Think & Learn Rich: Applying Accelerated Learning to Higher Education

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Abstract

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George Saridakis

Universities are being called upon to evolve their teaching approaches to foster higher-order thinking in learners. Elaborate constructivist solutions abound; however, professors lack the resources to implement them. This study explored an alternative, leaner approach called accelerated learning (AL) to resolve the issue. AL is a corporately and commercially adapted constructivist model that distinguishes itself, in its *preparation* phase, by its attention to emotional engagement; a quality that research admits has been greatly underutilized in higher education. Coupled with AL's meaningful *presentation* of curriculum, its in-class *practice,* and outside-the-class *performance* activities to an experience in learner's lives, it was hypothesized that this model was capable of eliciting sought-after critical thinking skills by virtue of offering value and enjoyment to learners, all the while demanding little resources from the professor. AL was thus applied to a Master's level Cybernetics course, with the author acting as the teaching assistant. Students all confirmed that they received both value and enjoyment from the course. Evidence of critical thinking was less ubiquitous, and believed to be notably compromised by insufficient adherence to the performance phase. Nevertheless, the apparent learning gains exhibited in some cases warrant formatively evaluated iterations of AL, with some refinements, and ideally, future teaching assistants.

Acknowledgements

In true constructivist fashion, this thesis is a culmination of the thoughts imparted in me by a multitude of professors and classmates over many years. Since acknowledging them all would require a thesis in itself (something I am currently very indisposed to doing), I wanted to at least do so as a group. However I do want to distinguish those people who have helped me through what I called my Odyssey towards graduation: Anne Brown, for her continuous patience and promptness with my stupid questions, Dr. Bob Bernard, for his reassuring support in the background, and of course, Dr. Gary Boyd, the professor with the wisdom of a sage and the openness of a wondrous child. Trust me, I mean that as a compliment – as you've come to know, I have to tendency to want to play as well. Thank you for letting me play with your course in a manner that I'm sure no student ever has before. As you shall see shortly, there was a method to my madness.

On another note, I would be remiss if I didn't acknowledge my family for supporting me on my journey to becoming a brilliant and inspirational educator, particularly my uncle Denis, who always pushed me to realize the potential he saw in me. He is no longer here to see the fruits of my labour, but at his passing I promised him I'd reach this point all the same. I thank him for his biggest push.

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Introduction

The corporate workplace today is raising the bar on what it considers "real education for the real world". Their demands for graduate hires with critical thinking skills underline the fact that they no longer want to accept human *containers* of knowledge, but rather human *creators* of it. Academics, naturally, have had the intellectual insight to respond, particularly those in the specialized field of Educational Technology. Recent research in that domain has both deconstructed what it means to possess critical thinking, and proposed frameworks firmly rooted in advanced learning theories, namely constructivism, to arrive at it. Unfortunately, this pedagogical action plan experiences a bottleneck that impedes it from attaining its goal. With the multiple, competing roles that are assigned to them and the minimal staffs to support them, professors do not have the resources required to actually implement what has been so meticulously researched and prescribed. This study thus sought to clear this impasse, and to do so, it quite fittingly employed critical thinking and chose to examine the situation from "outside the box". What it found were two unspoken assumptions that needed to be addressed and challenged.

The first assumption was that the onus is on the professor to "create" for the majority of the class. Though instructional designs have evolved past an instructivist mindset, recent constructivist models still require professors to, for instance, "negotiate learning goals", from which they are to "construct their teaching environment" (Laurillard, 2002). Unfortunately, even this scaling back of professors' roles from authoritative presenters to constructivist facilitators doesn't reduce the time investment to

an amount they have available, and as a result, they fall back on lecturing to fill class time and cover a heavy curriculum. While this sometimes succeeds in *transferring* knowledge, it is less effective than having students *create* it themselves, hence the problem.

The second assumption, perhaps a corollary of the first, is that learners actually *need* professors to structure the majority of the class in order for critical thinking to occur, *even though* many learners do not respond well to this approach at all (alas, a body of research exists on classroom boredom (Small et al, 1996, for instance)). It is as though those in institutions have subconsciously resigned themselves to a pedagogical version of the laws of thermodynamics: *This is the only way we can actually do this: We can't win, and we can't even break even. All we can hope for is to minimize learner's losses.* To be fair, this study acknowledges that professors *can* cultivate critical thinking in students by relating the wealth of their wisdom to them. Nonetheless, it is asserted that there has been an overdependence on the intellectual delivery of class sessions, via lecture and ensuing discussion, frequently causing the latter to come off as clinical and abstract at best. Internationally renowned creativity expert Ken Robinson would agree, stating that universities have held on to the habit of teaching "from the waist up, then only to the head, then only to one side" (Robinson, 2006).

What the author believed was missing was the quality of emotional affective engagement in the learning experience, or, simply put, the element of motivation: a desire to engage in behaviours (learning activities in this context) for the sake of an outcome one expects to obtain (Cady, n.d.). Whenever the author was put in a teacher's role prior to this study and intuitively designed his materials to be emotionally engaging,

his students, be they from elementary school or university, demonstrated not only engagement and enthusiasm, but learning retention as well. Thus, this study was designed to explore the effects of applying such an approach for not only one session, as had been done in the past, but for an entire course.

Such an expanded mandate, however, required a structured framework to design around. The one of central interest in this study was *accelerated learning*™, a four-phase framework employed in corporations that motivates learners before lessons even begin, presents content in an engaging manner, involves learners in various activities to integrate knowledge, and prescribes methods to take content outside the scope of the course and relate it to learners' lives. The research question at hand is whether accelerated learning could be as successful in a graduate course in a university as it is in the corporate and personal development worlds, with the hypothesis being that it could be.

The research method that was used to assess this hypothesis was action research, and the population was the students of a Master's level Cybernetics course. In the spirit of Stringer's action research interacting spiral (Creswell, 2005) of looking, thinking, and acting, the author formed an initial action plan as to how course content was to be designed. After implementing it, he looked at student feedback, thought about how to adjust course content in accordance with student reactions (with the aid of consultations with the course professor), and acted to make the adjustments, after which the cycle would start anew. Sources of data to draw upon as the course unfolded included digital audio recording of the classes, e-mail exchanges on First Class, mid-term results, and the students' projects. At the course's conclusion both an informal "wrap-up chat" was held

and a more formal student evaluation survey was passed out to collect learners' valuable final thoughts of their entire experience (accelerated learning materials are provided in the appendix).

Both the wrap-up chat and the evaluations indicated that as an initial foray, the accelerated learning intervention was a relative success. The additional attention that was brought to the scaffolding of the curriculum was very appreciated by the course's most novice student, whose performance in the course was amongst the best. Meanwhile, all students involved derived both value and enjoyment from in-class activities designed to advance their projects. The designs would however need to be calibrated in the future to ensure that a balance be achieved between novice and advanced student needs. Furthermore, much improvement could be achieved by ensuring continuous student involvement both inside and outside the class as early into the course as possible. To render this possible, the use of future teaching assistants is recommended.

Literature Review

In what is being called "a revolutionary age in technological change" (Lee, 2007), institutions of higher education are increasingly called upon to upgrade what they consider "real education for the real world". With instantaneous access to digital innovations levelling the global playing field, workplaces now turn to the superior skill sets of its employees for a competitive edge (Carnevale et al, 1999). As the international workforce jockeys for position to obtain the finest minds available, the bar on employee expectations has soared: One workplace report speaks of orders for a new kind of worker, whose skills "were previously required only of supervisors and management" (Carnevale et al, 1999), while another claims that in this millennium, 40 percent of new jobs call for employees in the top 50 percent of skill levels (White House, 2000).

Much like in sports, organizations turn to "developmental grounds", in this case colleges and universities, to recruit promising new talent. There's a challenge that begins here however, when the workplace tries to specify what exactly it wants. In an effort to grasp the intangible, the results read like a Christmas list. Just a few of the terms bandied about are creative thinking, problem solving, and analytical reasoning (Peter D. Hart Research Associates, 2008; White House, 2000). From the academic perspective, descriptors like these have commonly been funnelled together into the concept of critical thinking (CT). Convenient yet enigmatic, CT has become the term of choice for researchers, who prescribe it to close the gap between what is learned in schools and what is required to function effectively in the workplace and in society (Maiorana, 1992; Lee, 2007).

A New Brain Drain

Given the voracious demand for highly skilled employees, this gap is only widening. Studies that sought critical skills in higher education practices did not always find them (de Sanchez, 1995; Pithers, 2000; Pithers & Soden, 1999, Lee, 2007). The literature reflects this from employers' perspectives as well; in a poll conducted on behalf of the American Association of Colleges and Universities, employers stated that while they were confident that college graduates would succeed in entry-level positions, they were wary of their ability to advance any further (Peter D. Hart Research Associates, 2008). Author and cultural critic Neil Postman went so far as to characterize the gap as civilization's race between education and disaster (Greenwood, 1993), but adds that although education is far behind, it is not yet out of the running. A study by Millard (1997) quotes a perennially pertinent statement by John Gardner to summarize what is expected from higher education as a result: "Our kind of society demands the maximum development of individual potentialities at every level of ability...an approach to excellence and a conception of excellence that will bring a whole society to the peak of performance"

Defining the Solution

With such demands being placed upon them, educators must seek out and implement methods to elevate students' critical thinking skills. This brings forth a fundamental question: what exactly is critical thinking? Ludwig Wittgenstein once said that every word has a cloud of meaning. That being said, there is possibly no term cloudier than CT, as interpretations of it are notoriously divergent (Halonen, 1995; Lee, 2007). In a recent meta-analysis conducted by Abrami, Bernard et al (2008), no less than

seven different studies were cited which offered their own definitions. It was not in this study's interests to explore them all and debate the merits of each; instead, the fundamental goal was to explore a method to develop, in college and university students, the cognitive skills employers want.

Research on this topic thus began with an article helpfully entitled, *Workplace Basics: the Skills Employers Want* (Carnevale et al, 1999). Truth be told, many qualities called for in the article, such as self-esteem and leadership, surpass the scope of cognition. That being said, it notably indentified "knowing how to learn" as "the most basic of all skills, because it is the key that unlocks future success" (Carnevale et al, 1999) Subsequent industry analyses, such as the equally forthright U.S. Department of Labor's *What Work Requires of Schools*, also compiled a comprehensive list of desired qualities that transcended thinking and ventured into personality traits. To form an idea of which thinking-related qualities were most in demand by industry, Figure 1 was compiled with these reports and the meta-analysis of six others featured in Greenwood's *National Assessment of College Student Learning* (1993). The numbers on the right indicate the number of times the terms were brought forth in the various reports.

1	Problem solving	4
2	Acquiring information	3
3	Organizing informatiom	3
4	Maintaining/remembering information	3
5	Reasoning	3
6	Evaluating information	2
7	Decision Making	2
8	Learning to learn	1
9	Recognizing problems	1
10	Defining problems	1
11	Inventing solutions	1
12	Interpreting Information	1
13	Planning	1
14	Allocating	1
15	Analyzing	1
16	Adapting	2
17	Understanding systems	1

Figure 1: Compilation of thinking skills sought after by corporate workplace reports

With such a lengthy list of skills being sought from higher education, it is little wonder that a term like critical thinking has been adopted as a catch-all. Rather than reinvent the wheel by sorting through the terms to create an operational definition for the study, a pre-established definition was sought for the sake of greater validity, on the condition that it would correspond satisfactorily with the list of desired skills above. Amongst the studies cited by Abrami, Bernard et al that had created their own definitions, one by Facione (1990) was given particular attention. It consisted of a panel of 46 scholars, educators and leading figures in CT theory and methodology that used a systematic qualitative research methodology called the Delphi method to arrive at a consensus on the roles and definitions of CT in education (Facione, 1990). The amount of experts involved and the rigor of the procedure employed in that study granted the consensus list of CT cognitive skills and sub-skills that they produced much credibility. Nevertheless, to validate its usage in the study, an association exercise was attempted to

verify whether the qualities requested in the list above were correlated with Facione's skills. The results are shown below:

Thinking skills from job analyses compilation		Association	Facione's CT Framework	
1 Problem solving	4	A,B,C,D	A Interpretation	A1 Categorization
2 Acquiring information	3	B		A2 Decoding Significance
3 Organizing informatiom	3	A1		A3 Clarifying Meaning
4 Maintaining/remembering information	3	E		
5 Reasoning	3	D	B Analysis	B1 Examining Ideas
6 Evaluating information	2	C		B2 Identifying Arguments
7 Decision Making	2	D		B3 Analyzing Arguments
8 Learning to learn	1	A		
9 Recognizing problems	1	A	C Evaluation	C1 Assessing Claims
10 Defining problems	1	A1		C2 Assessing Arguments
11 Inventing solutions	1	D		
12 Interpreting Information	1	A	D Inference	D1 Querying Evidence
13 Planning	1	D		D2 Conjecturing Alternatives
14 Allocating	1	B,C,D		D3 Drawing Conclusions
15 Analyzing	1	B		
16 Adapting	2	F	E Explanation	E1 Stating Results
17 Understanding systems	1	D, F		E2 Justifying Procedures
				E3 Presenting Arguments
			F Self Regulation	F1 Self-examination
				F2 Self-correction

Figure 2: Comparison of workplace list to Facione's cognitive skills and sub-skills list

Admittedly, these associations are highly subjective, but no less than the numerous other attempts to dissect and categorize the subtle nuances of cognition. Given the fact that each element could be associated to one or more Facione traits (however loosely), it was deemed that the latter's list would be suitable to assess critical thinking in the study.

The Academic Response

This stacking of workplace demands against academic interpretations brings a new vividness to Postman's race metaphor, as does an examination from the educational perspective of the issue. With or without the influence of the workplace, educational technology has pushed itself to evolve, and in the most recent era speaks of "a new appreciation . . . of the significance and necessity of paradigmatic shifts in methods of instructions and philosophy that promises a broader psychological, sociological and educational experience for the individual." (Millard, 1997) To educational technologists, such paradigmatic shifts describe, to name one, the pedagogical migration from instructivism to constructivism. Gong (1997) offers an emphatic example of why this migration took place. In observing practices in Hong Kong schools that employed traditional instructivist methods of rote learning and memorization, she compared students to "Peking ducks that were stuffed with information" (Gong, 1997), thus deprived of the opportunity to think on their own.

In response to such allegations, many constructivism enthusiasts concluded that the remedy would be to implement the opposite; that is, have learners construct the information themselves (Kirschner, 2006), allegedly developing CT along the way. As a result, several variants of constructivism were formed. Amongst them were pure discovery learning, where learners are essentially left alone to solve a problem (Mayer, 2004), problem-based learning, where teachers guide students through a problem-based scenario (Hmelo-Silver, 2004), activity theory, where learning takes place in authentic environments in which subject matter and its community are observed directly (Scanlon

& Issroff, 2005), and situated learning, a highly structured derivation that resembles activity theory, but includes additional components such as expert performances that learners can model from, collaborative construction of knowledge, and activities of articulation and reflection to bring forth tacit and acquired knowledge (Herrington & Oliver, 2000).

In the interest of fairness, it must be briefly pointed out that the more radical forms of constructivism have drawn as much criticism as their instructivist counterparts at the other extreme. Discovery learning, a "minimal guidance" category of constructivism, has been shunned for disregarding cognitive architecture (Kirschner, 2006) and proven, through analysis of studies in three different decades, to be largely ineffective (Mayer, 2004). However, participants in the substantially more guided and comprehensive approaches of activity theory and situated learning have been very satisfied with their learning experiences (Scanlon & Issroff, 2005, Herrington & Oliver, 2000). Moreover, given their balance of structure and experiential learning opportunities, one can assume that these approaches implicate the students in many of the elements of Facione's list of CT skills.

One needn't be satisfied with such an assumption, however, in the wake of research conducted to address the gap even more directly. In her book *Learning to Think: Disciplinary Perspectives*, Janet Gail Donald (2002) offers a cognitivist collection of the most important competencies to acquire in any discipline. These include *selection*, the ability to choose and order information units while distinguishing critical elements and relations, *representation*, which centers the ability to identify how the interconnected

units form a systematic whole and how that whole can be modified, and *synthesis*, which consists of deducing patterns, exploring complexities, identifying gaps, and constructing action plans to ratify them (Donald, 2002).

