Systems Thinking in High Schools for 2100

Gordon Kubanek, P.Eng., B.Ed.

1 Morris St. Alexandra 3714 VIC Australia [temporary]
01161-35772-1019 [fax –2049 @ work]
kwfletch@shepparton.net.au
621 Southmore Dr.W. Ottawa ONT. K1V 7A4 Canada [permanent]
0111-613733-5671 [fax – 8452 @ work]
chust@monisys.ca OR gordon_kubanek@ocdsb.edu.on.ca

Abstract

How do we change passive into active learning ? How can we change the fundamental structures in and around the classroom so all learners become system thinkers? This workshop by raising more questions than giving answers, will lead us through the six step process of Goodman to attain that goal. The anonymous, monolithic, content driven educational system is "turning off" too many students. The resulting high drop out rates, lack of interest in learning and violence are robbing us of a well educated, literate citizenry. Using systems thinking we shall begin to design the structures in and around the classroom that change the relationship between teacher and student, student and content, school and society. When the same values that change the classroom occur in the surrounding structure we can not only "produce" the elite of tomorrow, but more importantly, reduce the level of distress of our "under achievers".

Part A - Introduction

Students sometimes tell me that I cannot make them do the work I ask, and they are right. All I can do is create the mood in which they become passionate and interested in learning. I believe that Systems thinking can help to change the learning process by allowing more active, experiential learning that can give all students the opportunity to achieve success.

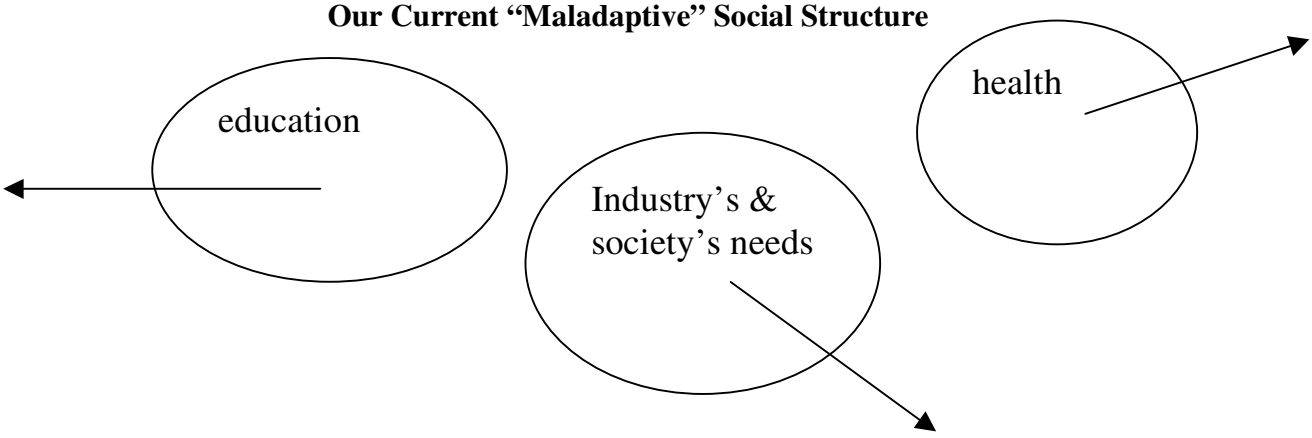
Here are two suppositions to consider: I. Structure influences behavior. II. People always do exactly what makes sense to them. This means that when we see students dropping out, taking drugs, pulling out a gun or alternatively thinking creatively we must accept that we play a large part. Many of the near pathological behaviors seen in High Schools today may seem irrational but may be seen as reactions to a structure which is not meeting their needs. Furthermore the present disjointed delivery of educational, physical and mental health services gives unsatisfactory results. The societal stresses which we see, which are obvious in our High Schools, will accelerate unless we change the structure of our delivery system. We shall explore how the principles of System Thinking can create the environment where students are passionate about learning, dare to risk while they learn and can reflect upon what they have achieved.

But, you may ask, what does this all have to do with systems thinking? For me, the real value in systems lies in its ability to make explicit long-term affective domain variables and analyze the inter-relationships between observed behaviors. With this view we can better understand the issues and propose alternative solutions to the problems High Schools currently face. We shall see how systems thinking in the classroom and school, and how a systematically designed structure in the Ministries of Education and Health, working in partnership with Industry, can not only "produce" the elite of tomorrow but more importantly reduce the level of distress of our "under achievers". We need better systems thinkers not only at the Universities and senior management levels but in the factories and kitchens and garages as well.

