity for action generated by critical consciousness of the world and the related impetus to transform it for the better. Integrating critical consciousness and systems thinking allows educators and learners alike to build this essential skill.

HOW DO WE TEACH THIS?

HELP LEARNERS TO IDENTIFY SYSTEMS

Systems are more than collections of items. As Meadows (2008) explains: "A system is an interconnected set of elements that is coherently organized in a way that achieves something." Systems have at least three essential characteristics: elements, interconnections, and purpose. The elements comprise people, places, behaviors, and things. Interconnections are the dynamic ways that elements interact with each other. Finally, systems have purpose — the *for what and to whose benefit* a system operates. Identifying systems across places, eras, and disciplines helps learners to "build muscle" to recognize elements, interconnections, and purposes when they encounter systems at work in their lives.



BUILD SYSTEMS THINKING ATTRIBUTES

Systems thinking attributes (STAs) are capacities that learners build as they engage in systems thinking.[23]

These may include:

- "Forest thinking," or the ability to identify a system as a whole;
- The ability to identify complex causes and effects;
- The ability to identify relationships among system elements;
- The ability to see visible and hidden elements of systems;
- The ability to think across time, making predictions about the future and making sense of the past.

Educators using systems thinking should take care to identify the specific metacognitive skills, such as "forest thinking," that their systems approach makes possible and build appropriate assessment instruments to ensure that learners are getting as much as possible out of systems-based approaches.

INCORPORATE PROJECT & PROBLEM-BASED LEARNING APPROACHES

Project and problem-based learning strategies center students in exploring real-world problems. Both approaches have been shown to develop a host of skills, including critical thinking, collaboration, communication, and teamwork. A wealth of literature drawing from STEM classrooms has shown that both teaching strategies benefit from a systems approach and themselves accelerate systems thinking attributes.[24]

23 Nagarajan, S., & Overton, T. (2019). Promoting systems thinking using project-and problem-based learning. *Journal of Chemical Education, 96*(12), 2901-2909.

24 See Nagarajan & Overton (2019) for a comprehensive review of this literature.

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