While Donald's focus is on *what* is to be acquired, a second author offers, in complementary fashion, *how* to acquire it. Diana Laurillard, in her book *Rethinking University Teaching* (2002), develops a constructivist model based on Gordon Pask's conversation theory. The framework centers itself on social feedback loops occurring between student, teacher, and the learning environment, and distinguishes four types of interactions. The first interaction is *discursive*, and it is where teacher and student negotiate the topic goal through an iterative exchange of each other's conceptions. The second is *adaptive*, in which the teacher adapts the learning environment based on student conceptions and negotiated goals, and in turn the student adapts their actions to achieve their goal. The third interaction is *interactive,* where the interdependence between student and environment cause both to continuously evolve. Finally, the fourth is *reflective*, where students integrate information into knowing by pondering their experiences.

Where the Rubber Doesn't Meet the Road

If higher education then has developed sophisticated pedagogical frameworks to respond to the workplace's demand for what we are referring to as CT skills, the question becomes, why aren't these frameworks being used? Jonassen (1991) posits that it is because of the deep roots that traditional practices like behaviourism have extended into education. Meier (2000) further describes this as "the ever present inertia of traditional

educational approaches that has tended to erode fresh new starts over time in order to return to the comfortable but deadly norm" This is probably true, but other authors (Kassem, 2005) add a much plainer explanation: time constraints. A conversation with professors involved in this study confirms this. In addition to teaching courses, the professors juggle duties of researching, supervising theses, attending conferences, and involving themselves in community service. Unfortunately, this puts them in the unflattering position of not being able practice what their own program preaches. This pedagogically fatal dose of reality, if nothing else, has at least led some professors to formally recognize the need for pragmatic assessment of an instructional design to acknowledge such practical concerns (Hannafin et al, 1997). Educators are thus faced with the challenge of engendering critical thinking in students while keeping professors' workloads light at the same time.

Shopping Elsewhere

The story thus far conjures the metaphor of the rock and the hard place: the corporate workplace is no longer satisfied with the abilities of higher education graduates, but the professors do not have the resources required to implement the frameworks that would render those abilities satisfactory. In the interests of escaping the impasse, a second metaphor is conjured: thinking outside the box. If education cannot find a method that is both effective and viable to foster CT skills in students, then it behoves the study to look elsewhere in society to seek examples of those who have done more with less.

As it were, a very prominent field exists that is worthy of benchmarking: manufacturing. The manufacturing world has a luxurious advantage over education in one respect: its outcomes are immensely more tangible and measurable. As commonly put, a manufacturing plant's raison d'être is to "produce widgets". Assuming a hungry market, manufacturing constantly looks for ways to develop the largest quantity of widgets in the least amount of time. If it doesn't satisfy the market both in terms of quality and delivery time, its market share will be scavenged by competitors. The most conscientious manufacturers are thus constantly scrutinizing their practices to uncover ways to manufacture their widgets "leaner", that is, with greater efficiency. In the spirit of lean manufacturing then, it is worth an effort to borrow this practice for our purposes and do the same.

Education through the Lean Manufacturing Microscope

A widespread manner of "manufacturing higher education" is through the use of lectures and readings. Clearly, such components offer professors the ability to leverage both rich experiences (their own CT skills, in fact) and reusable resources to fill out a course with little additional time being demanded of them. It is then assumed that students will somehow profit from the advanced notions imparted by the professors and the readings to, at some point, hone their CT skills. This, precisely, is what is to be scrutinized in lean manufacturing fashion.

In *Critical Thinking across the Curriculum: Building the Analytical Classroom,* Victor Maiorana (1992) illustrates the ineffectiveness of conventional practices at providing CT skills by conjuring a metaphor of his own: the display window of a store.

Maiorana states that teachers confuse teaching *about* the subject matter with teaching the subject matter *itself.* When professors give a lecture or assign readings, they present a pre-manufactured product in a display window. In doing so, students do not have a full grasp of the product because they weren't given the opportunity to manufacture it themselves, which is where CT would have developed.

Maiorana doesn't stand alone in his assessment. Herrington and Oliver (2000) speak strongly of the abundant inadequacies of extracting essential principles, concepts and facts from authentic contexts to teach them in an abstract and decontextualized form. Millard (1997) flatly states that "it is widely recognized that the educational yield from lectures is generally low", and Paul (1989) effectively explains why:

> "The self-contradictory mindset of teachers who realize that critical thinking is important, but who do not know how to promote critical thinking skills in students, dovetails perfectly with the passive attitude of most students. Most are unprepared ... to think critically...They assume the textbook...or the professor will tell them what to do or say . Hence, even though the professor may think that critical thinking is being required, most students will not produce it for the simple reason that they don't know how."

Furthermore, adds Small et al (1996), the passive attitude the situation engenders causes students to "struggle to maintain attention" (which they equate to becoming bored), which deteriorates learning even more. As less attention is paid, less information is retained, and less of the material is rendered capable of being applied.

Enter AL

The next step in the benchmark then would be to examine what actually works in manufacturing. As it were, education is not the exclusive domain of schools; it exists in a comparable format in manufacturing that is, of course, known as training. Immersed in the manufacturing culture as it is, training in no way escapes its mindset; Like an actual

production line, a training department is mandated to deliver its own outcomes, trained employees, in as effectively and efficiently a manner as possible, so that these employees can then contribute to the optimal production of widgets. In other words, lean manufacturing created a demand for lean training. And so, a lean training methodology was found and adopted, one that is formally labelled as accelerated learning™ (AL).

To further support the pertinence of corporate training methods in higher education, a brief history of AL is offered. AL originated from the research of Bulgarian psychiatrist Georgi Lozanov in the 1970s. Lozanov discovered that Baroque music and positive suggestions accelerated the healing process of psychiatric patients. Sponsored by the Bulgarian government, he explored the possibilities his research could create in foreign language learners, and found that "the combination of music, suggestions, and childlike play allowed learners to learn significantly faster and more effectively" (Meier, 2000). News of the promising results spread virally in the field and before long, organizations such as the Society for Accelerative Learning and Teaching (now the International Alliance for Learning) were formed around the world to perpetuate Lozanov's research. Interestingly, their conferences have attracted corporate trainers and college professors alike. As a matter of fact, AL has already made its footprint in the enterprise of adult education, where 200 AL programs in the United States were identified at last count (Wlodowski, 2003).

In adult education, the term accelerated learning is taken literally, as courses are presented in less time and for a shorter duration than their conventional counterparts (Wlodowski, 2003). However, as a catch-all descriptor (much like "critical thinking"), "accelerated learning" refers to the general notion of being able to learn faster than with

conventional methods (such as lectures) by espousing a philosophy of highly engaged multi-modal learning "that seeks to de-mechanize and re-humanize the learning process as a whole-body, whole-mind, whole-person experience" (Meier, 2000).

Citations of formal corporate applications of AL begin in the 80s, when a training director at Bell Atlantic applied AL methods from a workshop to rewrite courses for customer service representative training, thereby cutting training time in half and improving learning and job performance significantly (Gill & Meier, 1989). A second AL viral effect ensued, first in phone companies alone, then in training circles at large, about the dramatic results. Meier (2000) reports similar results of training time being reduced to up to 75% and measurable learning outcomes improving by 507% in industries ranging from airlines, to manufacturing, to insurance, to retail. Independent research was equally supportive in reports of its use in applications of e-learning (Bonanno, 2000), employee orientation (Earl, 1997), public relations management (Fall, 1999), human services administration (Lynott, 1998), and even staff meetings (Pattison, 2001).

The AL Edge

This repeated reporting of reduced training time becomes very appealing given the conundrum of the resource-strapped professors and the ravenous employers, and warrants further investigation into the AL phenomenon. In reality, AL is a composite of a multitude of ideas that were developed thanks to Lozanov's disciples, but there's an element in particular that distinguishes it from common educational practices. That element is emotional engagement.

For all the obvious evidence society offers on the impact of emotional engagement, be it in politics, popular culture, or sports, it is seldom used in higher education. This is admitted frankly as such by Michael J. Dunkin in his paper *Research on Teaching in Higher Education*: "In all, very little concern with contextual effects upon socio-emotional aspects of classroom behaviour is apparent in research in higher education. It is as though the classrooms of higher education are not only inappropriate contexts in which to display such things as emotions, but they are also inappropriate places in which to conduct research on emotions" (Dunkin, 1986). In trying to determine how this came about, a professor involved in the study offers general insights to a complex story. He relates that in the 60s, some professors chose to be quite emotional, to the point where riots based upon their teachings took place. By the 70s, universities, contending not only with disturbing external events, but the finding that students were failing to learn essential knowledge and skills, "clamped the lid back down" on such teaching styles and gradually weeded out most "emotional professors" by not giving them tenure.

While this makes the aforementioned phenomenon understandable, research would suggest that the pendulum swung back too far in the other direction; the radical use and abuse of emotion by some was met with a radical barricade of conservatism on everyone that has compromised higher education ever since: "Matters of emotion have largely been marginalized in the mainstream discourse of educational leadership research, theory, and practice. As a result, emotional ways of knowing remain underexplored and, in effect, silenced for their epistemological power in our lives." (Beatty, 2002). This does not mean that Donald's assets and Laurillard's methods are invalid. It *does* suggest,

however, that without the explicit introduction of emotional engagement, they are incomplete: "Cognitive theories lack an adequate conceptualization of the impact of motivation and emotional factors in learning." (Csikszentmihalyi, 1990)

If one ailment of today's universities is the absence of emotion from teaching, the prescription would be to put it back: "Brain research tells us that reason and emotion, in contrast to their typical characterization as dichotomized and even warring factions, are more aptly described as different yet connected aspects of the 'seamless blend of thinking and feeling' that is the human mind." (Beatty, 2002) Whenever education caters to this symbiosis, its intention is manifested. Park (2004), for instance, found that positive emotions broaden the scope of attention, cognition, and action, and in so doing, they enhance cognitive processes such as information processing, communication processing, negotiation processing, decision-making processing, category sorting, task sorting, and even creative problem solving. Furthermore, the benefits are not restricted to students. Dunkin reports in his research that positive behaviour in students induces the same in teachers (Dunkin, 1986). As a result of this "virtuous loop", the learning environment is enriched: "If positive learner behaviour enhances student achievement, and if students elicit positive teacher behaviour, then students may be encouraged to assume responsibility for their own behaviour and purposely help their teachers behave more effectively" (Dunkin, 1986). The findings thus encourage the use of a framework that is motivational, while remaining feasible to professors. In this regard, AL merits a closer examination.

The AL Anatomy

In comparing the components of accelerated learning with the classical pedagogical paradigms, it can be deduced that it is a mixture of many, as it often includes behaviourist stimuli, instructivist procedures, cognitivist schemata, and constructivist discovery at once. While this may seem counterintuitive, research has shown that elements from opposing philosophies can actually be successfully integrated into one design (Hannafin et al, 1997). Furthermore, such designs, which newly configure bits and pieces of classic models, have been hailed in one study as "The New Constructivism" (Spiro et al, 1991).

The first phase in AL is *preparation*, where emotional considerations first rise. In alignment with Lozanov's work, generation of positive emotions is considered a critical precursor to optimal learning. The presentation phase fosters it through such means as positive physical and social environments, clear and meaningful goals, declarations of learner benefits, and curiosity arousal (Meier, 2000). In companies, such investments commonly take the form of an in-house marketing campaign. According to corporate research, it is at those times when workplace training programs are most successful (Waitley & Witt, 1985; Carnevale et al, 1999).

Academic research however, while not necessarily using the label of preparation, supports this phase as well. Its underlying idea was espoused as early as the beginning of the 20th century, when mathematician turned philosopher Alfred North Whitehead asserted that the first stage of learning should be "Romance", in which one provides "the motivation to engage in the process of discovery" (Millard, 1997). Similarly, subsequent studies favour each of the nuances of the phase. "Anti-boredom literature" has

underlined the importance of attention-capturing material (Kopp, 1982; Small et al, 1996). Millard (1997) invested much time impressing the benefits of writing skills like pride, prestige, status and a sense of mastery to his writing students, many of which went on to get published and pursue doctoral degrees. While discussing instructional design frameworks, Duffy and Cunningham (1997) offer the metaphor of the mind as a rhizome, an underground entanglement of plant roots that symbolizes the inextricability of context from the individual. That being said, they consider of the affordances of the environment as significant learning scaffolds.

The second phase of AL is *presentation*, whose purpose is to ensure that learners come into contact with subject matter in a meaningful and engaging way. This entails lectures that are enhanced with real-world examples, interactivity, colourful visuals, and props, among other interesting elements. This variety not only incorporates surprise and novelty to generate interest (Small et al, 1996), but also implicates "whole brain-body involvement" (Meier, 2000), thereby appealing to all sensory learning preferences to ensure that information is absorbed (Carnevale et al, 1999; Whiteley, 2004).

The presentation phase also draws merit from a scaffolding point of view. Schemata have been given utmost importance by researchers (Elstein 1994; Kirschner et al, 2006; Mayer, 2004). The presentation phase's emphasis of meaningfulness encourages classic cognitivist methods of building them through the leveraging of pre-existing knowledge and metaphors (Knupfer, 1993; Ganguly, 1995; ChanLin & Chan, 1996). By employing different means (and senses) to present a topic, learners traverse multiple passes of a complex topic - or through multiple nodes of its rhizome as it were - to add richness to their schemata (Spiro et al, 1991), ostensibly by thinking critically

about them. Pursuing the rhizome metaphor, it follows that interesting elements of instruction would extend to instructors themselves. Studies acknowledge the importance of a teaching figure who is interested in learner engagement, who takes the particularities of an audience into consideration, and who has the ability to present complex material in an interesting manner (Small et al, 1996; Millard, 1997).

The third phase of accelerated learning is *practice*. Meier (2000) calls this "the very heart of AL", and claims that it can account for 70 percent or more of a total learning experience. In that light, AL could be classified as a predominantly constructivist framework, especially since the prevailing philosophy is that "it's what the learner thinks and says and does that creates the learning, not what the instructor thinks, says, and does" (Meier, 2000). Hence, the practice phase is characterized by guided activities such as games, simulations, and teachbacks that integrate new knowledge and skills.

As was the case with preparation, references in support of the practice phase can be traced far back into the research, this time to classic educational reformer John Dewey, who described "learning as a form of doing", and the learner as a problem solver, "where the emphasis is on the process itself and not on the solution or conclusion" (Millard, 1997). Whitehead would then add, that "elation flows from the use of these skills in enlarging one's understanding" (Millard, 1997). Aside from classical support, the practice phase also gains validity through its resemblance with situated learning, whose use of authentic activities, role-playing, collaborations and articulations (Herrington & Oliver, 2000) all circle around the same prescription of advanced skill acquisition through "guided doing" (Mayer, 2004; Lee, 2007).

The fourth phase of AL is *performance*. In corporate circles, its purpose is to transfer learner's new skills to the job and to ensure that performance continually improves. It therefore implies initiatives outside the learning environment such as action plans, peer support activities, and ongoing coaching. In schools of course, this idea roughly translates to homework. Within the AL context however, this sort of homework is enhanced by the three previous phases. For example, in a study on online collaborative learning (Lee, 2007), case studies were chosen on the basis of their relevance (preparation) and interest (presentation), after which ample practice was performed as a group (practice). By the end the study, students were able to critically analyze and synthesize course concepts on their own, thereby attaining the goal of the performance phase.

The theme of performance underscores the whole point of education in the first place: to qualify learners for the real world. It is no surprise then that forms of integrative, contextual, applied learning are so highly endorsed by that world (Carnevale et al, 1999). A poll by Peter D. Hart Associates (2008) indicated that 69 percent of employers thought that supervised/evaluated internship/community based projects, where students applied college writing in real-world settings, were most useful in assessing whether college graduates had the skills and knowledge necessary to succeed in their companies.

Moreover, the real world value of the performance phase has been equally supported in academic circles. In a study on computer-mediated conferencing, results of a class project were observed for five years. In the project, students modelled a real life experience of theirs in the form of a system. While doing this, they were asked to

comment on one or more classmates' systems as well. It was found that most exercises led to significant suggestions for improving the focal systems, and that some comments yielded practical insights that students were committed to implementing (Boyd, 2005). This in effect demonstrates how AL comes full circle. It starts with emphasis on how the subject can yield personal benefits. When the learner is then given the latitude to construct data that is meaningful to them, (Millard, 1997), they are able to fulfill Whitehead's vision of making "sense of ideas for themselves so that their learning transforms every aspect of their daily life" (Millard, 1997).