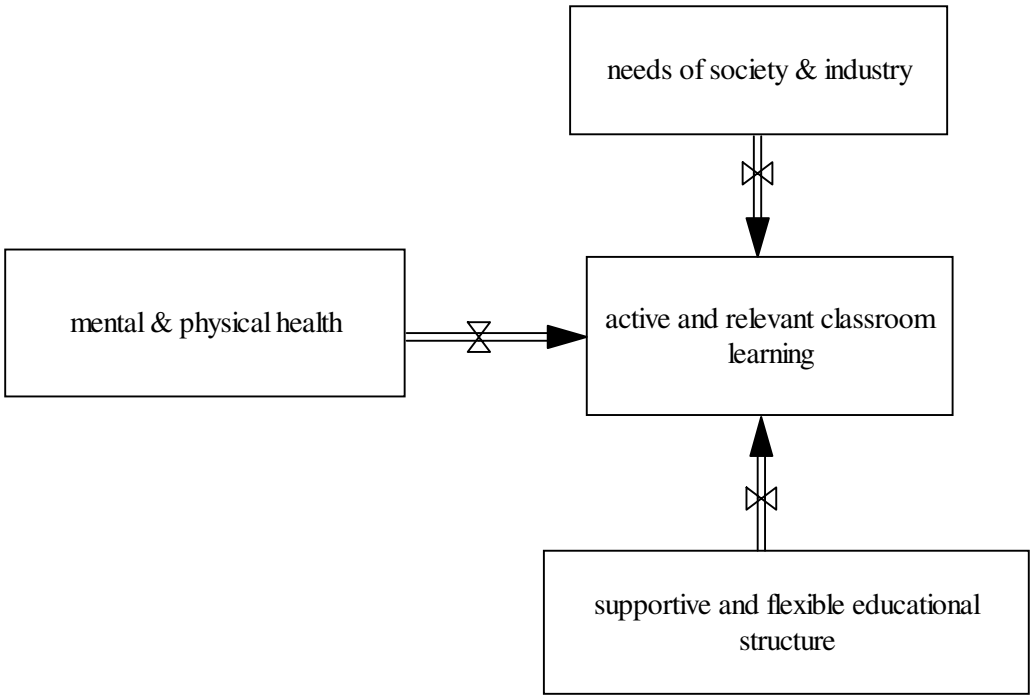
I would propose that we are currently focussing on short term, "symptomatic" solutions. The current lack of integration between the education, health care and industry is "maladaptive" and potentially pathological environment for our youth. "While health development consists of a number of tasks that require ongoing coordination and integration in the individual's adaptation to the environment, pathological development has been reported to involve a lack of integration between the individual's cognitive, social and emotional competencies, thereby resulting in maladaptation." (Apolucci,E. Genius,M.1999)

I shall be working with the concept that the structural archetypes that are best for the individual also apply to the societal systems as a whole, thus the following diagram may characterize our current delivery systems (at least in the English speaking world). We need to define goals in terms of long term "fundamental" solutions. Systems thinking can play a key role in constructing a more meaningful learning experience which is reflected in the adaptive social structures around and in the school.

Our Current "Maladaptive" Social Structure



Contrasting "Adaptive" Social Structure in the Year 2100



The Task at Hand Today

We shall use the six step systems thinking process (Goodman & Karash,1995) to envisage the classroom learning experience in the year 2100 with the supporting structure necessary to have dynamic, active, meaningful learning for ALL students. The six steps are:

1. Tell the story
2. Draw behavior over time graphs
3. Create a focusing statement
4. Identify the structure
5. Going deeper
6. Plan an intervention

Your Role

As I present my ideas I shall need your feedback. We shall write down all ideas and use them for a brainstorming session later in the workshop. My ideas are meant to provoke or as de Bono would say "PO" (De Bono,1998) and to be a launch pad as we construct our future classroom of 2100.

Part B - Building Our Classroom of 2100

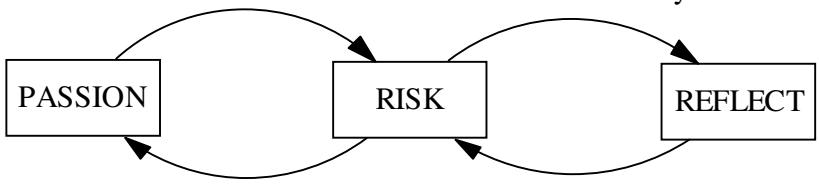
This story illustrates how systems ideas can be found in the most unlikely of places. In building our systems thinking classroom keep in mind that our goal is to help build systems thinkers like this adult sheep farmer. Three concepts in this story are key ideas in the model building process.

Step 1: Tell the Story

I met a sheep farmer during the shearing time. At the end of the hard day, with a satisfied look on his face, we chatted. I asked the sheep farmer: " What skills from school have been the most useful to you in your work." He was quiet for some time. Then he replied: "You have to **love what you do**. When you really like what you do you notice all kinds

of things, you **learn quickly, mostly by your mistakes**, because just listening to others does not create the understanding within you.“ A while later the farmer continued, slowly: "This is how it is – working hard during the day you spend the money, and on my computer at night – thinking, analyzing and **reflecting upon my work** – that is when I make my money. I was flabbergasted – for me this was systems thinking at its best. Not once did he say anything about content, even specific skills – he had only talked about attitude, risking mistakes to learn & reflection. Let us draw the parallels with the six-step system thinking process and these ideas from the farmer.

Sheep Farmer	**Systems Thinker**
A. Students must care passionately about their subject/issue	A. steps 1 & 2 – tell the story to the motivate & draw behavior graphs to arouse interest
B. Deep, personal learning happens by making mistakes	B. steps 2 & 3 – list variables, create relationships, outline the model
C. Without a time to think & reflect about your work no progress is possible	C. steps 5 & 6 – build the model and the key relationships that make the system either succeed or fail



