

Ability of systems approaches to assist in more effective problem solving and education on environmental health issues.

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Abstract: Environmental health issues are often complex containing multiple stakeholders with different needs and beliefs. In order to achieve progress in addressing such complex issues we need to understand the different perspectives and needs of all stakeholders. We need to understand all of the factors affecting the situation, both mental and physical, and to use this knowledge to design our problem solving and educational efforts. Systems thinking provides us with tools to assist in this.

In the past, an Environmental Health Officer (EHO) who wanted to educate the community or business would have published a media article, prepared brochures or information kits and handed these out to people. They would hope that the target audience read the material and change their ways. But unfortunately we are often disappointed when the response is not as high as we would have liked. We try again, bombarding them with more and more information but still the response is low. Why? Eventually we start to wonder if the people are reading the material or if they are, maybe they simply don't care. It is a frustrating, time consuming and expensive exercise. So why doesn't it work as well as we would like?

I believe we need to look at how people learn, the things that interfere with learning, reasons why people are behaving the way they do, what our requests mean to them and to design our educational programs to address these issues. Let's start by looking at the learning process.

Many people assume learning to be a simple process of reading or hearing information but that's not true. People learn at different rates, they have different learning styles- some people prefer to hear material, others to see it and some to do it, and there are many impediments to learning that can thwart our efforts such as not remembering, bias, defensive routines, politics and other game playing which result in little change. In order to improve learning we need to understand these issues and look at ways to overcome them. Systems thinking provides us with some tools to achieve this.

So what is systems thinking? In order to answer that I would like to look at the way most of society thinks. If you asked someone 'what causes what?' chances are they will provide you with a list of causal 'factors' in response. They will also weight each of the factors in the list- this one is most important, this is second and so on (Richmond 1990 p938). This is known as laundry list thinking and it assumes that: (1) each factor contributes as a cause to the effect i.e.: causality runs one way (2) each factor acts independently (3) the

weighting of each factor is fixed and (4) the way in which each factor works to cause the effect is left implicit (represented only by positive or negative influence) (Richmond 1990 p938). In reality its not that simple.

Systems thinking assumes that each factor is linked, and effects each other, that is the causality is bi-directional and the importance of each factor will change over time. Helping society to see the interconnectedness and to think systemically can help raise the quality of political debate on environmental health issues. For example- energy conservation. This is often debated in terms of what it will cost and the changes required to business and societies behavior. To many, it is seen as not worth the effort. This is largely because they do not understand the benefits. Therefore little is achieved. Donella Meadows highlights that energy conservation would not only save consumers money, it would also cut urban air pollution, acid rain, greenhouse gases, the production of radioactive wastes, the trade deficit, and the defense costs in the Persian Gulf- only a few of the effects that would radiate through economic and environmental systems if we embraced energy conservation(Meadows 1991). By preparing a model of all the factors affecting the issue and using this model to explain the system to politicians, it would help them to understand the implications and lead to better policy decisions.

But its more complicated than that I hear you saying. There are other issues involved, including politics, brown business pressures, tariffs and globalisation, etc. True, there are many complex issues interacting to cause the behavior we see, and all of these factors need to be included in the models developed. It is only through looking at the interaction of all factors- physical and mental, that we can develop effective solutions. This brings me to my next point.

We all have a mental model or underlying assumption of the way the world works- the things we believe to affect issues and to be true. Everyone has different mental models as they are built from past experience, facts and beliefs(Thurman 1993; Morecroft 1992). These mental models are often flawed as we don't understand all factors affecting the system- we simplify cause and effect, ignore feedback processes, and fail to appreciate time delays between action and response(Sterman 1994).

Donella Meadows provides some excellent examples of flawed mental models in relation to environmental issues:

- One cause produces one effect. There must be a single cause, for example of acid rain, or cancer, or the greenhouse effect. All we need to do is discover it and remove it
- All growth is good- and possible. There are no effective limits to growth
- There is an 'away' to throw things to. When you have thrown something 'away' it is gone
- Technology can solve any problem that comes up. There is no cost to technology, no delay in attaining it, no confusion about what kind of technology is needed. Improvements will come through better technology, not better humanity

- The future is to be predicted, not chosen or created. It happens to us, we do not shape it
- A problem does not exist or is not serious unless it can be measured
- If something is 'economic', it needs no further justification. EF Schumacher writes 'call a thing immoral or ugly, soul destroying or a degradation of man, a peril to the peace of the world or to the well being of future generations; as long as you have not shown it to be 'uneconomic' you have not really questioned its right to exist, grow and prosper'.
- Relationships are linear, non-delayed, and continuous, there are no critical thresholds, feedback is accurate and timely, systems are manageable through simple cause-effect thinking
- Results can be measured by effort expended- if you have spent more for weapons, you have more security; If you use more electricity, you are better off; if you spend more for schools, your children will be better educated
- Nations are disconnected from one another, people are disconnected from nature, economic sectors can be developed independently from one another, some parts of a system can thrive while other parts suffer.
- Choices are either / or, not both /and
- Possession of things is the source of happiness
- Individuals can not make any difference
- People are basically bad, greedy and not to be trusted, Good people and good actions are rare exceptions.
- The rational powers of human beings are superior to their intuitive powers or their moral powers
- Present systems are tolerable and will not get much worse, alternative systems can not help but be worse than the ones we've got.
- We know what we are doing (Meadows 1991)

It is these flawed mental models, these underlying assumptions, that people have that often lead to disagreement in discussions. We become defensive as someone challenges our assumptions, our beliefs. Unfortunately we don't realise that we have them and that they are simplifications of a complex system and likely to be flawed. Instead, we recognise that we are feeling upset, we don't like what the person is saying and we react. Often we assume that the other person doesn't have all the facts and is therefore wrong. We refuse to listen to them- we know better. The result is often very negative. For the same reasons mental models can also affect learning.