The AL Litmus Test

While it is interesting to compare AL to educational technology literature in piecemeal fashion, it would also be insightful to compare it holistically to academic frameworks like Laurillard's that were designed to address the same issue. Upon analysis, the two models do not allow a seamless juxtaposition; but then again, none was expected, otherwise there'd be no need for both. It was found, however, that their respective steps resemble each other and the successful template of AL can be fitted to Laurillard's context-specific conversational constructivist model to produce optimal learning outcomes. The latter's conversational approach begins with discursion, a teacher student-dialog about the goal at hand. In AL, this would be the equivalent to the presentation step, with the provision that the presentations are conversational (which AL implicitly encourages in any case). Laurillard then talks of adaptation, where teacher and student align their actions with the negotiated goal. This is comparable to AL's preparation phase, where material is tailored to provide the learners with much-valued

benefits. Next, the conversational model steps into interaction, wherein student and learning environment are in a mutual feedback loop, causing each to react to the other's behaviour. This too can be covered in AL by the presentation phase, but is more pertinent in practice, where learning activities and their degree of effectiveness will be directly influenced by learner's contributions to them. Finally, Laurillard concludes with reflection, where learners integrate information by pondering experiences. While some degree of this occurs in AL's practice phase, the more appropriate counterpart is the performance phase, which deals with information integration that occurs outside the classroom, in the "real world".

Hence, the two models are actually quite similar, with a primary distinction that falls in line with this study's raison d'être: "Accelerated learning" explicitly acknowledges positive emotion and places it *first*. In the conversational framework, it would be the equivalent of learning student goals at the outset, adapting one's initial presentation perspective, and *then* beginning Laurillard's discursion. Dunkin, who claimed neglect of emotion in his higher education research, would agree to this, and to the rest of the AL approach in general: "On the basis of findings that student participation, student-to-student interaction, and teacher encouragement correlated positively and quite strongly with both student growth in critical thinking ability and higher level studying processes, college teachers might see value in increasing the occurrence of such processes in their classrooms" (Dunkin, 1986). As a result, students, once scaffolded through the first few teacher-led sessions, could be empowered to take over and co-create the course in the direction of their own personal motivations, thus

enabling them to develop CT skills, or, to paraphrase seminal motivational author Napoleon Hill, to "think and learn rich".

Research Purpose

The purpose of this study is to examine the effects of implementing an accelerated learning and personal development inspired teaching methodology into a university course. Within this study, several major areas will be explored:

(1) What are the most appropriate ways for instructional designers to arouse interest in a Master's level university course before it begins, and then sustain it throughout?

(2) How can the course be presented in such a way that it is meaningful to the Master's students?

(3) How can the content of the course be practiced such that it is effectively integrated into students' cognitive/affective structures?

(4) How can the content of the course be performed beyond its scope such that it seems likely to have medium and long-term value?

(5) How can an accelerated learning framework be adapted and evaluated in a higher education setting to ensure that it meets the critical thinking demands of the workplace?

It was the study's hypothesis that reframing the instructional design of a course into an accelerated learning framework would bring the same significant improvements in learner engagement, enjoyment, and performance into the classroom that are enjoyed in corporate and personal development environments. It was therefore postulated that soliciting students' motivations before and throughout the course, and then relating the course content to these motivations, would arouse interest in students and make the course more meaningful to them. Initially, PowerPoint-assisted lectures, complete with

exercises, were used to integrate course material. As the course carried on, its design allowed for other practices to emerge. The outside-of-class performance aspect of the course in the study, Cybernetics, has historically and successfully been handled by a class project (and to a certain extent, student research for their in-class lectures). The project thus remained intact as ongoing modifications to the design of the course took place, but as with the practice phase, enhancements for it surfaced. Finally, it was believed that by holding debriefing sessions after each session, the AL framework could be steered to meet the needs of the course as well as the study.

Research Method

Both the research purpose, which contained a heightened interest in positively and immediately affecting the learners' experiences, and the framework studied to fulfill that purpose, which encapsulated a large assortment of techniques to do so, lent themselves well to a highly interactive research methodology that would benefit from the study's embedded omnipresence in the course to treat each week's session as an iteration in which it could apply an intervention, observe its results, and respond the following week with adjustments. To this end, action research, which has been described by Stringer (1999) as an interacting spiral of looking, thinking, and acting, was deemed the optimal method with which the research could be carried out.

Within the realm of action research, Creswell (2002) distinguishes two categories: practical and participatory action research. In practical action research, educators seek to address a situation that is idiosyncratic to their learning environment (Creswell, 2002). Conversely, participatory action research aims at empowering individuals both in educational settings and at large. While the study espoused some tenets of practical action research, such as action plans and a focus on student learning, its holistic aim of imparting transferable knowledge and abilities both within and beyond the classroom made it more characteristic of participatory action research. Furthermore, the issue it addressed is definitively not local and idiosyncratic; Quite contrarily, the study perceived the Winter 2009 Cybernetics course as a microcosm of higher education in which it could design interventions to stimulate the critical thinking capacities that the professional workplace demands.

Procedure

The nature of action research poses an inherent preliminary conundrum reminiscent of that of the chicken and the egg: the determination of a starting point in a continuous loop. What would there be to "look at, think about and act upon" at in the first session of the course when nothing had happened in class yet? While the first session could have ostensibly unfolded as the starting point of this study, the use of AL dictated measures to be taken before then. This study postulated that critical thinking could be achieved via accelerated learning. Accelerated learning, in turn, occurs when instruction is intentionally designed to cater to the interests of its learners. Hence, to begin the study as proactively and effectively as possible (in other words, on the right foot), student feedback about the course was collected and analyzed before the first session had even begun. This feedback was of two different kinds: comments from students of the course in its previous offerings who were asked to reflect about it once they had completed it, and comments from the current students of the course, who were asked, prior to the beginning of the semester, what their hopes and expectations of the course were. In doing so, the course could be initiated by addressing students' most common wishes and concerns.

Once the first session had passed, it was easy to embark upon Stringer's spiralling model of action research. While details of each session will be expounded in the Results section, a brief generalization of them can be offered here. Each session of the course was being observed ("looked at") for student engagement, and by extension, critical thinking. After each session, a private debriefing about the session between the professor and his assistant took place, which subsequently provided input as to how the next

session of the course should be designed (provided it followed the AL framework, naturally). The next session thus took place with the design adjustments that were "thought about" being implemented ("acted upon"). The results of this next session were then observed, thereby perpetuating the cycle until the conclusion of the course.

Participants

By design, the study benefited from convivial circumstances brought about by the professor and the teaching assistant, whose combined skill set would, at least in theory, serve the students well.

The Professor: The professor in this study was Dr. Gary Boyd. Dr. Boyd has researched and taught cybernetics for over 30 years, undeniably rendering him an advanced subject matter expert in the course and capable of reshaping content as needed to accommodate the accelerated learning framework. To this quality must be added his openness to having the course redesigned and his faith in his teaching assistant, all of which, combined, made the study possible.

The Teaching Assistant: The role of teaching assistant was undertaken by me, the author of this study. I had designed the study and proposed it to Dr. Boyd shortly after having successfully completed his course myself as his student during his previous offering the year before. During that offering, I had emerged as a prominent contributor to the course, having demonstrated promising presentation skills as well as an ability to comment extensively on my classmates' projects on our online forum. This, along with

my prior interest in teaching, particularly with AL, laid the foundation of this study: Being familiar with both the pedagogical model of AL and the pedagogical content of cybernetics, I possessed the critical abilities necessary to play the role of a teaching assistant using a method I believed in for a subject I knew. Despite my newness in the role, the ability to explain cybernetic content to students would never be an issue, as I would always work in collaboration with Dr. Boyd, who would capably handle all questions beyond my scope of knowledge. This collaboration was colloquially referred to during the semester as "the tag team approach". Whenever Dr. Boyd or I would handle the presentation phase of a session, one would lecture and the other would support with interjections to answer questions or offer valuable alternative perspectives.

The Students: The predominant element of the study that *wasn't* convivial was the amount of students who participated in it. No longer benefitting from the "core course" status it once had, the Cybernetics course has been prone to low student enrolment. Nonetheless, the initial enrolment rate prior to the beginning of the semester was eight students, which was considered good. This number however had dwindled to five students who had shown up for the first session. By the third week, one more had joined while two others had dropped it, leaving the student count for the remainder of the study at four.

Regardless of the student count, the study had to carry on and make the most out of the circumstances. The caveat of small sample size thus became an advantage in individual student focus. With only four students, each one could be given a substantial

amount of attention, giving the study the luxury of discussing them individually. Unlike Dr. Boyd and me, they shall be introduced via pseudonyms to honour confidentiality, though some general information can be offered for the sake of context. Three of them were in the course's encapsulating Educational Technology program for over two years, and thus brought the value of "veteran student experience" to the study, which they each coupled with promising individual qualities. Jason, for instance, was a student representative for the program, which bode well for the level of student engagement desired in the study. Catherine had international work experience in the field, which would make her very attuned to the performance phase of the AL framework. Stan would also be familiar with real-life performance though through different means, having had 33 years worth of experience in a school board. This left the newcomer to the program, Mitchell. Though he was in his first year, he, like Stan, had also worked in schools, having served as a high school teacher. If nothing else, Mitchell would bring a fresh newcomer's perspective to the course and the study.

Data Sources

The study was an interesting one in terms of data, for the "shape" of the course was in continuous evolution as the professor, assistant and students adapted to each other. This highly interactive design oftentimes produced data of different modalities that emerged from the use of various techniques, many of which were conceived from one week to the next. Other forms of data, in contrast, stemmed from instructional components that Dr. Boyd had used for years, and were kept in the course owing to their

compatibility with the AL framework. Descriptions of all forms of data will unfold in the Results section; for the moment, the major categories are presented below.

Preliminary Questionnaire: Prior to the beginning of the course, enrolled students were given a questionnaire asking for their motivations for enrolling in Cybernetics and their expectations for the course. I reflected upon the responses to determine how to elicit student engagement as early as possible into the course.

Recordings: The majority of the classes were digitally recorded (save for two unfortunately, due to low batteries) so that the conversations could be reviewed and analyzed for evidence of critical thinking and for ideas on how to improve the following session.

MAXCACs: A MAXCAC is Dr. Boyd's coined acronym for Metaphors, Aspirations, eXpectations, Commitment, Anxieties, and Capabilities. At the beginning of the course, students were asked to fill out a form with their thoughts on each of the above attributes with respect to their involvement in the course (and add a photo of themselves as well). Dr. Boyd considers a student's MAXCAC, to a certain extent, as a predictor of the way they will interact (Boyd, n.d.). It is also of use to the student; once they express their perceptions, they can use these parameters to approach the course consistently while addressing their concerns, which can lead to more effective learning.

PowerPoint Presentations: Over the course of the semester, all participants had produced PowerPoint presentations. The ones designed by Dr. Boyd and I will be discussed in terms of the elements of AL we sought to adhere to, whereas those of the students will be analyzed for evidence of critical thinking. Worthy of immediate mention is the fact that the presentations I had produced were in adherence to the accelerated learning model, to the extent where the slides' backgrounds were even color coded in accordance with the four phases of AL. To account for the preparation phase, "red slides" were created that introduced each topic and described the potential benefits it contained in learning and performing it. "Orange slides" would then present the topic in as meaningful and relatable a manner as possible. Intermingled with these presentation slides were "yellow slides", that contained activities that had students practicing the content in the class. There were no corresponding "green slides" for the performance phase, for this phase, inherent in its nature, was to be carried out outside of the classroom. Hence, the performance phase was represented by the course project, which was to be developed online.

First Class Archives: First Class was the computer-mediated communication tool that was used to pursue the course outside of the classroom. Aside from its elementary function as an e-mail application, it was also a repository for most of the artefacts that were produced throughout the course. Its primary purpose in the course, however, was that of a digital developmental ground for the course projects. The project was a component that Dr. Boyd had been using in the Cybernetics course for many years. Serendipitously, it was perfectly congruent with the need for an outside-the-class, life-

experience-driven performance component in the study, and was thus appropriated. The project was composed of five phases of questions that would cause each student to relate the cybernetic concepts taught in class to a particular personal experience of their choosing (their jobs, their hobbies, their families, and so on), thereby enabling them to uncover (and prescribe) applications of cybernetics in their everyday lives.

As part of the course's design, students were to be assisted in traversing the project by all other participants. Each student had their own dedicated folder within First Class in which they would answer the project questions in e-mail messages. In this way, I, Dr. Boyd, and the remaining students could enter the student's folder and reply to the message with comments or questions. This, it was hoped, would induce critical thinking in both the students providing the feedback and the student whose work was being given the feedback, as that student would usually think about the feedback to respond to it and advance their project.

Assistant Notes from Sessions and Debriefings: In addition to recording each session, I carried a large notebook with me to class in which, whenever possible, I would jot down notes about both the content that was being presented in a session as well as observations pertaining to student behaviour throughout it. Essentially, I was discerning what was stimulating students' interest and participation, and what was making them look disinterested or disengaged. Following each class, I would hold a debriefing session with Dr. Boyd in his office to discuss my observations and brainstorm on ideas to improve the overall quality of the following session.

Mid-term: At Session 10 of the course, students were administered a midterm exam. While the first portion tested declarative knowledge pertaining to contributors to Cybernetics, the second portion was open-ended, and simply asked students what they thought was the most interesting cybernetic concept they had come across thus far and why. Copies of each student's test were made in order to examine the depths to which they were able to answer this second question.

Intervention Artefacts: In the final weeks of the course, a variety of techniques were used to ensure that students would fill course requirements (and the study's as well!). This produced a small assortment of artefacts – some created by me, some by the students, and some together. These will be detailed in the Results section in order to demonstrate how I attempted to implement accelerated learning and whether I was successful at doing so.

MAXCAWs: A MAXCAW, for all intents and purposes, is the complementary and reflective bookend to the MAXCAC. Whereas a MAXCAC is a preliminary assessment of the aforementioned parameters, a MAXCAW assesses them once the course has concluded to observe the evolution of the student's train of thought. Note that the final initial parameter of Capabilities gets replaced with W for Whatever, as in, whatever else the student wants to say.

Internship Evaluation Forms*:* These forms, much like the MAXCAW, also assessed the students' reflections on the course as it concluded. Rather than soliciting

thoughts on Dr. Boyd's parameters however, the Internship Evaluation Form asked students to evaluate the effectiveness of the tools and techniques that were used vis-à-vis each of the four phases of accelerated learning.

Analysis

Research literature indicates that, not surprisingly, a consensus on a *measure* of critical thinking measurement has been as difficult to reach as a *definition.* A recent critical thinking meta-analysis by Abrami, Bernard, et al (2008) found an assortment of assessment tools that covered "a broad range of formats, origins, psychometric characteristics, areas of application, and scope of constructs to be measured" Furthermore, even standardized measures of critical thinking have come under much scrutiny over their validity and reliability, with their testing yielding inconclusive results (Abrami, Bernard et al, 2008).

Fortunately, action research is capable of circumventing this dilemma through its inherent ability to offer results in a qualitative rather than quantitative fashion. That being said, it becomes incumbent upon the study to present a legitimate analysis technique of deriving results within this allowance. Facione's study (1990), which involved an interactive panel of 46 CT experts, features a consensus statement that offers suggestions for such a technique:

"In theory there are several ways persons can be judged to be more or less proficient in a given CT skill or at the integrated use of related CT skills. One way is to observe a person over time performing those activities, processes or procedures generally regarded as presupposing that skill for proper execution. One then makes a judgment regarding the degree to which the person possessed the general skill in question. A second way is to compare the outcomes (if any) that result from executing a given skill against a set of criteria." (Facione, 1990)

Following Facione's guidelines, the study's technique was formulated within its action research context. By means of the data sources, the students were observed over time. This time, in congruence with Stringer's action research spiral, was divided into cycles, or portions of the study's timeline that were deemed as one action research

iteration of it. Within one cycle, data sources were examined to trace instantiations of critical thinking. In conjunction with the suggestion of Facione's panel of experts, the pertinent data collected from one cycle was then compared to the study's operational criteria for critical thinking.