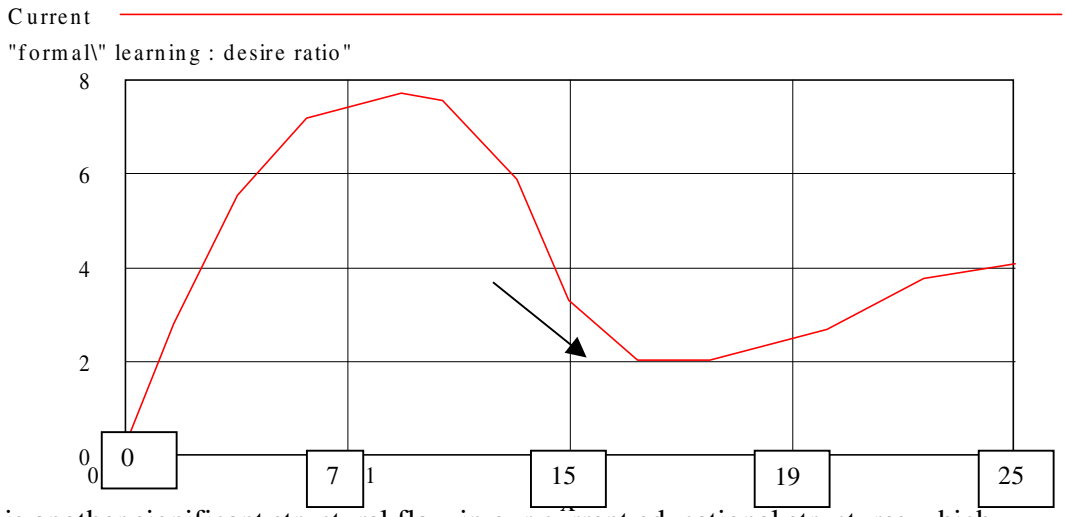
For many students the “crises” in learning & emotional turmoil peaks around 15. This is the age when most High School potential violence and lack of curiosity occurs. As a teacher of that age I can tell you that the idealism, desire to help others and drive to “change the world into a better place” that once was the hallmark of the healthy teenager is often absent. How do we help the students have passion? In answering this question we cannot exclude the social factors from our model. Education must be seen within a larger context. I do not place any blame on the children, rather I question the society and educational structure where adults portray a very negative & dark emotional state for teens as “normal”. You have only to think of a movie like Cruel Intentions or the music of Marilyn Manson to see the role models that teenagers now have. Furthermore, according to the National Foundation for Family Research and Education of Canada strong bonding between parent and child is needed to develop an emotionally and mentally stable teenager. A supportive family unit is thus a necessary foundation upon which schools build. “ Secure bonding to parents is a direct cause of emotional and behavioral health, productivity and happiness in adolescence. On the other hand, insecure attachment to parents is a direct cause of clinical levels of emotional and behavioral difficulties in adolescence, including youth crime.” (Genius, 1995)

Step 2: Draw 'Behavior Over Time' Graphs

Based on my experience as a teacher I would characterize our current educational structure as early exponential intellectual growth coupled with low emotional growth. The academic pressure quickly bankrupts many students’ emotional resources. There has been research to support this thesis for decades (Forester,1955). Furthermore the dangers

of accelerated early learning, including increased risk of teen suicide, are thoroughly analyzed by Uphoff and Gilmore(1985): "...those pupils who were very bright but very young at the time of their school entrance did not realize their potential. They tended to be physically immature or emotionally unstable, socially they seldom showed leadership. From junior high school on 50% of them only earned "C" grades…. In many cases early entry may results in maladjustment in school, and even may have a adverse effect on adult life." My thesis is that passion and desire to learn are at risk if formal learning starts too early. I have defined this important quality as the "formal learning:desire Ratio. The current learning process is graphed below as an oscillatory model which is unstable and easily collapses into maladaptive behaviors such as drugs, drop-out and violence.

For many students this is the Current Educational Formal Learning to Desire Ratio



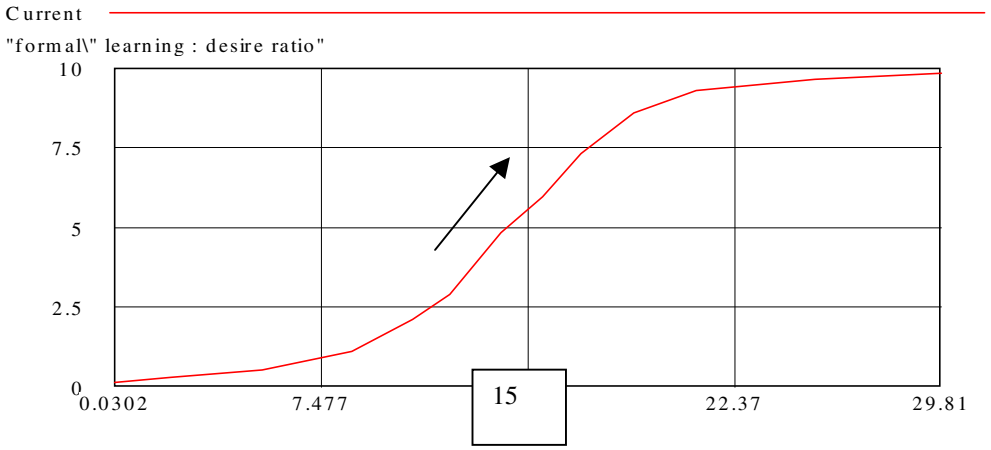
There is another significant structural flaw in our current educational structures which adds to the oscillations in learning described – at least in USA, Canada and Australia as I have experienced them. The course contents and teaching methods seem to be mainly intended to meet the learning style and goals of the small (20%) College track student. As a result of our over emphasis on intellectual learning at an early age many students feel threatened by learning and some are overwhelmed. Many may lose the early enthusiasm that they felt in grade 1. How could we recapture that joy in learning? How do we create an environment where making mistakes is not threatening?

