Systems Thinking "in 25 Words or Less"

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When we were first exploring the idea of systems thinking in our school district, a fellow school board member drew me aside and asked me to tell him "in 25 words or less" just what systems thinking was and what it had to do with educating children. I was stumped! Many months later, and somewhat further along, another school board member tactfully cautioned that we should not mention systems thinking in our upcoming public hearings because "people's eyes glass over" if it seems too deep!

For such a good idea, why is systems thinking in education so difficult to explain at first? People with some understanding of systems thinking (from those who have just caught glimpses of it, to those who use system dynamics modeling in their classrooms) are all very good at conveying their enthusiasm about it. Explaining it succinctly to people without that background is not so easy, however. Partly, this is because systems thinking is a big idea which applies to education at several different levels, from specific curriculum tools to the broader purpose, management and philosophy of education. Also, because a systems viewpoint seems foreign to some people, explaining it has to relate to their own experience to make sense, and that takes time too. Here is one try, with a few more than "25 words or less."

"Systems Thinking" is a term that is gaining wider use and acceptance, but it is not widely understood. Although it sounds like a great idea, it is still quite confusing. Systems thinking does present a different way of thinking, but there is nothing mysterious, incomprehensible, or foreign about it. It is easiest to approach it as another form of common sense, only from a different perspective. At first, to get a good understanding, you need to suspend your own previous assumptions for a while and try to look at familiar things from a new angle.

Here is an example arising from the educational experiences we have all shared. In school, we have been taught that social studies, math, language arts, science, and art are all separate disciplines, or bodies of knowledge. This stems back to the early days of modern science when the idea of reductionism took hold: the idea that you can best understand something by taking it apart and studying all of its pieces. Consequently, we have made great strides in the advancement of knowledge as experts have become more and more specialized. In education, students have followed this same model, with their instruction becoming more and more compartmentalized as they proceed through school. Our high schools have become collections of separate departments, each with their own facts to teach. Although we know that in the "real world" we seldom deal with each subject in isolation, we leave it to our students to synthesize all this information on their own...if they can.

From a systems thinking point of view, this synthesis is the most important part. Systems thinking encourages you to step back and see the whole picture, rather than focusing on just its parts. It is an attempt to see the "forest" as well as the "trees." Systems thinking explores the interdependencies among the elements of a system, looking for patterns rather than memorizing isolated facts. It focuses on the feedback loop structure of a system because that structure determines the system's behavior over time.

With a little bit of practice, you will see these patterns emerge. Furthermore, the patterns are strikingly similar across disciplines. Once you can begin to spot the similarities, it becomes much easier to understand each discipline itself, along with the big picture. For example, exponential growth is one very common basic pattern in systems. Starting with mathematics, exponential growth is what develops if you take a very small number and, for example, double it. Next you take your answer and double that; keep doubling your answer again and again. In this example, 1 doubled becomes 2, then 4, 8, 16, 32, 64, 128, 256, 512, 1024, and so on. At first, your results are still small numbers, but as you keep doubling the answer, the results start to make much bigger and bigger jumps. Squaring a number takes even more dramatic leaps!

Whatever the multiplier, the growth builds upon, or reinforces, itself. If you stop to think about it, you can see that this pattern is ubiquitous. It applies to unchecked population growth, whether of bacteria in a petrie dish, gypsy moth caterpillars in your backyard, or human population. Just think of a family reunion or family tree where one elderly couple might have three children, nine grandchildren, and twenty-seven great-grandchildren: a very large family from just one couple! In social systems, you see the same pattern in the spread of a rumor, or the spread of an epidemic. Only a few people may be involved at first, but it spreads more rapidly as more people do the spreading!

In economic systems, a bank balance left to accumulate interest grows exponentially; a small amount of money at first grows to a large sum as the interest rate applies to a larger and larger principal. Spiraling wage and price inflation also behave this way. Every chain letter or pyramid buying scheme appeals to our basic understanding of exponential growth to lure participation. In fact, anything that you would already call a "band wagon," "snowball effect," or "virtuous cycle" probably fits the pattern of exponential growth.

Once you can recognize the patterns in these systems, you gain a deeper understanding of them. If you can grasp it in one example, you gain recognition and understanding of the rest. Furthermore, you begin to see how these structures determine the behavior of the systems in remarkably similar ways, and you can think in broader terms about their implications. For example, you learn that exponential growth cannot go on forever; there are almost always limits which are also part of the system. Sometimes you can even see your role as part of some systems--part of the problem and part of the solution. In effect, you come to see the "forest" as well as the "trees" because you can see the interrelationships among the elements of the system.

Back to education, young children are intuitively good systems thinkers, probably because their learning has not become so fractured yet. In their eagerness to learn, they bring all that they know to their learning. Everything is related and relevant. We do a pretty good job at supporting this in kindergarten. When the children study the ocean, for example, they read and write ocean stories, count and sort sea shells, study and taste fish, and tie it all together with art projects. They might even discuss beach erosion and pollution in this interdisciplinary endeavor. They know that "everything is connected to everything else." What's more, they love it! In their interdisciplinary, learner-centered approach, they are pretty good budding "systems thinkers." Perhaps we would all be too, if our thinking had not become so compartmentalized as we progressed through school.

It is fun to explore the ideas of systems thinking because their applications are all around us. In education, we cannot expect to overhaul our current system, at least not all at once, but we can encourage our students to build on their early systems thinking tendencies, so that they are better equipped to deal with the much more complex systems they will face. They will need these decision-making skills.

Systems thinking is the broad concept we have discussed so far. The curriculum tool for building this skill is "system dynamics," a specific computer simulation technique. Students learn to specify and quantify the relationships and structures of a system and then simulate them to observe the behavior of the system over time under varying assumptions. They build a computer model of the system based on their experience and research and then experiment on it. For example, in a model of the gypsy moth caterpillar population, students would have to specify exactly what factors cause the population to grow exponentially. As the simulation unfolds, they would see that these same factors also play a role in the population's exponential decline.

System dynamics is the cornerstone of systems thinking. Learning system dynamics makes accurate, confident systems thinkers. Although systems thinking by itself yields fascinating and valuable insights, system dynamics gives you the tools to go further into critical thinking and problem solving. At the curriculum level, it makes education engaging, learner-centered, and relevant. By understanding the underlying system structure of the subject at hand, students gain not only a deeper understanding of that subject, but that insight also transfers to a deeper understanding of other subjects as well. Also, system dynamics modeling is interdisciplinary because students must bring all of their knowledge and experience to the task. For example, to model an epidemic, students would start with the biology of the infection, but political, economic, and social factors are also very important. System dynamics ties education together, and math becomes a natural part of all subjects. This synthesis offers students the confidence and problem solving skills they will need as they face increasingly complex social, environmental, and political systems.

Systems thinking may seem foreign, even frustrating, at first. Because it is a different approach than we have been taught, it sometimes takes a while to "sink in." There are also different levels of pursuit from just being aware of systems to building system dynamics models. At the beginning, just try to look for examples that apply to you and think of systems thinking as adding another dimension to your good common sense. Then, keep going, because it is exciting and important!

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