While this analysis technique aligns itself well with the research method, it is only half complete, for it is missing consideration of the hypothesis. The study was conceived with the belief that, in a simplified cause and effect conceptualization, accelerated learning could beget critical thinking in students of higher education. It was concluded then, that the appropriate analysis that would ensue was one in which, true to action research, cycles of the study can be recounted in chronological order, much like a story, but with an emphasis placed on evidence of *not only* critical thinking having occurred, but of accelerated learning having been applied in the first place *as well*. As a result, both sides of the cause and effect relationship could be examined to evaluate the rigor and validity of the study.

This being said, it was deemed that the analysis would benefit greatly from a visualization that would lend structure, clarity, and context to it. In considering the study holistically, one realizes that there are three different constructs (not to mention their respective sub-constructs) at play: accelerated learning, action research, and critical thinking. To integrate the three of them into one system in such a way as to be able to accurately represent what transpired and correctly guide the analysis of the results, Figure 3 was eventually produced:

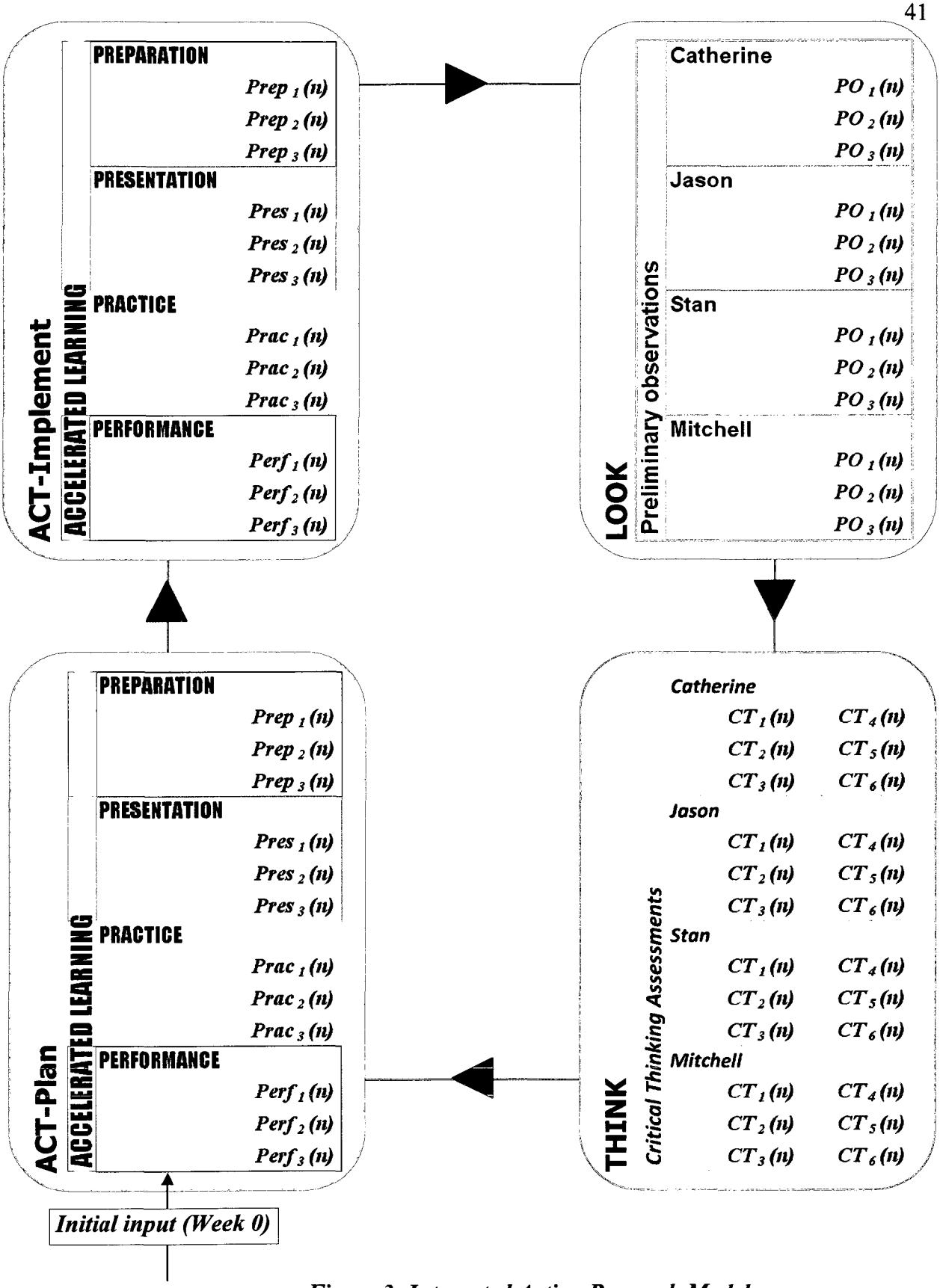


Figure 3: Integrated Action Research Model

As can be seen, the system contains within it multiple subsystems by virtue of the study's three constructs and four students. This assertion of construct hierarchy first required the determination of the "dominant construct"; For instance, was accelerated learning utilized as a component of action research, or vice-versa? Upon reflection, it was reasoned that the analysis of accelerated learning was but one step of the study, after which data was collected and analyzed for critical thinking. In this light, it made most sense to design the system with action research as the dominant construct.

System diagrams commonly begin with in initial input, or signal, or action, setting a process into motion. In this study's case, it was the collection of preliminary data about the course from both former and the upcoming students. This set off Stringer's two-part Act step of conceiving (planning) AL components to address previous and upcoming student feedback, and then implementing them. Seeing as how all "acting" in the study involved designing AL interventions, it was concluded that the entire AL framework represented the Act portion of the study. The analysis was thus set up to track instances of AL's phases, namely preparation (*Prep*), presentation (*Pres*), practice (*Prac*) and performance (*Perf*).

After acting, one "looks" at what happens as a result. This looking, as elaborated by Creswell (2005), consists of gathering information and analyzing it in a broad, preliminary manner. For this study, the looking was associated with preliminary observations (PO) that were made about the students during sessions, debriefings, and in First Class, following the students' exposure to AL in class.

The thinking phase, by definition, is the deepening of the understanding of what occurred through the use of interpretive processes (Creswell, 2005). In the study, this corresponds to Facione's rubric for defining critical thinking. As such, the preliminary observations made about the students in the Look Phase get broken down into critical thinking assessments (CT) in the Think Phase.

It is to be briefly noted that once all of these constructs were situated, there was an attempt to graphically demarcate the beginning (and end) of a cycle. This proved to be unexpectedly troublesome, owing to discrepancies between Stringer's theory and the study's reality. For starters, the mere nuance of declaring the first step as "look" rather than "act" causes a counterintuitive (and annoying) result of having a cycle begin with the observation of one session and the end with the running of the next, thereby implicating portions of two sessions within one cycle. Furthermore, "looking", "thinking", and "acting" did not occur in a strict, discrete sequence in the study as it does in theory, but actually overlapped. For instance, the author would often take notes ("look") while Dr. Boyd was presenting ("acting"), thereby causing cycles to overlap and contain mini-cycles within them. After a geometric mapping of these discrepancies led to needless complexity, it was eventually assumed that the dissection of the study's action research spiral was arbitrary and secondary to the overarching evolution of its results. Hence, for the sake of clarity, a cycle will usually consist of the beginning of a session and end with the plans that were made for the following week.

Results

Appropriately enough, the compilation and editing of the study's results was a thorough exercise in critical thinking in itself. The multivariate composition of the analysis, in addition to the abundance of information that existed amidst the data sources, posed a considerable challenge in presenting the results in a fully representational yet literarily efficient manner. Eventually, a set of guidelines was developed in order to do so.

The first guideline pertained to the proper partitioning of the study's timeline into cycles. At first the intention was to offer fifteen: one for the data collection prior to the semester, and one for each week that a session took place. It was soon found however that this was not accurately representative of the cycles that actually emerged, and the cycle designs were thus altered. The results still dedicate one cycle to preliminary data collection and analysis, and one to the first three sessions of the course. In this period, participants, course content, and the AL frameworks were being introduced to each other, and so cycles were "thinly sliced" to be able to capture the various initiations. Once these concluded however, the course's structure and the study's interventions formed "eras" in its timeline that spanned multiple weeks. The results are thus presented in seven cycles, one for the pre-course data collection and analysis, three for the introductory period during which AL was gradually integrated, and three cycles for the eras that ensued.

The second guideline related to information selection. Much like a movie editor must do, a plethora of data had to be considered and then edited to ensure the succinctness of the results. It was assumed that the most effective manner of succeeding

at this task would be to focus on the most novel (yet pertinent) elements of a cycle, and treat them as a given thereafter. For instance, much text is invested in the first cycles in describing and quoting Dr. Boyd to illustrate his influence in the study. As student involvement and input of data increased in later cycles, attention is taken away from Dr. Boyd (since his persona has been well-established) and placed more on the students.

The third and final guideline pertained to information reporting. The transposing of the multiple constructs engendered potential conflicts in the ability to describe the results coherently. How, for instance, could the storytelling nature of action research be respected if the story had to be stopped at every sentence so that it could be dissected for evidence of accelerated learning and critical thinking? In response to this challenge, a multi-layered reporting of the results is offered. The results for each cycle begin with a literary account of what happened, and end with an instantiation of the tables presented in the Analysis section. Between the two, a brief summary of the story linking events to AL and CT is offered to make the transition.

Cycle 0: November - December 2008

In the weeks preceding the beginning of the semester, I had two missions. First, I was to identify the course's commonly perceived strengths and weaknesses, as written in past students' summative evaluations, so that I could determine which course components I would preserve and which I would modify such that they would adhere to the AL framework. Second, I was to solicit the intentions and expectations of the upcoming students to customize the course as best I could such that it would appeal to their

particular learning dispositions. The 14 summative evaluations of past students that were gathered contained the following themes.

The Professor: Dr. Boyd received numerous superlatives, as much for his personality as for his technical expertise. He was described as helpful, respectful, and encouraging. In addition, students enjoyed his stories for the way they contextualized subject matter, and appreciated his prompt and relevant feedback. However, they wanted him to be more organized. Anecdotes of searching for files and waiting for web pages to load in mid-lecture underscored how student's engagement, their "learning bubble", if you will, would often be burst by such involuntary interruptions. This wish for organization was not only present in logistical matters however, but in his content delivery as well. Further comments suggested that while some students seemed to marvel at his lecturing unconditionally, the less experienced ones couldn't follow him when he would explore a topic extensively.

Course Content: The subject matter itself was lauded for its ability to present a variety of interesting new ideas about organization and education. Those who were able to follow became capable of ascertaining how systems behaved and of forming ideas on how to improve them. Again however, there was a second category of students that had struggled. This group couldn't progress effectively from the theory to the practice, couldn't detect a sense of direction in the course, and couldn't understand the course's educational relevance, notably in relation to other courses in the Educational Technology program. These factors likely contributed to the common wish for a standard textbook, presumably to be able to be to envision the various elements of the course captured together as a whole.

Student Lectures: The course featured a portion wherein students, either alone or in pairs, would give a lecture on a cybernetic topic in lieu of Dr. Boyd. Feedback on this component was unanimously positive; Student lectures clarified material to peers and bestowed a rewarding sense of expertise to its presenters.

Course Project: The term-long project, in which students were called upon to demonstrate their cybernetic comprehension by relating its concepts to their personal experiences, was the veritable trademark of the course. Students enjoyed the project for being able to look at a life situation of theirs from a systems point of view, and for sharing their experiences with each other. However, it was also mentioned that more direction during the course of the project would have been appreciated.

In concert, these results gave me many ideas as to how I could improve the course. Dr. Boyd's popularity and expertise already gave it a strong foundation, but I would help him significantly by assisting in administrative affairs to preserve session momentum and engagement. To bridge the apparent divide between students content with course delivery as it stood and those wishing for more explicit indicators of direction and relevance, I would serve as an intermediary, who, in conjunction with the presentation phase's desire for meaningfulness, would scaffold learners toward a better grasp of course content. While the offering of a course textbook was beyond my scope of abilities for the study, I would at least address the underlying desire for course continuity by designing presentations that were uniform and consistent in their appearance. More importantly though, I would also cross between topics and reinforce material by revisiting key slides. Wherever possible, I would cross-reference the cybernetic curriculum and that of other courses in Educational Technology. Given the reported

benefits of student lectures and the project, these elements would be retained for the study, especially since they meshed well with the AL framework. To answer to the need for more guidance through the project, I would second Dr. Boyd as a project consultant, much like I had done unofficially the previous year as a student.

To gauge the upcoming students, I created a simple questionnaire that asked three questions: what were they hoping for and expecting in the course, which elements and activities they've enjoyed in past courses, and which ones they had disliked. In e-mailing them the questionnaire, I took the opportunity to introduce myself as well. I wanted to convey a lot of enthusiasm for what I was about to undertake, not only to create a positive environment as prescribed in the preparation phase, but because I was genuinely excited about the study. I explained the premises for my involvement, emphasizing my intentions of bringing structure to the course. I then requested that they fill out the questionnaire to help me make the course valuable, memorable, and fun for them.

Out of the eight students that were registered for the course at the time, I received a reply from four, three of which had actually replied to the questionnaire. When replying to what they had liked in the past, students stated that they enjoyed being exposed to new ideas and approaches of doing things, and being "made to think". This bode well for the end goal of the study, for the students already seemed predisposed to think critically. Equally promising was one student's desire to apply the course to their research interests, thereby demonstrating a strong inclination for long-term application, congruent with the performance phase. Finally, there was, once again, the wish to have the course's material overlap with other ones in the Educational Technology program.

Student dislikes were equally plentiful, and in some cases challenging to address. True to the research, one-sided lectures were alluded to and shunned ("stuff things down my throat so fast that I can't digest it"). To this, I would respond with activities (i.e. the practice phase) which would render the material "digestible". There was also an expressed dislike of randomness and lack of continuity, which I would address through the design of meaningful and self-referencing presentations. By the same token however, and even by the same student, there was a statement of dislike for *too* much structure: "(I want) to learn, to question, to be questioned and to be guided, but not restricted to being conformed to a box". This sentiment was echoed by a second student, who did not want the course to be *too* organized, for fear of being deprived of personal exploration of course topics.

While these statements seemed innocuous enough, I interpreted them as subtle resistance to the structured approach I had been advertising. Other portions of responses I had received weren't subtle at all. I was particularly taken aback by one response that defended Dr. Boyd's practices ("that's the way Gary does it") and questioned how my involvement would not "ruin" his reason for taking his course. I replied to the student (after regaining my composure) discerning that I would be there to complement Dr. Boyd and not compromise him.

The following pages contain two tables with which I was able to form an initial AL game plan for the course. Table 1 resumes generalized student feedback statements, each of which is assigned one or two AL labels. These labels correspond to the phase(s) of accelerated learning I would respond to the statement with. The numeric subscripts of these labels keep track of the number of times an AL phase was called into play. Table 2

is a set of AL responses; in it I took the AL labels I associated to the student statements, placed them in order, and prescribed what I could do in response to each statement.