A beginning could be to acknowledge that we have at least three totally different learners with needs and learning styles which need to be separately addressed. The Self Mastery Club of Los Angeles, California has a model which I find relevant to this thesis. They propose that there be three learning environments in schools as shown below (Brown, 1998). They have designed a curriculum to meet the needs of the "at risk" students – the ones who we currently deem trouble makers.

Category	At risk	Trade school	College prep
Objective	Keep in school	Learn a trade	Go to college
Approach required	Lead me	Show me	Tell me
Teaching style	Counseling	Apprentice	Lecture/experiment
Curriculum	Develop self-esteem	Trade specific	Three R's

How can we design a new structure so that ALL learners have positive feedback from their educational experience and thus lead more productive adult lives? For long term success in learning a "sustainable" S-shaped curve is a more desirable behavior. A key feature of this curve is the "vector" direction at age 15. I believe that the quantity of knowledge at this age is not so important but the movement towards wanting to know and experience for its own sake is vital.

This could be Our Future Systems Thinking Formal Education to Desire Ratio



Step 3: Create a Focusing Statement

What do we want our great grandchildren's educational experience to be like? How can we help create an atmosphere where dynamic change is not only accepted but is the foundation for the educational structure and in the classroom learning experience of the generations to come? We will need to design a structure in which LEADERSHIP, which I propose is more likely to lead to sustainable long-term change, is encouraged. What we have now is management which I believe reinforces short-term solutions and results in unstable changes in the learning environment. Teachers and Schools allocate resources and manage activity which is driven by the gap between desired and current learning outcomes. In the teacher as leader model the reinforcing structures rather than balancing structures are the object of the teachers energy. In this structure the teacher is involved in the design & implementation of the structure, not managing the activity in the structure.

If we use this proposition as a base from which to move from we can see that there is much that can and should change. Not only should the leaders be more proactive but the teachers in their own classroom should move from managing activities to implementing structure within which the students are actively exploring, risking and finding their own solutions to life's issues. Thus, it is our "Weltanschauung" which needs changing. What is our goal as leaders in Schools, Universities, Governments and Industry? I would propose that we support the development of emotionally & mentally balanced young people who have the courage and desire to make the world better for themselves, and their peers. We need to design with the long term social implications and mental health of the individual in mind. Our teaching style and course contents should also be designed around the same premise. The current polarity between the "hard", real world,

intellectual needs of the workplace and the "soft" self–development requires redesigning so that they compliment rather than oppose each other. I am sure that to those of you familiar with Soft Systems Methodology (SSM) this will sound familiar. Certainly the idea that education is an unstructured, political situation where "perceptions need to be addressed as realities" (Forbes, 1999) rings true.

Some of the structures that I think need addressing are shown below. None of this is meant to be inclusive or to be "the solution". Rather these areas of concern must be only viewed as "food for thought" as we enter our brainstorming groups to try to see how difficult it is to move to our theoretical classroom of 2100 and how inter-related all these issues are. So, how do we move from:

>Passive learning	to	Active Learning
>teacher centered teaching	to	student-centered learning
>content driven curriculum	to	emotional/intellectual health driven
>individual tasks	to	group tasks
>teacher as manager	to	teacher as leader
>only College prep teaching style	to	variety of teaching styles
>Computers in the computer lab	to	computers as a tool in all classes
>Politicized, "decaying" Public schools	to	healthy mix of alternatives
>Separate Education, Health & Industry Agendas	to	Common Education, Health & Industry Agendas

Step 4: Identify the Structure

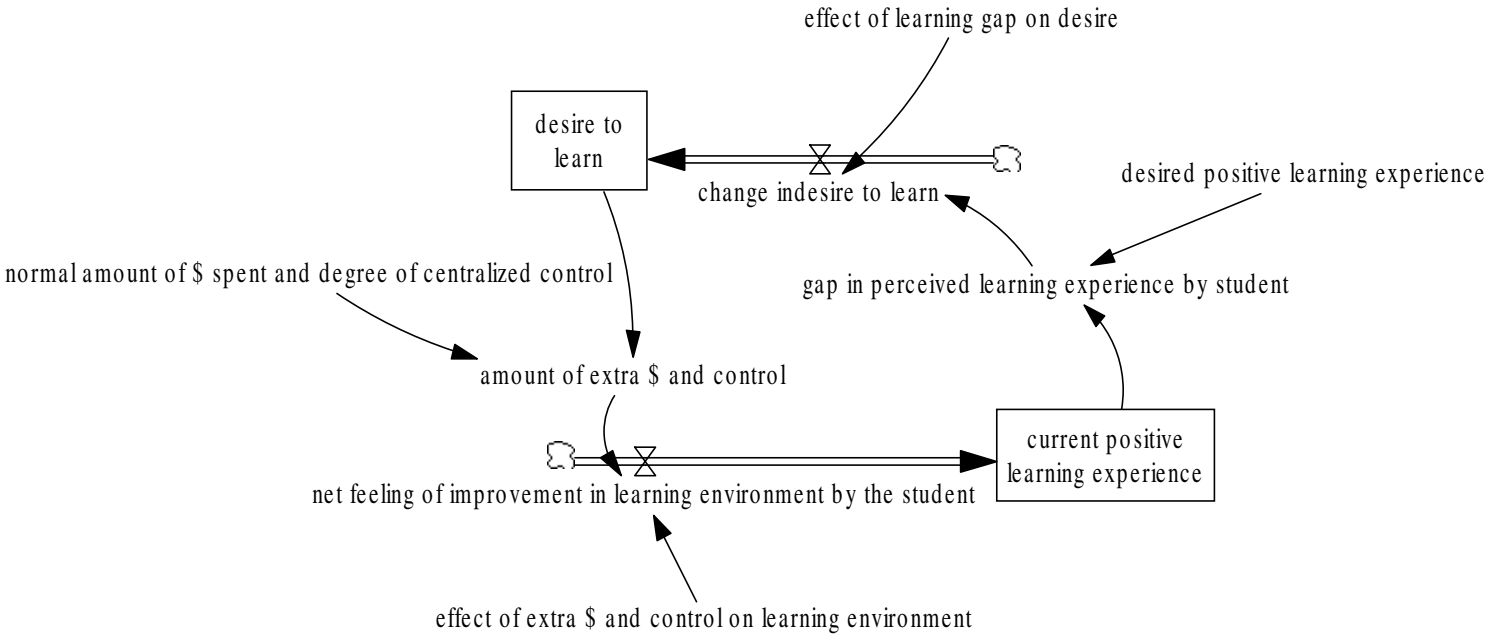
We shall now separate into four groups brainstorming session to design a meaningful education delivery system for 2100 with explicit linkages with Health, Industry & Society. I will provide some papers that you can refer to in your discussion groups. As System Dynamics practitioners this is your opportunity to demonstrate how your skills can be applied to what is probably a new question. Each group should end up with a stock & flow diagram of their part of the system on a flip chart page. We shall split off into groups to draw a system dynamics model of these areas of concern using the 4-step procedure of model building from the M.I.T. Guided Study Program (Albin, 1997):