It is not enough to simply hand people paper or case studies if what you are trying to teach them is in conflict with their mental models or not important to them. Thrusting legislation at them certainly doesn't help gain cooperation or improvement. You need to find out peoples perspective, understand their mental models and why they behave the way they do. You can then use this to design more effective educational programs. You also need to look at your actions, your mental models and how these affect the outcome of the educational program.

For instance I thoroughly believe that we will have much more success in getting business to become sustainable if we stop using 'greeny' language and start using 'business' language. We also need to realise the factors that affect their business, their priorities and how our requests impact on these factors. We can then design our programs to suit. For example instead of talking about cleaner production and zero emissions, which many business managers see as side issues that they don't have time or resources to deal with, we can talk about business process reengineering, continuous improvement, strategic planning and value adding which they see as core business. We can incorporate our 'environmental' needs into their terms, to fit with their mental models.

There are currently several educational advertisements on public health issues that demonstrate the concept of mental models. Some examples of these are:

- The Quit Campaign- everyone knows that smoking is bad for you. For years we have spent money educating people about the health effects only to find they don't care. Why? Because many people had an underlying assumption, a mental model that said it's okay to smoke for a short time but I'll stop when I get older. The latest Quit campaign targets this mental model with the message – every cigarette is doing you damage.
- Similarly speeding- everyone knows they shouldn't speed, but people still do. Why? Because they have an underlying assumption that it doesn't matter if they speed. The latest speeding campaign targets this belief and the excuses people usually use to convince themselves its okay- just going for a burn, the boss would kill me if I was late, I didn't want to keep the kids waiting, etc. These statements flash across the screen as you see a crashed car on fire, a man bed-ridden in hospital, the police telling a wife (with children in the background) that her husband is dead.

These advertising campaigns are simple examples of addressing mental models and may not solve the issues completely but they are likely to make people rethink their behavior more so than simply saying don't do it.

Another tool provided by systems thinking is Learning Environments or Management Flight Simulators. These are realistic computer simulations in which learners are presented with a problem, required to execute a sequence of inquiries, decision, and actions and then receive information about the ways in which the situation evolves and changes in response to their actions(Thurman 1993). They call upon the learner to respond through decision making (Rice 1966), problem solving (Cruickshank 1966) and / or role playing (Pollack 1973). Because the simulation proceeds into the future participants see the consequences of their actions (Smith 1986; Spannaus 1978) (Thurman 1993).

The use of Learning Environments has several advantages. They provide low cost laboratories for learning. They allow time and space to be compressed or dilated. Actions can be repeated under the same or different conditions. One

can stop the action to reflect. Decisions that are dangerous, infeasible or unethical in the real system can be taken in the simulation. Thus controlled experimentation becomes possible, and the time delays in the learning loop through the real world are dramatically reduced. In the real world the irreversibility of many actions and the need to maintain high performance often override the goal of learning by preventing experiments with untried possibilities (if it ain't broke, don't fix it). In the simulation one can try strategies that one suspects will lead to poor performance or even (simulated) catastrophe (Sterman 1994 p317).

They are much more effective than case studies which are traditionally used for education (Graham et al 1992). With case studies all you can do is discuss the case and the outcome, you can hypothesize the results of alternative actions, but you can't actually test them. By using a computer simulation you can test each of the scenarios and see the outcomes. Similarly you can run scenarios that represent the different mental models of the stakeholders and see the outcomes. In this way it diffuses the potential for argument over whose view is right as the computer model will independently and unbiasedly produce results for each possibility. The students or stakeholders can then explore through the model structure to work out why the results are not what they expected. In this way it can help people to truly understand the system, to see the bigger picture and alter their mental models accordingly.

An important side effect of these computer simulations is fun. The learning process incorporates discovery, enjoyment, play and sometimes competition. People can sustain interest in the subject matter, and the learning experience is more powerful and enduring (Graham et al 1992 p163).

Such simulations for learning and training are common place in the military, in pilot training, in power plant operations, and in many other real time tasks where human operators interact with complex technical systems. There are many simulations now being developed on a wide range of dynamically complex settings such as business management and environmental issues. They have enjoyed great success in pre-college education, universities, and corporations (Sterman 1994 p319).

EHO's could use these Learning Environments to help raise understanding and awareness of environmental issues within their communities; to assist stakeholders and decision makers to see the interconnectedness of the world and to understand the importance of their decisions. Information on three environment related Learning Environments are attached as an appendix to this paper.

In summary, I believe that the Environmental Health issues that we deal with are becoming more and more complex. Issues such as sustainability involve many stakeholders, all with different interests and priorities. They involve power plays and conflict. To gain progress on such issues will require EHO's to have strong negotiation, facilitation and systems thinking skills. I believe that the systems thinking tools outlined today will greatly assist us in moving forward on these issues.

Thankyou.

Author Profile:

Jodi Smith started her career as an EHO before specialising in design and management of educational business sustainability projects. She then moved into the corporate development field where she became a corporate and strategic planner, specialising in change management and consultation. She is undertaking a research PhD on the design of more effective educational programs on sustainability. The concepts presented today are related to her study and focus on systems thinking and system dynamics. These are two fields that are in common use throughout the world but relatively rare in Australia. To learn the systems skills Jodi is doing an on-line course from Massachusetts Institute of Technology (MIT) in the US.

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