INITIAL INPUT

Summative evaluations			
Pro $_1$	Dr. Boyd is esteemed	***Prep*** $_1$	
Pro $_2$	Dr. Boyd is knowledgeable	***Pres*** $_1$	
Pro $_3$	Dr. Boyd is responsive	***Prep*** $_2$	
Pro $_4$	The content is interesting	***Pres*** $_2$	
Pro $_5$	The content is valuable	***Prep*** $_3$	
Pro $_6$	Class presentations help all students learn	***Pres*** $_3$	
Pro $_7$	Project helps students relate material	***Perf*** $_1$	
Pro $_8$	Projects foster learning conversations	***Perf*** $_2$	
Con $_1$	Dr. Boyd is disorganized	***Prep*** $_4$	
Con $_2$	Dr. Boyd doesn't connect with "novice minds"	***Pres*** $_4$	
Con $_3$	Students are unable to apply theory	***Prac*** $_1$	***Perf*** $_3$
Con $_4$	Students cannot see the course's direction	***Pres*** $_5$	
Con $_5$	Students cannot perceive course's relevance	***Prep*** $_5$	
Con $_6$	Projects lack direction	***Perf*** $_4$	
Questionnaires			
Like $_1$	Being exposed to new ideas and approaches	***Pres*** $_6$	
Like $_2$	Being made to think		
Like $_3$	Being able to apply the course to research interests	***Prep*** $_6$	***Perf*** $_5$
Like $_4$	Being able to relate the course with other ones	***Pres*** $_7$	
Dis $_1$	Being taught too much too fast	***Prac*** $_2$	***Perf*** $_6$
Dis $_2$	Randomness / lack of continuity	***Pres*** $_8$	
Dis $_3$	Too much structure	***Pres*** $_9$	***Perf*** $_7$

Table 1: Summary of past and upcoming student feedback

ACT ACCELERATED LEARNING

PREPARATION

Prep $_1$	Let Dr. Boyd carry on (if he ain't broke...)
Prep $_2$	Let Dr. Boyd carry on
Prep $_3$	Bring out more valuable aspects of the content
Prep $_4$	Assist in course administration
Prep $_5$	Explicitly underscore value of each topic
Prep $_6$	Suggest that course project be done on research interest

PRESENTATION

Pres $_1$	Let Dr. Boyd carry on
Pres $_2$	Cultivate interest in the content
Pres $_3$	Keep class presentations
Pres $_4$	Scaffold novice minds with relatable examples
Pres $_5$	Create a uniform and self-referencing set of presentations
Pres $_6$	Cultivate interest in the content
Pres $_7$	Relate content to ther courses during presentations
Pres $_8$	Create a uniform and self-referencing set of presentations
Pres $_9$	Student presentations will allow them to "think freely"

PRACTICE

Prac $_1$	Scaffold novice minds with relatable activities
Prac $_2$	Create an effective ZPD through activities and project

PERFORMANCE

Perf $_1$	Keep projects
Perf $_2$	Encourage students to discuss their projects
Perf $_3$	Scaffold novice minds with project questions
Perf $_4$	Second Gary in providing students guidance with their projects
Perf $_5$	Suggest that course project be done on research interest
Perf $_6$	Create an effective ZPD through project
Perf $_7$	Course project will allow them to "think freely"

Table 2: Initial Action Plan

Cycle 1: Session 1

Despite all the front-end analysis of Cycle 0, the first session, in all honesty, was mostly ad-libbed, for several reasons. First, both Dr. Boyd and I had given in to the temptation of two rare weeks of freedom afforded by the Christmas holidays. Second, I thought it would best for me to make an unassuming entrance into the course, given that my whole-hearted introduction e-mail was unpleasantly met with what I perceived as backlash. Third, I thought it would be interesting and valuable to treat the first session of the course as the action research equivalent of a control group, and assess "how accelerated" Dr. Boyd's session already was without any treatment.

Dr. Boyd began his course by identifying its potential value and instructing how students could obtain it for themselves: "The point is to get insights as to whatever processes or activities you are dealing with and get a handle on how things work and fail and what can be done about that. In order to bring that about, I found two things useful - to go through the basic gamut of systems that steer themselves or are co-steered and their constraints, and to get you to choose a project in which you have had personal experience in the last few years and have you analyze it from a modeling point of view." It struck me how without any formal AL interventions as of yet, Dr. Boyd's instincts as to how to begin the course were in direct alignment with AL's preparation phase.

He continued by sharing his view of the course as three conversations: why we are doing this course, what it means (and how people's understandings of it differ), and what methods exist to learn things well. With that, he presented the first piece of curriculum, the Frank-Boyd Star, a mnemonic device he co-created that featured a set of pedagogical variables. "This class of variables is very important for *any* course or *any*

learning activity. My aim is to help you understand some basic aspects of steering systems in such a way that you can apply that knowledge in your professional work… and maybe the rest of your life too."

As he was drawing the star on the whiteboard, Dr. Boyd solicited and integrated ideas from the students as to what other components would be. While doing so, he related to the class the challenges of capturing all the variables in real-world phenomena: "Even in our society at large, we have a much more turbulent system than most people assume - this was very painfully shown in October and November with the financial collapses." The star was quickly proving to be a comprehensive and practical tool. His walkthrough of it not only allowed him to relate the variables to real-world scenarios, but to other course elements as well. He used one of the star's variables to segue into an introduction of his both his MAXCAC tool, and eventually myself.

To remain unassuming in this session as planned, I only allotted myself two or three minutes to speak. Nevertheless, I still wanted to reaffirm my teaching style, but at the same time, reassure students that Dr. Boyd would lead the course. Despite a cool reception to my warm-hearted e-mail, I opened up to the students in colourful fashion: "In terms of education, I consider myself to be a hopeless romantic, in that I hold two ideals very dearly. First, I think it should be fun. Those of you I've been classmates with have seen me do presentations with splashy colors, dance music, sketches with my sister's dog…"

"He doesn't actually bring the dog to class", added Dr. Boyd, to some chuckles.

"My second ideal, I continued, is to be highly pragmatic. My job has highly influenced me to ensure that I have something valuable to contribute. Make no mistake, this is Gary's course. Many people took it because of Gary, and there's absolutely no problem. I am here to act as a consultant to Gary, and help him steer the course and make it more fun and valuable"

With that, Dr. Boyd thanked me and resumed his walkthrough, and began telling stories about early cybernetic devices that featured feedback control. He went on to say that this phenomenon was actually ubiquitous in nature, and how, to large extent, much of our world can be modeled into predictable systems. "A great deal of what we do is predictable. Though people can be **<RUFF!>** unpredictable, excuse me, for the most part people follow rules." The "RUFF" was Dr. Boyd actually making a barking sound to demonstrate unpredictability. It was good to know that he was capable of being colourful as well.

He concluded the drawing of the star by once again underlining its significance: "That's my basic way of organizing the course, or asking questions about an instructional undertaking. It's a scheme for developing instruction which I find very useful ,and when I'm reading a paper describing one, I try to see whether in that paper all these classes of variables are dealt with or not, that's a way of criticizing such papers." He then showed examples of projects and MAXCACs from previous semesters before sending the class to break.

After the break, Dr. Boyd gave students the opportunity to talk about themselves and their inspirations for taking the course. Ironically, two of the most vocal students were Rex and Fay, who would both drop the course soon thereafter. Regardless, Dr.

Boyd engaged them into recounting their academic journeys and exchanging points of interest with him. Of the students who would remain in the course, Catherine had not yet joined (she would do so the following week) and Stan had to leave at the break. This left Mitchell, who, after resuming his elementary and high school experience, expressed an interest in a career change and a desire to learn "the way things work", and Jason, who had a strong interest in learning outside the classroom and the development of a learning schema that he could successfully apply in any context. Both their inclinations, I found, would be addressed very well by the course. The session concluded with Dr. Boyd going over how the projects would be run and what books would be used.

It is to Dr. Boyd's credit that many of his session's elements were already in line with prescriptions in the AL framework. In terms of the preparation phase, he quite often pointed out the value of the course and its components. He also created a positive and inviting social environment with anecdotes and humour (not to mention barking), and at the end of the course, drew students into situating themselves within it by soliciting their backgrounds and interests. In the presentation phase, he provided a vivid history of the course, including the current point it had evolved to, and related it to pertinent real-world stories of all kinds. The practice and performance phases, understandably, were fairly light in this first session. He solicited suggestions as he created the Frank-Boyd star, but students were speaking very briefly. As for the outside-the-classroom performance phase, he did as much as possible at the time, which was to introduce what was to come, and show some examples. Consequently, critical thinking then was negligible in students, with regards to the subject matter. The action plan then would simply consist of

maintaining the positive atmosphere of the course, resolving a few technical glitches that hampered the lecture as it did in the past, and getting the students increasingly involved.

Tables 3 through 6 resume the first session with respect to the study's model.

ACT (Implement) - AL

PREPARATION

Course goals established
Learner benefits established
- value of course
- value of Frank-Boyd star
- value of MAXCACs
- value of project

Positive social environment
- friendly prof
- friendly TA
- student input solicited
- jokes
- barking
- student intros

PRESENTATION

History/context of course
Course as three conversations
Frank-Boyd star
Real-world stories
- fly ball governor
- grain grinding machine
- plants and animals
- economy

First Class setup not ready

PRACTICE

Suggestions solicited for Frank-Boyd star

PERFORMANCE

Intro and examples of MAXCACs
Intro and examples of projects

LOOK - Preliminary Observations

Catherine

Not there

Jason

Has performance-related interests
(learning outside the classroom)

Wants a generic learning schema

Stan

No significant involvement

Mitchell

Beginner's mindset
- "I want to know the way things work"
- Career transition
- Open to new ideas

Tables 3 & 4: Implementation and Look Phases of Cycle 1

THINK - CT **Assessments**

Catherine

Not there

Jason

Nothing yet

Stan

Nothing yet

Mitchell

Nothing yet

ACT (Plan) - **AL**

PREPARATION

State goal & benefits of Topic 1
Maintain +ve environment

PRESENTATION

Continue with visuals

Continue with stories

Set up First Class in advance

PRACTICE

Involve students in lecture more

PERFORMANCE

Continue discussing MAXCAC
Continue discussing project

Tables 5 & 6: Think and Plan Phases of Cycle 1

Cycle 2: Session 2

The second week of class saw the departure of Fay and the arrival of Catherine. This caused Dr. Boyd to review the ubiquity and the value of cybernetics, while adding a few new points to it: "We're all personal scientists, making models of the world, testing them, and revising them when they give us a bum steer. The other important thing about being personal scientists is that we're not only testing our own models, but we're grabbing models that other people tried before us .We're all construing the way the world is and what's likely to happen.". In wrapping up his big picture, he also explained how the course fit into the Educational Technology program: "What I've found in this program, is that the level where things are often most needed is the level where you've got good instructional design, but you don't know how to fit it in an organization. Often the problem isn't what we focus on, but how it connects with other things and other people. That's the perspective I'm really trying to develop here. But I'm also trying to make sure you understand the basic mechanisms about how systems behave."

I had found this high-level contextualization of the course very potent in promoting its benefit to the students. As he was reviewing the MAXCAC and project components, I decided to reinforce the point: "Last week I said I was obsessed with value, so for my project last year, I modeled my job. I chose it because it was super convenient: I knew it inside-out, and being so intimate with the material, I could connect it with all these concepts in the class, and gain insights about my job. By looking at it in a cybernetic way, you could play around with your own job and see if you can improve it."

After speaking of the MAXCACs, Dr. Boyd went to his laptop to share those that were submitted, including mine. In his, Mitchell had likened his return to school to someone who has seen a movie (referring to his teaching days), but was now going back to read the book to deepen his knowledge. Dr. Boyd commented about wanting the class do more than read books, and then chatted about Mitchell's photo of him playing a guitar. Dr. Boyd would soon make use of this idiosyncrasy; eventually, so would I.

As well as Dr. Boyd was already touching upon many aspects of AL on his own, it was time to for me to formally begin integrating it into the course. My first intervention was The Beacon Statement, a slide which said the following:

Educational Cybersystemics is about understanding the co-controlled systems we are in, as well as those that are in *us*, in order to improve our performance.

"I made this in response to past student surveys that desired a sense of direction in this course. Like I've told Gary, this course is like a buffet, because you learn a bit of everything. In the past, students have been frustrated when trying to figure how it all ties together. The Beacon Statement is the central theme of the course, and anything we talk about will come down to different aspects of it."

With that, Dr. Boyd brought up PowerPoint slides that he created on the course's first topic, Information Theory. As prescribed in the action plan, he was more intent in this session on involving the students in his lecture: "My first question to you, is can you have communication without control?"

Mitchell and Jason offered brief guesses, but it was the newcomer Catherine who got the ball rolling by asking a question of her own:

"When you talk about control, in what sense do you mean?"

"Ah, replied Dr. Boyd, that's what I wanted to bring out. Wittgenstein said that every word has a cloud of meaning, and has different meanings in different situations."

"Well, offered Catherine, if you think about a plant or something, if it were to die, it's communicating that it's missing water."

"That's interesting; the plant starts wilting, so you know you've got to put water in it. Now the plant didn't learn to wilt in order to attract people's attention, but on the other hand flowers do emit perfume to attract bees, so they have learned to communicate to get bees to relate to them. So there are some interesting things to play around with there."

As it were, Dr. Boyd had various methods for getting the students to talk. His next question was whether you could have control without communication, which he silently answered by tipping over a chair. The thud seemingly lured Rex into a discussion. With the topic of modulation, the professor leveraged Mitchell's MAXCAC photo to pull him into the lecture.

"As a guitar player, what is your notion of modulation?"

"I guess a tone going up and down..."

"Yes, OK, so you have a tone, and you press upon something and it either increases or decreases its volume or pitch - technically that's frequency modulation, and something that makes the loudness go up and down is amplitude modulation"

For the next little while, Dr. Boyd lectured from his PowerPoint slides, which presented potentially complex topics in an accessible manner. His diagram of modulation involved what he amusingly referred to as "blue spaghetti" that was getting "squashed by a guillotine". His discussion of signal-to-noise ratio contained an example of him having a conversation at a restaurant about cybernetics with a woman while

pleasant background music was playing. The scenario illustrated how it was up to the receiver to discern which element was the signal and which one was the noise. His explanations of the laws of thermodynamics mentioned not only the aim of minimizing energy losses in train engines and the like, but human endeavours as well: "when you speak, speak as well as you can; when you make music, make it as best you can". The session ended with Dr. Boyd asking the class to read up on the upcoming topic of Systems Theory.

In sum, the session succeeded in inching AL along, as planned. The preparation phase was well represented, as both Dr. Boyd and I continued to impress the benefits of the course and to maintain a friendly atmosphere, which would always be the case. The presentation phase was strong from a delivery standpoint, and showed mild improvement in student participation in the lecture. Unfortunately, when there wasn't mild improvement, there were significant stretches of time where students would sit passively; leaving me unconvinced that, in the spirit of his lecture, they were "receiving Dr. Boyd's signals". This to me demonstrated the gap that a lack of more formal student involvement (i.e. not just haphazardly contributing to lectures) produces. As a result, I would describe what the students displayed as "trickles of critical thinking" at best. While it was still too early to embark them on their projects, I would be able to correct this and get the students more involved by explicitly inserting practice phase activities in the course. That being said, Dr. Boyd and I agreed in the debriefing that I would take charge of creating the slides for the following week, ensuring that within them, in-class activities would exist to bring forth greater participation from the students.