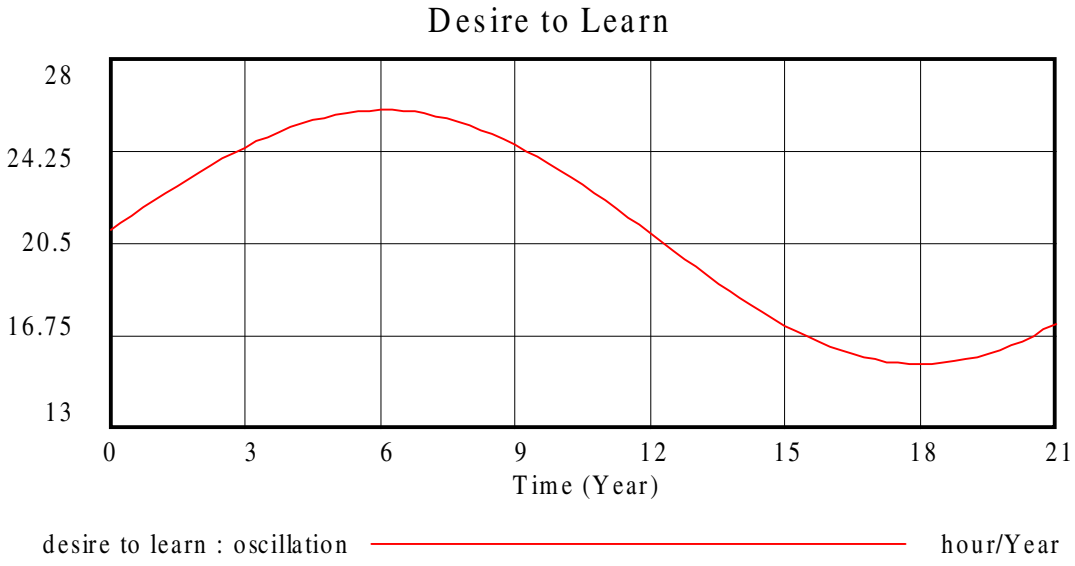
1. Purpose of the Model
2. Model Boundary [Endogenous & Exogenous components]
3. Reference Modes
4. Basic Mechanisms

Group topics are:

A. in the classroom – active learning, learner centered & cross curricular in design
B. how to use computers as a dynamic, open ended tool, role of modeling
C. teacher as "leader", not manager. The teacher is not an "island in the school" but linked with other teachers & administration, Industry, health & social services
D. integration of health issues, industry's needs and society's values into the educational paradigm to help slow learners, ADD, learning disabilities, behaviorally disturbed students & creative students who do not realize their potential. Use the ideas of the Self Mastery Club & having real apprenticeship programs outside of schools in partnership with Industry.

One example of the current educational process which results in wild oscillations is the following model. The oscillations can represent both the students' experiences and the changes the system suffers as a whole. The dangers lie at the low points of the oscillation which may result in the demise of the system.