The tabular resume of Cycle 2 is presented below:

ACT (Implement) - **AL**

PREPARATION

Course benefits reinforced
- value of course within Ed Tech
- Beacon Statement
- project as job-imnprovement tool

Personal attention to student perspective
- going over Mitchell's MAXCAC

PRESENTATION

Real-world observations
- we're all personal scientists
- Mitchell's guitar experience
- spaghetti-guillotine modulation
- history of topic/Shannon
- signal vs noise - talk vs music
- available/potential energy - train
- information requirements - photo

Attention-capturing techniques
- chair tipping

PRACTICE

Progressive student questioning

PERFORMANCE

Elaboration on project phases
Brief walkthrough of a project example

LOOK - **Preliminary Observations**

Catherine

Questioning meaning of control
Wilting flower as communication
Questioning meaning of a channel
Asking for clarification on application of concepts

Jason

Brief statement on communication without control

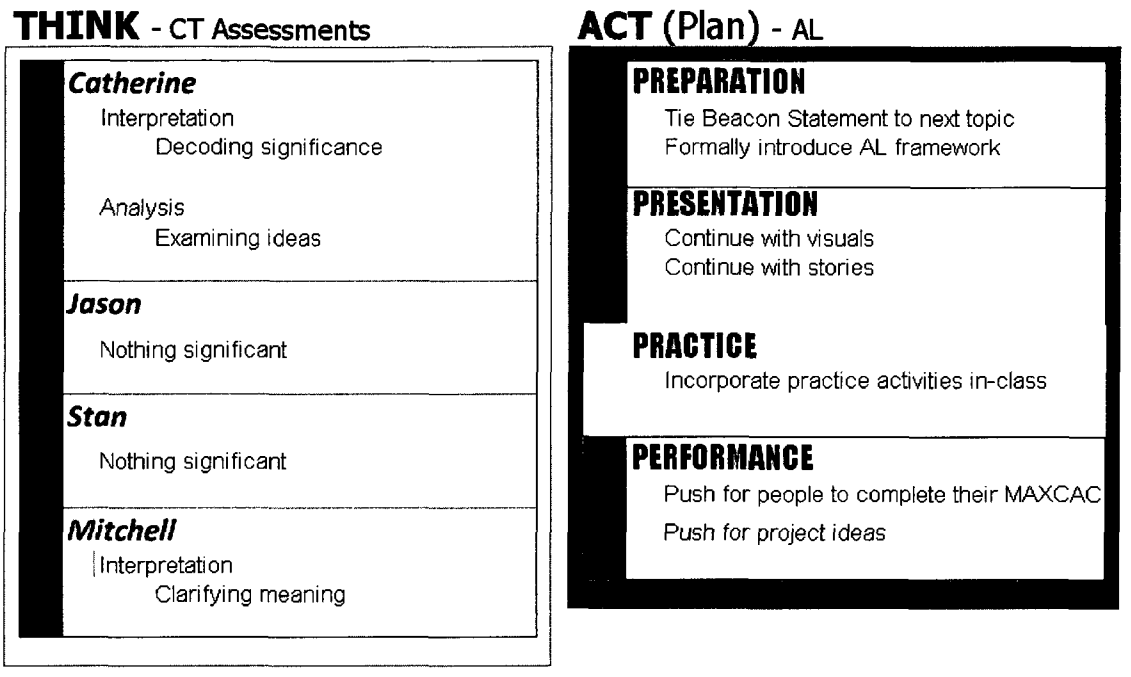
Stan

No significant involvement

Mitchell

MAXCAC clarification (when asked)
Relating concept to previous knowledge
Asking for clarification

Tables 7 & 8 – Implementation & Look Phases for Cycle 2



Tables 9 & 10 –Think & Plan Phases for Cycle 2

Cycle 3: Session 3

In Session 3, the student roster for the course was finalized at four, following Rex's departure. To my content, these four were rapidly called upon by Dr. Boyd to share the homework, about picking a system to describe, they were supposed to do at the end of their assigned reading. Catherine was first:

"Uh oh...heh heh, I just kind of went over it, in my head...but I was thinking...maybe a library would be easy?"

Dr. Boyd took this in stride and asked her to answer the questions on the spot. She offered some brief, elementary responses before he let her off the hook with a friendly "I won't stretch you any further."

Up next was Mitchell, who, thankfully, *did* do his homework. He chose to relate systems concepts to his experience as a school teacher.

"I was looking at it from the point of view of a school administration, and as I was doing so I realized that I could break it down into five components: administration, sports staff, teachers, students and parents, which I grouped together, and then maintenance staff".

"Why did you group students and parents together?" queried Dr. Boyd.

"I know they are separate, but from the point of view of a teacher, the student and parents act like one."

"You mentioned looking at the system from an administrator's point of view. If you were to look at it from another point of view, the purpose might be different. From the parents' point of view, the purpose of the school would be, what, babysitting?"

"Ha ha! Unfortunately, that's often true!"

"Stafford Beer said, slightly cynically, that the purpose of the system is what it does. When you're modeling a system and trying to understand it, it is necessary to look at the various stakeholders; different stakeholders, parents, teachers, school boards, have different purposes"

"And you would represent that with different systems?" jumped in Catherine. Dr. Boyd answered her and quickly returned to examining Mitchell: "OK, and what are your intangibles?" to continue to scaffold Mitchell's beginner's conceptions with his own expertise before moving on.

"Jason, did you pick a system?"

"Umm, I didn't quite get to the activity, but I was thinking of a student body. After listening to him though, that's more like a tangible aspect of a student government." Dr. Boyd agreed, but with little else do discuss coming from Jason, Mitchell intervened to fill the void.

"You know, I got a really cool diagram of my source system!" His efforts were rewarded, as Dr. Boyd allowed him to walk through it for the class, questioning him at every turn.

"Anyway, Mitchell eventually said, I know a school could be a much more complex diagram than that, but I just wanted to get…"

"Sure, reassured Dr. Boyd, we have to start with a first rough cut notion of things. Reality in detail is incredibly complex. But the question is what can we get a hold of that would give us some notion of the decisions we would have to make."

The last one up was Stan, who also came prepared and also chose to leverage his school experience. He however took things to a larger scale by using the purpose of the Quebec Reform Education Plan, which was 'To educate, to socialize, and to qualify'. "That's nice, actually, retorted Dr. Boyd, because to educate without socializing you could produce monsters..." He and Stan proceeded to have an educational dialog similar to that of his with Mitchell's.

With the exercise complete, I briefly took over the class to formally introduce the AL framework (Appendix A). Much like Dr. Boyd did with his star, I related to it all the course components we had come across so far, including the star itself, which I customized with the pedagogical variables of the class. To underline how I was trying to suit the course to the students' taste, I displayed the elements they had mentioned in my questionnaire (Mitchell and Jason's elements in any case; Stan never filled the questionnaire and Catherine wasn't registered at the time). After I showed them what they wanted to be provided with, I showed them what they should be providing themselves. To do this, I displayed Michelangelo's *Creation of Adam:*

Figure 4: Creation of Adam

"That's George on the left and Gary on the right", quipped Dr. Boyd.

Actually, as I explained to the class, to me the man on the left (Adam) symbolized a student, and that the man on the right (God), symbolized a teacher. Most symbolic of all though was the act of their fingers touching, which I considered to be a powerful metaphor for learning. Leveraging PowerPoint's animation capabilities, I stressed the idea that learning occurs best and fastest when both teacher and student reach out and connect to each other. In other words, while I endeavoured to stretch and help them grasp cybernetics, they would have to stretch and reach Dr. Boyd and me as well.

Dr. Boyd would begin his lecture from that point, but I would now interject more regularly and for longer periods of time by virtue of the practice slides I had prepared. In the spirit of scaffolding, the activities in these slides were straightforward, so as to easily elicit answers that could be leveraged for deeper discussion. The first one, quite simply, asked students to pick out, out of four pictures, the one that wasn't a system and to explain why. The second one featured a behaviour-over-time graph with an exponential curve heading towards zero. After providing examples of what kind of events this could represent, I asked them to come up with some of their own.

"I got one for ya, said Mitchell, I'm reading a book, and as time goes by, I'm understanding less and less until bam, I fall asleep." It was actually a valid example.

The next exercise would be more challenging: Using both the projector and the marker board, I led them through a guided example of how to create a behaviour-over-time graph and a causal loop diagram. This exercise required a considerable amount of critical thinking, but it seemed as though the warm-up exercise fulfilled its purpose. Catherine was very astute in challenging some of the answers I was giving (they were

straight from a book, but Dr. Boyd conceded that the book was simplifying), while Stan was drawing similarities between the examples and world affairs.

Up to that point, I had found that Jason was rather keeping to himself for someone who made such emphatic statements about learning in his questionnaire. That being the case, when I spotted an opportunity to give him what he claimed he wanted, I seized it. "Jason, when companies imitate an idea from their competitors, what cognitivist concept are they using?" As he had asked, I was questioning him *and* trying to get him to tie courses together. He offered a concept of Piaget's. I responded that I was thinking of a schema, though he may have been right as well. The exchange ended soon thereafter; I must admit that I did not possess the extended recollection of the Learning Theories necessary to draw out more discussion from him.

What I did have more recollection of however, was the Research Methods course. As the session was concluding, I attempted to demonstrate the parallels between cybernetic modeling and statistical analysis. The students' prolonged silence, as Gary and I were discussing this, led me to suspect that I had lost them, as only Catherine offered a brief remark.

The session concluded with reminders to submit MAXCACs and think of project ideas, as the latter needed to get under way soon. In addition, Dr. Boyd recommended various readings for the next class. I however had interpreted the anticlimactic student silence in the session as a message to stay basic and focused, so I asked Dr. Boyd to pick the one article he found most critical, which he did.

In assessing the session with Dr. Boyd during the debriefing, I told him that, in my opinion, the class took another step in the right direction. I was satisfied with the

preparation phase given the continued use of openness and humour, to which I added my "value slides". The presentation phase went well as usual, but the highlight of the session was really Mitchell. While everyone, thankfully, contributed to the session, he was the victor that the spoils went to; for he came to the class the most prepared. Consequently, he earned the most coaching from Dr. Boyd and visibly had the most to reflect upon...and built CT skills with.

In trying to categorize the homework discussion, I found that it could fall under both performance (because the homework was done outside of class) and practice (because its subsequent articulation was done in class). In any case, it was clear that both needed to be escalated through the continued use of in-class exercises and the igniting of the class project. Speaking of escalation, it was time for me to step up as well. Dr. Boyd did well with my slides, but had the disadvantage of deciphering *my* train of thought as opposed to *his*, which caused him to pause more often. After being stunned into tentativeness, Dr. Boyd and I agreed that I should get over it, and for the sake of the study (and my own benefit), take over the lead lecturing role for the next few sessions, thereby begetting the era of Cycle 4.

The tabular resume of Cycle 3 is presented below:

ACT (Implement) - **AL**

PREPARATION

Positive environment
- Encouragement of discussion
- Use of humor

Frank-Boyd star applied to the class
Creation of Adam metaphor

Beacon Statement, tied to session topic

PRESENTATION

Presentation of AL framework

Real world observations

Extended learning conversation with Mitchell

Learning conversation with Stan

PRACTICE

Discussion of homework

Identifying systems

Relating to behavior over time graphs

Creating a causal diagram (guided example)

PERFORMANCE

Assigned reading
Reminder of project
Brief walkthrough of a project example

LOOK - **Preliminary Observations**

Catherine

Didn't do homework seriously
Questioned how to model different purposes
Offered answers in guided example
Challenged exercise answers correctly
(distinguished finer details than given answer)

Jason

Didn't do homework seriously

Identified a non-system in class exercise
Related concepts to another course when asked

Stan

Modeled (& explained) his job as a system
Related my metaphor to earlier course content

Offered answers in guided example

Brought different scenarios to concept presented

Related causal loop exercise to world affairs

Mitchell

Modeled (& explained) his job as a system

Posited aspects of my job after discussing it
Questioned system boundaries
Offered personal example of a BOT event
Offered guesses in guided causal loop example

Tables 11 & 12 – Implementation & Look Phases for Cycle 3

THINK - CT Assessments

Catherine

Evaluation

Assessing Claims (causal loop answer)

Inference

Querying evidence (causal loop answer)

Conjectuiring alternatives (causal loop answer)

Jason

Interpretation

Decoding significance (identifying a non-system)

Categorization (tying content to Piaget)

Stan

Interpretation

Clariying meaning (explaining his system)

Categorization (identifying inputs and outputs)

Inference

Conjecturing Alternatives (raising what-if scenarios)

Drawing conclusions (causal loops in world affairs)

Self-Regulation

Self-correction (Reassessed his homework after feedback)

Mitchell

Interpretation

Clariying meaning (explaining his system)

Categorization (identifying inputs and outputs)

Inference

Conjecturing Alternatives (to viewing his system)

Drawing conclusions (drifting to sleep as BOT)

Self-Regulation

Self-correction (Reassessed his homework after feedback)

Table 13: Think Phase for Cycle 3

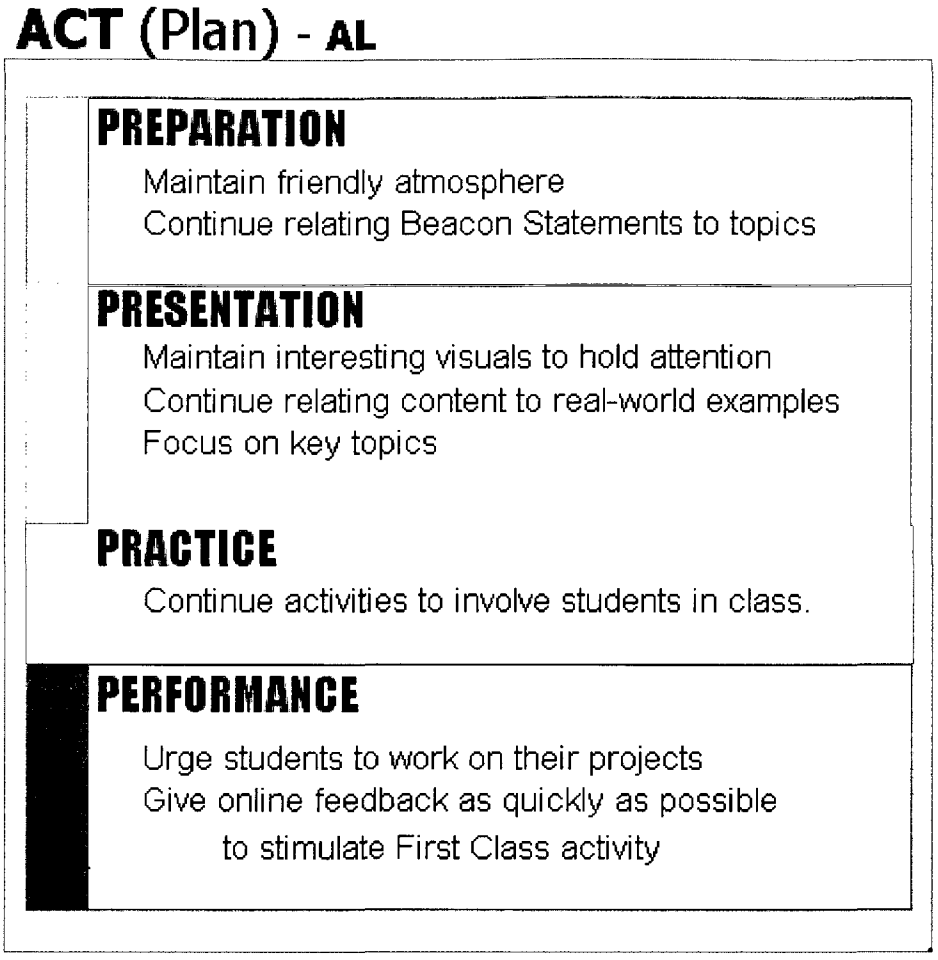


Table 14: Plan Phase for Cycle 3

Cycle 4: Sessions 4, 5, and 6 (first half)

In all the sessions of Cycle 4, I was tasked with creating the slides from the course and leading the lectures. This took nothing away from Dr. Boyd, who would still greatly contribute as a commentator. Naturally, this would also be the cycle in which I would submerge the sessions into the AL framework to the best of my abilities. Additionally, this was also the time where the students would finally begin to work on their projects in First Class.

Session 4: I began the fourth session relating the Beacon Statement to that week's topic, emergence. Like all cybernetic topics, it was a concept whose omnipresence made it easy to relate examples to. Encouraged by the results of the practice interventions, I showed the class a video of U.S. president Barack Obama's inauguration, which took place only hours before, and asked them to identify the different ways Obama "appeared presidential". The simple and curious exercise elicited answers (his voice, clothes, body language, etc) from everyone.

From the exercise I concluded that Obama looked presidential "on many levels". I continued by using mathematics to demonstrate how increasingly sophisticated levels can emerge from simpler ones. Next I presented the topic as levels in a pyramid, comparing it to Bloom's taxonomy and Maslow's hierarchy of needs for further scaffolding. Finally, I walked the class through each level of emergence, for which I included an example and an explanation of how one leads to the next. Furthermore, many of the examples actually repeated content from previous sessions, which helped students review older material in a new light.

To date, this lecture had been the one with the most visuals, the most connections with real world examples, and the most references to other material both inside and outside the course. Consequently, it became the most inviting slide show for participants to comment on, which they all did. I considered it a resounding success, and ended with many thanks from the students and congratulations from Dr. Boyd.

Session 5: Unfortunately, the success of Session 4 would contrast starkly with the results of Session 5. Between the two, I was beset by personal setbacks that took much of the time I would have otherwise used to prepare materials for the course.

Consequently, Dr. Boyd would make do by lecturing with slide shows from previous years. Naturally, he was adept at teaching it, but in using old slides, problems with the flow of the class that I had helped to eliminate resurfaced. For instance, Dr. Boyd had to pause and judge each slide before discussing it, choosing to skip one every now and then, and internet links he clicked on would not work.

On my end, it seemed that my personal distractions hindered my effectiveness in class. An effort of mine to elaborate on a concept of Dr. Boyd's backfired; in my anxiousness to explain, I came off hurried and verbose, and wasn't responded to. Even worse, when it came time for me to present the few slides I had managed to prepare, I confused matters by leading them through an erroneous example. While Dr. Boyd presented a knowledgeable lecture as always, I found that my personal lack of preparation for it led to the many mishaps and to poor student participation.

Session 6: Disappointed in myself for Session 5, I vowed redemption the following week. In addition to researching the topic, game theory, extensively, I took additional measures and arrived to class well in advance to connect Dr. Boyd's laptop, write notes on the whiteboard, and apply electrical tape to it to create reusable tables for exercises.

I kicked off the session relating my established Beacon Statement (Appendix B) to game theory and went to the whiteboard to showcase a corrected version of the table I had erred on the previous week. While doing so, I described how the table was a cybernetic depiction of a game, with each axis of it representing a player. The inherent appeal of discussing games quickly became apparent, as Catherine, who was apparently

pretty competitive, was arguing whether Player 1 had truly obtained the best scenario in the solution given that Player 2 had scored more. This reinforced my lifelong belief that learning could be a most captivating activity if only the subject matter was presented in such a way that it would be, quite simply, fun.

I made note of Catherine's amusing competitiveness, but first, I had other students to involve. After working an example on how to obtain Nash's equilibrium (Appendix D), I called upon Jason to come up to the whiteboard and solve the next table. He seemed a little hesitant, but I assured him that I would help him through it. With just a bit of coaching, he became comfortable with the procedure and found the right answer.

Mindful of AL as ever, I did not let the exercises carry on for too long without contextualizing them in a meaningful manner. I thus related Nash's equilibrium to a World Cup match I once saw, where both teams played poorly on purpose to ensure a tie, being content with one point apiece. Dr. Boyd found it to be a very good example

Continuing to combine presentation with practice, I showed another table on the screen that represented a fighting match (with a picture from the UFC behind it), and emphasized how the numeric values in the grid represented the degree to which a player would incur a gain or loss. In the next slide, I recounted a story I found on YouTube about how a student used Nash's Equilibrium to earn a $300 an hour raise. I then related Nash to "the game of dating", with the two players being a couple negotiating what movie they would watch. I called Catherine up to solve the grid. More coaching would ensue, but to my delight it was from Mitchell and Jason, who enticed Catherine into a conversation with them on the procedures. The exercise ended with Dr. Boyd pointing

out how Nash Equilibrium was mathematical proof of the importance in turn-taking when couples select movies.

The subject then turned to the game of Prisoner's Dilemma, at which time I summoned Mitchell to the whiteboard. He rapidly demonstrated the importance of the practice phase, for at first, he wasn't as adept in performing table exercises as he had appeared to be when coaching Catherine. Soon however, he too would figure things out, emitting little exclamations of triumph along the way.

With Prisoner's Dilemma being a famous game in academic circles, it was only natural to take advantage of its importance and practice it. I had Mitchell and Catherine do just that, using four playing cards from a deck that featured characters from the Simpsons. Mitchell and Catherine each received one "Marge card" for when they wanted to cooperate, and one "Alien card" for when they chose to betray, as per the options of the game. I served as an impromptu game show host and led them through five rounds of Iterated Prisoner's Dilemma. The engagement in the class visibly hit a peak; as Catherine and Mitchell were engrossed in a "battle", Jason grew amused: "Oh, there's trust between those two!"

Equally as gratifying was the fact that Catherine and Mitchell were demonstrating the very point of Prisoner's Dilemma that I brought up minutes before, about how selfishness weakens a system. I reinforced the point with a real-world example and reused a slide from the Systems Theory session to couple the concepts together. I would couple them once more by leading the class through an "investment game" which illustrated, albeit in a simplified manner, how a lack of faith leads people to play poor games that cause negative causal loops within the economy. This time, I had implicated

Stan with whiteboard duties. Not surprisingly, he was inspired to add his own observations on world affairs. After the letdown of Session 5, I felt very much redeemed, as Session 6 had been the most engaging class to date, to the point where Stan and Jason were still discussing the content during the break.

As had been fervently wished by Dr. Boyd and me, project activity finally began during this period. As previously mentioned, the goal of the project was to have students apply cybernetic concepts to an experience of theirs. The first set of questions, officially known as Phase 1, was thus very accessible, barely requiring any knowledge of cybernetics at all: students were to simply choose a system-like life experience of theirs they were going to model, give it a name, describe the roles of the people involved in it, associate it with a metaphor, recount some of its history, explain its goals, and make a drawing of it. In essence, Dr. Boyd was scaffolding the students in getting them to discuss very familiar experiences at first:

1.1 Choose a real life "source-system" situation. Why did you choose it?

(Stan)
I chose the school board as my 'source-system' situation. I have 'lived' in this environment for 33 years. We were asked to pick something we have experience in. I hope to be able to do a cybersystems analysis of school as an aquarium. The aquarium metaphor works as school contains its members and separates them from the outside. The walls contain, sustain and protect the members inside. It is a self contained world that allows everyone inside to grow. At the same time the environment can become unstable, 'polluted', and hazardous if the 'right' balance is not maintained. What ingredients are needed to sustain and maintain a healthy aquarium so the inhabitants not only survive but thrive and grow? I see school as a thriving ecosystem. I do not see school as a factory or machine.

Aside from familiarity, another trait was already beginning to emerge from student work: inspiration. As with the preparation phase, the stories the students chose had

motivational elements to them, as seen in excerpts of Catherine's and Mitchell's works below.

1.2 Give your focal system a nickname

(Catherine)
Harmony Central (HC)
I have chosen this name because staffs within this organization have chosen their profession(s) and dedicated their lives to International cooperation. Everyone is committed, motivated, and passionate about working towards building a fairer planet together. It's the one common goal that everyone at the organization shares. Cheesy but true.

(Mitchell)
The program had a very positive effect on the students. They took great pride of accomplishment in the native skills they acquired. On one occasion the principal of the school and I went to the camp to see the program in its implementation. We sat in the teepee constructed by the students and ate a traditional lunch of rabbit stew and bannock prepared as well by the students. It was the first time I had seen some of the students actually smile and behave in a confident and relaxed manner. I was able to contrast their comportment with how I had experienced them in the school setting in the village and the changes were notable.

I imagined, after recalling my own project as well, that this motivation would be an asset to fuelling the critical thinking that Dr. Boyd's questions would require. However, there were also other elements in the project that would incite critical thinking: Dr. Boyd himself, and me. We would both have liberties to challenge the students' project entries to ensure they were satisfactory, as illustrated below:

(George challenging Catherine)
I'm just wondering, for the sake of upcoming system analysis, if you can "lump" some of them into one category if what they do are two aspects of basically the same thing. It would simplify analysis later on. I had plenty of characters in my system too, but they were doing the same basic things. Anyway, for now keep the whole gang, but you may want to fine-tune the granularity of these guys to simplify your system. But if you feel you must keep them as is, no problem either, you know best, and it's your model to play with.

(Catherine)
I suppose you could group all of the executives together, but because I have a sense of where the root of some of the issues arose, I feel as though they might intend to do similar things, but they act differently because they pursue different goals that aren't necessarily compatible nor are they visible at times. Most of the characters do in fact have very minimal roles, so I suppose I could eliminate some of them rather than grouping them together. It's hard for me to tell when I haven't come to the analysis portion. I feel I would rather wait and see what it all involves as you suggest.

Aside from what I personally considered a setback in Session 5, I was pleased with both my ability to implement AL in the classroom and the results it produced. I perceived that the curiosity arousal brought forth by the video and the Nash games elevated the potency of the preparation phase beyond what the standard "This is good for you" messages of the Beacon Statement did alone. In my own style, I carried on Dr. Boyd's custom of continuously interweaving course content with real-world examples in the presentations. Having experienced the impact of the practice phase (or lack thereof), the cycle culminated in my determination to lift the students out of their chairs, both figuratively and literally. True to the literature, this finally produced visible and sustained evidence of their thinking in action, something they also finally began to demonstrate in the performance phase, as the projects began in First Class

Under these circumstances, it would be logical to assume that I would carry on with such instructional designs. However, the course had reached its next era: the student lectures. I had no issues with this, given their reported popularity in the past, and the fact that it would potentially elevate students' involvement in the course to the next level.

The tabular resume of Cycle 4 is presented below:

ACT (Implement) - AL

PREPARATION

Positive environment
- Encouragement of discussion
- Use of humor

Beacon Statement tied to each topic

Leveraging of game appeal
- Friendly competition

PRESENTATION

Providing real-world examples
- Emergence in math (Session 4)
- Examples of the 10 emergent levels (S4)
- Demonstration of automata (Session 5)
- Nash Equilibrium - World Cup (Session 6)

Relating other courses
- Taxonomy comparison (Session 4)

Providing guided examples
- Nash Equilibrium (Session 6)

Relating previous sessions

Demonstrations of content in applications

PRACTICE

Observing levels (Obama, Session 4)
Coaching students through Nash (Session 6)
Calling on all students
Coaching students along their learning curve
Creating learning games

PERFORMANCE

Mapping a personal experience onto a system

LOOK - Preliminary Observations

Catherine
- Assessed Obama video (Session 4)
- Argued best scenario of a game (Session 6)
- Worked out Nash on the whiteboard (Session 6)
- Played Iterated Prisoner's Dilemma (Session 6)
- Described her system (5 questions, First Class)

Jason
- Assessed Obama video (Session 4)
- Worked out Nash on the whiteboard (Session 6)
- Coached classmate on Nash (Session 6)
- Explained his choice in the Investment Game (S6)

Stan
- Assessed Obama video (Session 4)
- Worked out Nash on the whiteboard (Session 6)
- Related Investment Game to current politics (S6)
- Explained his system nickname (First Class)
- Described his system (3 questions, First Class)

Mitchell
- Assessed Obama video (Session 4)
- Worked out Nash on the whiteboard (Session 6)
- Coached classmate on Nash (Session 6)
- Played Iterated Prisoner's Dilemma (Session 6)
- Described his system (4 questions, First Class)

Tables 15 & 16 – Implementation & Look Phases for Cycle 4

THINK - CT Assessments

Catherine

Interpretation
- Categorization (project)
- Decoding significance (Obama, project)
- Clarifying meaning (project)

Evaluation
- Assessing claims (arguing best scenario)

Explanation
- Justifying procedures (performing Nash)
- Presenting arguments (project)

Inference
- Drawing conclusions (Prisoner's Dilemma, Investment Game)

Jason

Interpretation
- Decoding significance (Obama)
- Clarifying meaning (coaching Nash)

Explanation
- Justifying procedures (performing Nash)
- Presenting arguments (coaching Nash)

Inference
- Drawing conclusions (Investment Game)

Self-regulation
- Self correction (performing Nash)

Stan

Interpretation
- Categorization (project)
- Decoding significance (Obama)
- Clarifying meaning (project)

Explanation
- Justifying procedures (performing Nash)

Inference
- Drawing conclusions (Investment Game to world affairs)

Mitchell

Interpretation
- Categorization (project)
- Decoding significance (Obama, project)
- Clarifying meaning (project)

Explanation
- Justifying procedures (performing Nash)
- Presenting arguments (coaching Nash)

Inference
- Drawing conclusions (Prisoner's Dilemma)
- (Prisoner's Dilemma, Investment Game)

Self-regulation
- Self correction (performing Nash)

Table 17: Think Phase for Cycle 4

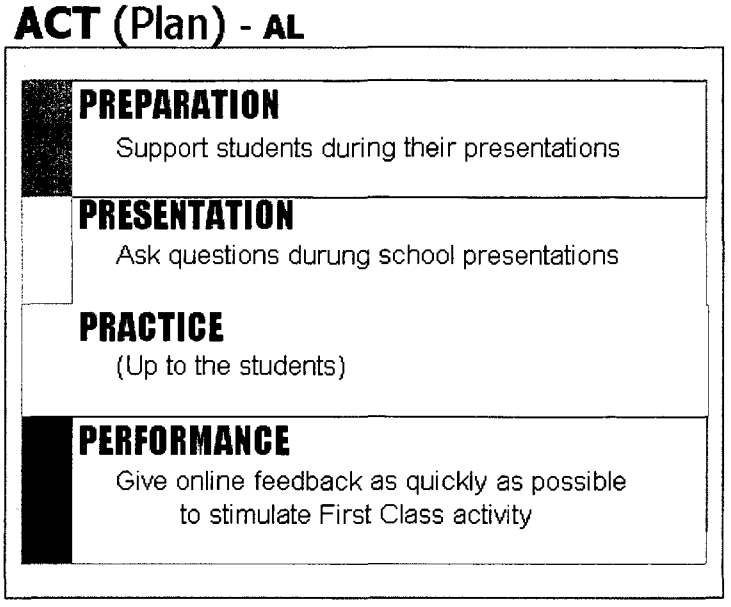


Table 18: Plan Phase for Cycle 4

Cycle 5: Sessions 6 (second half), 7, 8 and 9

During Cycle 5, the students were given the keys to drive the course in whichever direction they saw fit. That being said, I was still hoping that they would emulate my lectures and adopt AL at least to some extent.

Session 6: Mitchell

The first student to present, fittingly, was Mitchell, who despite possessing the least experience in the program, had consistently shown the most initiative. As a beginner, sophistication was not his forte: his slides were essentially plain black text on a white background. His enthusiasm however, was there as always ("This is kind of neat, it's the first time that my PowerPoint gets shown in class!"), which bode well.

Mitchell was presenting the law of requisite variety (LoRV). He began by a simple definition of variety using algebraic variables, and then advanced the concept by placing variables in a table.

"The set of outcomes Z are possible outcomes, like George's table we were just looking at. It's the same idea."

Plain slides or not, I was quite pleased at his ability to segue from my game theory lecture into his own, and in such a quick manner.

As Mitchell continued, any of his assertions that weren't quite accurate would be corrected by Dr. Boyd on the spot. Mitchell would take this in stride and carry on, scaffolding us to a level that allowed me to contribute comparisons to game theory. When Mitchell reached discussion of the law itself, he showed formulas, different interpretations, and even philosophical views that had caught his eye, all the while remaining honest about the limitations of his understanding. He would conclude

impressively by corresponding LoRV constructs to those of information theory and feedback loops, with Dr. Boyd rounding out the discussion by identifying real-world implications of the topic.

In sum, I found that Mitchell did a good job, and I was pleased to see that he chose to emulate Dr. Boyd and me (ergo, AL) to a certain extent, given carte blanche. Conversely, the one visible deficiency that his lecture had was a lack of the practice phase. Mitchell walked the class through minor examples and provided no explicit means to truly get them involved. Subsequently, their input was reduced to one comment by Stan and one more by Jason, who, after I shut the classroom door to block out some noise in the hallway, exclaimed "We have requisite variety!"

Despite the otherwise fine job by Mitchell, this deficiency gave me an almost instant sense of "designer's remorse". Given the promising outcomes of my last and best lecture to date, I regretted not giving the students a rubric that would guide them to designing more AL-compliant lectures, albeit with allowances to avoid complaints of conformity. Now it was too late; once one student had presented, I couldn't impose rules on the rest of them.

Session 7: Catherine

The following week, it was Catherine who would commandeer a lecture, and the contrast between hers and Mitchell's would be quite palpable. Whereas Mitchell was the newest yet most industrious student, Catherine was the most seasoned, but by her own admission, also prone to procrastination. Alas, that manifested that afternoon, when she confessed to having worked on her lecture only on that very morning.

Thanks to her talents, it nevertheless had notable qualities, such as the attractive visuals that she was adept at creating. More importantly, she too formulated a near-AL framework for her presentation: She began with "Big Ideas", in which real world ramifications were discussed from the beginning (as opposed to the end, which Dr. Boyd tended to do), related those ramifications to the purpose of her content, and conducted a practice session through a section she had entitled "Understanding, Recognizing, and Thinking".

Catherine demonstrated flashes of her abilities by relating fundamental excerpts from an assigned book to her presentation topic of balancing loops. These excerpts, intentionally or not, related quite well to the Beacon Statement I would always start my lectures with, for they pertained specifically to examining and improving performance. She then deftly incorporated material from a second assigned book to segue into the crux of her topic.