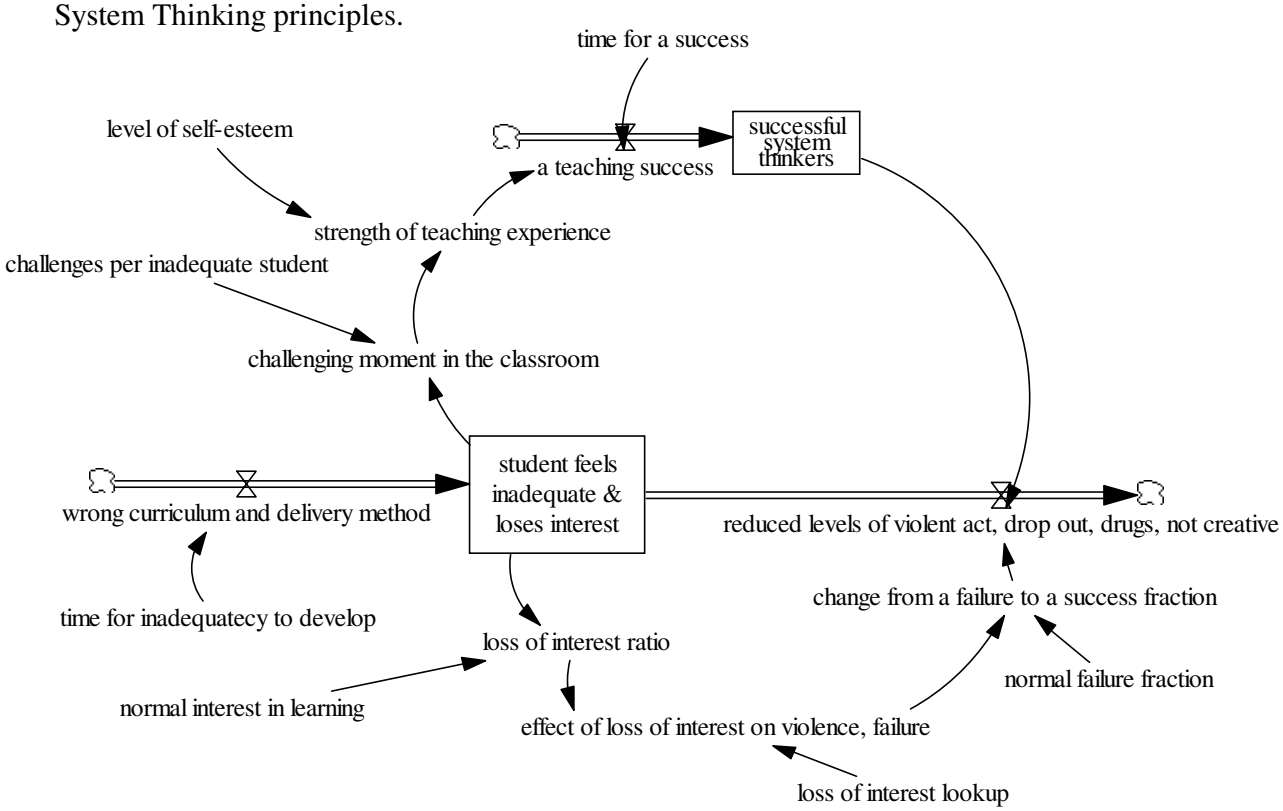


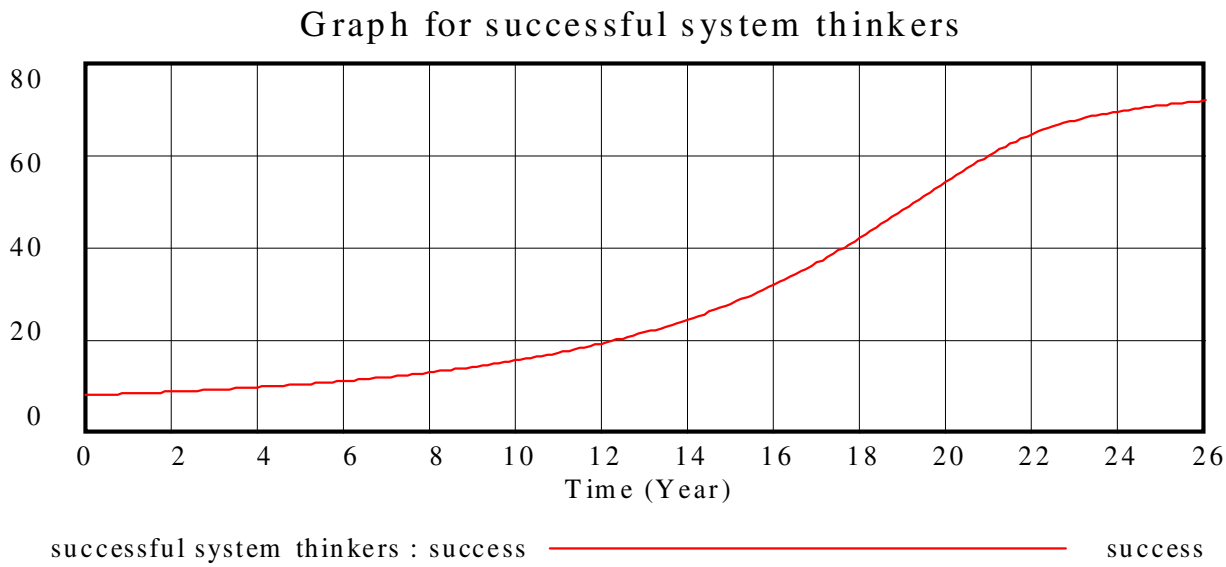


Step 5: Going Deeper

Now that you have built some models to show the basic mechanisms we will explain our model and relate it to the other models by building positive and negative feedback loops. Below is an example of a model from group A's topic. A possible way of looking at a learning is to construct a model of the students learning experience as matching that of an "S-shaped" curve. The model below shows some of the key features that could be

analyzed when trying to move towards a classroom learning experience designed around System Thinking principles.





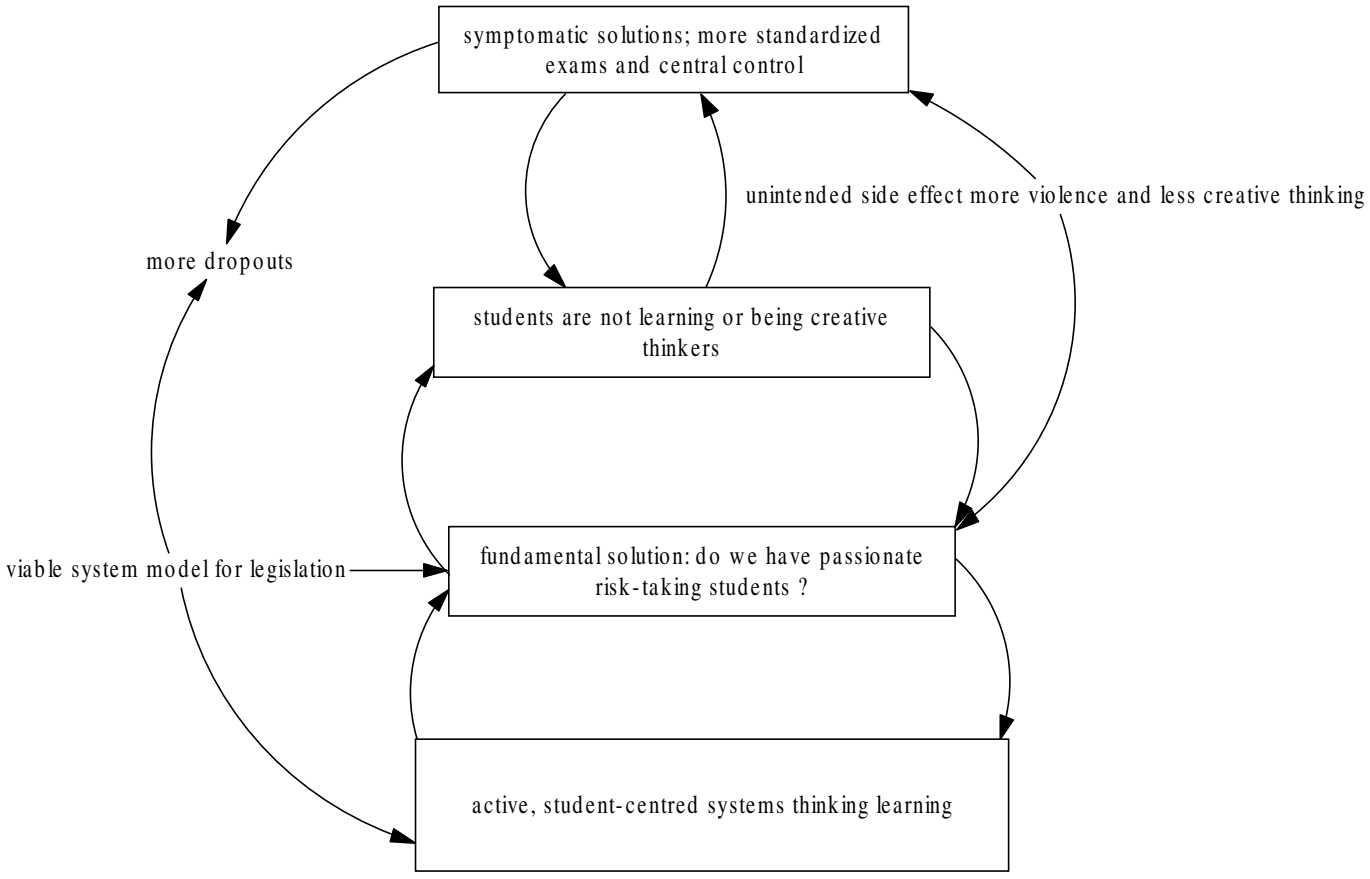
Some techniques which I have personally seen work which support this approach are as follows:

- student has same teacher for many subjects for many years [sub-school model of the ACT, Australia & Steiner schools worldwide] to develop personal relationships

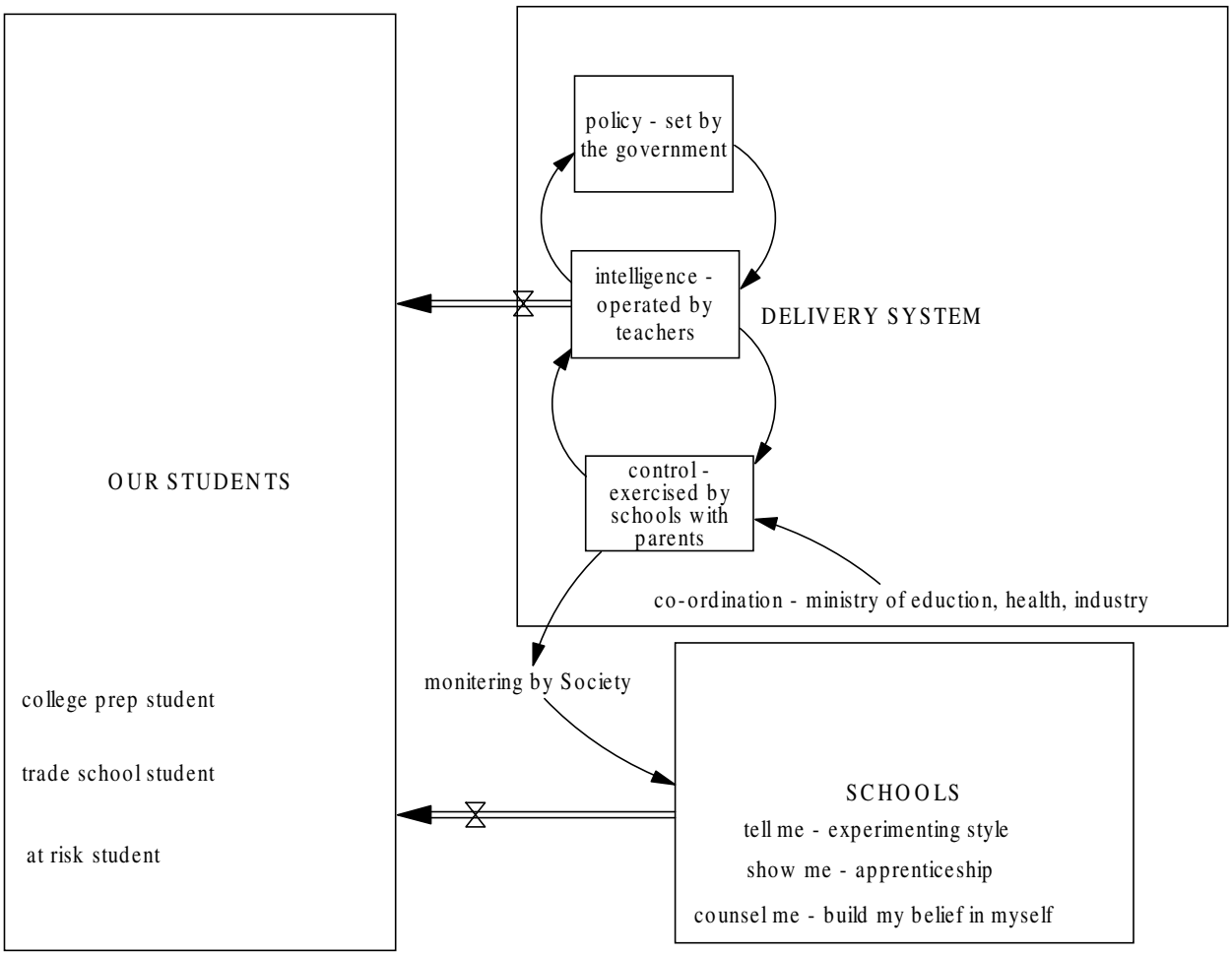
- schedule academic subjects in the morning and others in the afternoon – being 'efficient" with space is not conducive to optimal learning
- three types of classroom experience always available: counseling, apprenticeship & College prep– move the learning out of the class as needed into the work world
- computers in the classroom to be used as a tool as needed, not taught separately
- teach issues & problems, not subjects- cross-curricular courses
- focus in early learning is on the LOVE of learning, not the content
- evaluation based on "personal best", failure is still possible but the yardstick is you, so positive feedback is increased and risk taking increased [keep grade 12 exam]
- more work in groups with students of mixed ability, they teach each other
- allowance for mistakes, lots of exploration and experimenting with ideas

Step 6: Plan an Intervention

Given that one of our underlying aims is to use the principle of leverage to bring active systems thinking into our future classroom we must strengthen the fundamental solution and weaken the symptomatic solution. There are two levels at which change is needed: at the micro [classroom] level and the macro [societal] level. The first model below is about the former, and the second model is about the latter. The "shifting the blame archetype" is a useful way of seeing why we need to change form short-term solutions to a fundamental systems solution for our educational system.



Below is one possible model of the system macro-structure that could reduce the risk of costly, wasteful and damaging oscillations when changes are brought into the educational system. (Espejo & Harnden,1989)



In our case the fundamental solution (s) may include:

1. Teaching methods to be active, student- centered, cross curricular
2. Slow, confidence building learning in the early years to teach the JOY of learning and keep the DESIRE to learn alive during the teen age years
3. Explicit linkages in goals and policies between Education, Health & Industry Ministries
4. Have a variety of schools approaches, curriculums and teaching styles to keep the "at risk" kids in school and give the "apprentice" learners the practical skills that they need to meet Industry's demands
5. Teachers move from managing the classroom to leading in designing structures every day that allow the students to [almost] teach themselves.

Part C - Conclusion

System Dynamics has much to offer the field of education. We can offer our children and our students a more enriching learning experience and give them better tools to solve the problems that life will bring by building an educational system around the principles of systems thinking. As Jay Forrester (1994) states: "A systems dynamics education should sharpen clarity of thought and provide a basis for improved communication. It should build courage for holding unconventional opinions. It should instill a personal philosophy that is consistent with the complex world in which we live."

When we think of the people we work and play with, our employees, peers and bosses – what qualities do they have that we admire and respect? How can schools work with families, social & health services and industry to make possible an enriching adult life for ALL children? If we continue to rely on symptomatic solutions the divide between the have & have not learners will accelerate. I propose that a basic shift in our "Weltanschauung" that uses Systems Thinking methods can change our complex educational system so that the classroom experience are more engaging for the students.

I believe that there is now a "critical mass" of people who want change and also I believe enough is known about how students learn to begin making the needed changes. However I do not see a STRUCTURE within which the necessary changes can develop. Education as an institution needs to shake off its shackles of the past and "re-invent" itself. It may be that some of the ideas presented today may be part of that process. But of one thing I am certain, we have two choices. We will be subjected to uncontrolled, unstable, chaotic oscillations of the educational system as it responds to change if we use short-term, symptomatic solutions. Or we can consciously plan, design, and model for change using Systems Thinking with long-term goals in mind which provide fundamental solutions. The same traumas that successful, innovative private companies have gone through in the past decades are at the footsteps of our High Schools. We have created our own problems and I do believe that with the help of Systems Thinking we can solve our own problems.

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