Unfortunately, it was there where the effects of Catherine's procrastination took their toll. Her "Understanding, Recognizing, and Thinking" section, ironically, exposed her limitations of these qualities. She gave an example of a balancing loop about food and the world population that Dr. Boyd found too inaccurate. The example was somewhat salvaged however when it became a classroom activity in which we redrew the balancing loop so that it would make more sense. Dr. Boyd further capitalized on the occasion to introduce a system-drawing syntax used in modeling software called Stella, which the class would eventually use. The session ended with Dr. Boyd lecturing on the complimentary topic of reinforcing loops.

Session 8: Jason

In the third week of student lectures, Jason would present the topic of conversation theory. Up to that point, he had been the most enigmatic of the students, not using the capabilities I knew he had. Fortunately, he was contributing a little more in recent classes, so I considered his lecture as a potential turning point.

Following an overview, Jason spoke of the topic's contributors, one of which was Dr. Boyd himself. Like Mitchell, he sought to explain his topic by gradually building upon a simple notion, conversation itself. However, his lecture soon became disjointed, veering into a contributor's quote. It was most likely relevant, but having jumped too fast from the scaffolding, it was unclear as to how. To his credit, Jason tried to tie conversation theory with another course (like he first mentioned in his questionnaire), but it came off as incomplete: "Most theories we learn about deal with constructivism, however there seems to be a hint of behaviourism there. I'll let you guys try to figure that on your own terms."

In his defence, I knew that conversation theory was a particularly challenging topic, for it was the very same one I had lectured on the previous year. That being said, I knew that better scaffolding was possible. Jason however was now presenting random bullet points, mildly elaborating on each, but not clarifying how they were related. With all due respect, it seemed he didn't know himself. In one slide, he enumerated "three elements of a disciplined dialogue" and included a picture of a triangle. He had intended to demonstrate the interrelations on the triangle, but left it bare because he couldn't "quite figure out how to shape it yet".

Fortunately, Jason's lecture improved when he reached the definitions of fundamental conversation theory concepts. He displayed a basic understanding and offered very relatable examples, some of which I used the year before. His lecture was further ameliorated when he reached a slide with a sequence of diagrams that he could focus his thoughts on. It was there where he became most lucid, carrying out a respectable learning conversation with Dr. Boyd.

Jason presented an activity to conclude his lecture in which he had wanted to create a learning map for ski instruction using the notions he presented. But rather than this happening, a discussion ensued about how the acquisition of psycho-motor skills (like skiing) constituted learning conversations as well. Lastly, Dr. Boyd further clarified some of the definitions, allowing Jason to relate his experience as a snow board instructor to them. All in all, I recognized Jason's efforts and intentions, and appreciated how he too attempted to deliver an AL-like lesson. But it seemed to me that his lack of overt participation in previous sessions was directly proportional to the lack of depth he exhibited when teaching conversation theory on his own.

Session 9: Stan

In the last of the student lectures, Stan would lecture on viable systems models (VSM). As with everyone else, he had certain tendencies that struck me; in his case, it was his affinity for drawing tangents between course content and world affairs. As often mentioned, Dr. Boyd had that habit as well, which was perhaps why Stan, despite his 33 years in teaching, would often content himself with sitting quietly and listening to him. With the familiar role of teacher thrust upon him though, Stan had switched dispositions for his lecture, much for the better.

He began in an unexpected but welcomed manner: Instead of simply talking about the founder of VSMs, Stafford Beer, he played a sound clip of him giving a speech at a 40-year anniversary cybernetic gala. The clip was quite enjoyable, for Beer was obviously brimming with passion, effortlessly mingling personal anecdotes with epistemological beliefs. After the clip, Stan pointed out that Beer was not only renowned in academia, but in industry as well. From an accelerated learning standpoint, it was no wonder that a man as enamoured with his vocation as Beer made such significant contributions to it.

This aural introduction segued very well into Stan's slide show, which deepened our virtual acquaintance with Beer. It started with the sharing of some of his fundamental philosophies, and then explored the man's inspiration, the human body. Using diagrams, a most interesting and revealing comparison was made between the two. Then, quite logically, Stan walked through and discussed the sub-components that Beer had distinguished in his model. At most components, Dr. Boyd would ask for Stan's opinions of Beer's reasoning. Stan answered with much competence and poise, which drew Catherine into questioning him as well. He concluded by conducting an activity where we identified the VSM for our class (and the infrastructure around it). It was my impression that the clarity of his presentation made everyone feel confident and competent enough to participate. Given his background, I wasn't surprised to find Stan's session the most professionally carried out, both in terms of his materials (which he handed out) and his delivery.

On the whole, I found the students did a very respectable job with their lectures. Even without a rubric, they incorporated enough elements of AL to consider it

significantly present in the sessions. That being said, it remains to be seen how the performance phase was faring, with the online project.

By the end of the fifth cycle, Catherine and Mitchell had advanced to Phase 2 of Dr. Boyd's questions. Stan, unfortunately, had not advanced at all, while Jason submitted the first three questions of Phase 1. In Phase 2, the level of difficulty of the questions would increase slightly, becoming more technical in nature. This increase kept Dr. Boyd and I busy with comments that would further challenge students on their entries. Still, I did my best to make my comments very understandable, as shown in my comment to Mitchell below:

Consistency brings me to my next point. I read interesting details about an outdoorsman and students and foster parents and native land, but I don't see them in your diagram. The funny thing about a focal system is that there is no right or wrong one; it's ultimately what you say it is, and the rest of us go along with it. But I look at it as a movie. What I've read about thus far made a movie in my head about the characters I mentioned. What you're describing to me in the diagram is a movie about a school board. Does your movie show 90 minutes of native kids out in the land with the outdoorsman, the foster parents, and so on, or is it 90 minutes of what is going on in the school board?

This challenge of remaining consistent between the project's written description and its corresponding diagram also pertained to Catherine's project. In the following instance however she became aware of her inconsistencies on her own:

I have realized that I have abandoned HC as my focal system! Maybe it's all this report writing, but I am going with the project now, and not HC as my focal system.

Other times, I commented not to necessarily challenge a student, but to wonder aloud about aspects of the story because I was so drawn into it.

(Mitchell)
The students bought wholeheartedly into the first two goals of the program, namely getting out of their family situation and out on the land and learning the traditional knowledge. The academics were a different story, however. Their involvement with the academic program ranged from reluctance to outright refusal to be involved with anything academic.

(George)
I think you nailed the section on the goals. I would just add that they were indeed official goals set out by the school board. It was interesting to see how that third, academic goal was a hard sell. Perhaps bringing in an educated native that became a success because of academics would have helped, just to help even the motivational odds. Ideally the "educated native" would have been the teacher instead of the outdoorsman, but taking into account the budget, perhaps, at the least, that person would come in as a guest speaker.

(Mitchell)
It would have been ideal to have a native teacher as the outdoorsman to act as an example of academic success, and perhaps motivate the students, but interestingly, not many natives seem to be interested in teaching. In our high school, for example, there were no native academic teachers. The only natives on the high school teaching staff were the traditional culture and language teachers. In the elementary there was a smattering of native teachers in grades four to six. Grades K to 3, by contrast, were only native teachers as the language of instruction was in the native tongue.

By the end of the cycle, Catherine and Mitchell were able to answer mildly technical questions in layman's terms.

2.3 What are the main beneficial outputs of your focal system?
When did they occur?
Where do they go?

(Catherine)
Increased sense of community: this can be displayed externally within local communities in West Africa and Canada thus improving the image, confidence in, and trust in of all orgs involved (especially important for those orgs providing services to community members). For example, when I visited Senegal, I had already developed close relationships with the women who worked at the org through videoconferences, and so they were thrilled to receive me, and wanted to show me all of the great work they are doing during my visit. They took me to meet the women of a mini-savonnerie (mini soap factory) that they developed, and in so doing, it reinforced the connection between their org and HC to an external audience.

As can be seen, project answers regularly exhibited a richness that made it possible for cybernetic concepts to be easily appended to. In effect, this was the same strategy of leveraging the familiar that was being used to engage students in class. The satisfaction of this progression however was dampened by a major concern: the projects were running behind schedule, and were unlikely to progress for an additional week due to the upcoming mid-term. The bad news was this left only three weeks in the schedule. The good news was that with the student lectures completed, Dr. Boyd would allow me

to regain control of the sessions. Having been most satisfied with my most interactive lecture (game theory), I had designs on duplicating its recipe… and even spicing it up if possible.

The tabular resume of Cycle 5 is shown below:

ACT (Implement) - **AL**

PREPARATION

Demonstration of enthusiasm (Mitchell, Session 6)
Openness and humility (Mitchell, Session 6)
Presentation of purpose (Catherine, Session 7)
Curiosity-arousing audio (Stan, Session 9)

PRESENTATION

Scaffolding

Law of Requisite Variety (Mitchell, Session 6)
Conversation Theory (Jason, Session 8)

Tying different content together

Law of Requisite Variety (Mitchell, Session 6)
Balancing Loops (Catherine, Session 7)
Conversation Theory (Jason, Session 8)

Real-world examples / implications / metaphors

Law of Requisite Variety (Mitchell & Dr. Boyd, Session 6)
Balancing loops (Catherine, Session 7)
Conversation Theory (Jason, Session 8)
VSMs (Stan, Session 9)

Interesting visuals

Balancing loops (Catherine, Session 7)
VSMs (Stan, Session 9)

PRACTICE

Balancing loop exercise (Catherine, Session 7)
Conversation Theory exercise (Jason, Session 8)
VSM exercise (Stan, Session 9)

PERFORMANCE

Handouts (Stan, Session 9)
Project progression (Mitchell, Catherine, & Jason, First Class)

Table 19: Implementation Phase for Cycle 5

LOOK - Preliminary Observations

Catherine

Tied different academic content together (Session 7)
Provided examples (Session 7)
Asked many questions in Stan's lecture (Session 9)
Described her system (First Class, 5 questions)

Jason

Tied different academic content together (Session 8)
Provided examples (Session 8)
Described his system (First Class, 3 questions)

Stan

Provided an elaborate metaphor (Session 9)
Answered questions confidently (Session 9)

Mitchell

Scaffolded and contextualized his lecture well (Session 6)
Tied different academic content together (Session 6)
Provided examples (Session 6)
Described his system (First Class, 13 questions with revisions)

Table 20: Look Phase for Cycle 5

THINK - CT Assessments

Catherine

Interpretation
- Categorization (providing examples, Session 7, project)
- Decoding significance (project)
- Clarifying meaning (project)

Analysis
- Examining ideas (tying content together, Session 7)

Evaluation
- Assessing claims (question Stan, Session 9)

Inference
- Drawing conclusions (Balancing loop exercise, Session 7)

Explanation
- Presenting arguments (project)

Jason

Interpretation
- Categorization (providing examples, Session 8, project)
- Decoding significance (project)
- Clarifying meaning (project)

Analysis
- Examining ideas (tying content together, Session 8)

Inference
- Drawing conclusions (Conversation theory exercise, Session 8)

Stan

Interpretation
- Categorization (providing examples, Session 9)

Inference
- Drawing conclusions (VSM exercise, Session 9)

Explanation
- Presenting arguments (Answering to Catherine & Dr. Boyd)

Mitchell

Interpretation
- Categorization (providing examples, Session 6, project)
- Decoding significance (project)
- Clarifying meaning (project)

Analysis
- Examining ideas (tying content together, Session 6)

Explanation
- Presenting arguments (project)

Self-Regulation
- Self-correction (revising his project entries)

Table 21: Think Phase for Cycle 5

ACT (Plan) - AL

PREPARATION

Maintain positive environment, but make students more accountable

Find practical ways of bringing value (not just preaching)

Maintain curiosity arousal and novelty

PRESENTATION

Revisit content to reinforce and deepen knowledge

Maintain visuals, meaningfulness and relatability

PRACTICE

Give mid-term

Maximize student involvement, particularly on the project)

PERFORMANCE

Push for completion of project (!)

Table 22: Plan Phase for Cycle 5

Cycle 6: Sessions 10 through 14

The last cycle of the study is characterized primarily by numerous interventions designed to increase the involvement of all students. It started with the mid-term, which had been a staple of the course for years. Beyond it however, Dr. Boyd gave me the liberty of doing with the remaining sessions as I wished.

Session 10 – Mid-term: At first, I wondered whether I should attend this session, given that I wouldn't really have anything to do. But then, I remembered preaching to the students, while showing them *The Creation of Adam*, the need to commit to the course to get the most out of it. I therefore wanted to pass the message that I was doing everything I could to commit from my end as well, even if, in that instance, all I could offer was moral support.

If nothing else, the value I had received from the session was observing their body language, which hinted at their dispositions and performances. Thankfully, everyone looked calmly engaged (as opposed to stressed or upset). Even better, both Mitchell and Stan seemed upbeat and playful, smiling and waving at me as I looked on. Time constraints were not a factor, as everyone handed in the mid-term at their leisure.

With Dr. Boyd's permission, I made photocopies of the test to assess the students' absorption of the course so far, particularly with respect to critical thinking abilities. The first section of the two-section mid-term will not be explored, for it was a simple association exercise that required no explanations. The second (and final) section of the midterm featured a question asking students to explain which topic, aside from their own, they had found most interesting.

The first mid-term I looked at was Mitchell's, who had provided a five-page account of games theory. After enumerating themes and contributors, he posited the potential value of game theory in a training project as a means of assessing design options, and provided an example. Perhaps inspired by Dr. Boyd, Mitchell extended the topic into its philosophical implications, explaining how certain game-playing strategies can be proven to be beneficial to all players. Impressively, he related philosophy with math by comparing a payoff table of Prisoner's Dilemma with an alternate strategy, Minimax, and neatly summed up the scenarios in which a given game theory strategy would be most ideal. Mitchell then related the Tit-for-tat strategy to a biological phenomenon that he read about, and finished by observing that the three strategies he reported on formed a complete picture of the ways people can interact, thereby enabling someone to design a project or instruction. His efforts received full marks and an "Excellent" comment from Dr. Boyd.

Stan's topic of choice was emergence. Oddly, Stan based his answer not on my lecture, but on John Holland's book *Emergence* which he had read on Dr. Boyd's recommendation. He stated his interest in the evolution of simple repeated patterns into complex systems, and hypothesized that accelerated computer simulations could be leveraged as valuable course components in a variety of subjects in school. Stan, in essence, paved his own route in this question by using material he sought out independently from the course. While I was glad he exhibit critical thinking on the topic, I was perplexed that in so doing, he disregarded my lecture, and therefore the critical concepts that I had presented in it. For his efforts, Dr. Boyd gave Stan an 8 on 10.

I read Catherine's mid-term next. She had chosen the law of requisite variety as her topic, and like the others, had submitted five pages. She began her answer in Beacon Statement fashion, hailing the topic as a tool that enables cyberneticists to identify the various outcomes in a system in order "to implement controls to achieve positive systemic results". Like Mitchell, she had related the topic to an article she had read, and had evaluated the LoRV "as an important stepping stone that enables cyberneticists to play out different scenarios in a straightforward manner".

Catherine continued her discussion through the relation the LoRV had with the topic of Information Theory, and the application of LoRV in her own job, where she served as a facilitator in an international collaboration. She astutely identified inter-cultural differences as potential disturbances that must be taken into account and controlled for a desirable outcome to occur. She balanced her perspective by identifying limitations of the law and scenarios where additional, more subtle factors would have to be considered. In conjunction with other cybernetic tools, she asserted an ability to formalize these cybernetic notions into a system that she could apply to her workplace. As with Mitchell, Catherine received full marks and an "Excellent" from Dr. Boyd.

Jason's answer was two and half pages in length and a little peculiar, in that what I seemed to be reading was a transcript of his stream of consciousness. Instead of picking a topic, he picked two, game theory and LoRV, and began to switch subjects whenever he didn't know how to continue with the other. Thankfully, as he did with his presentation, he eventually resorted to leveraging his experience as a snowboard instructor to present his ideas more coherently. To his credit, he had the excellent idea of visualizing the concept exactly how Mitchell had shown in his lecture, with a grid that pitted

snowboarding disturbances on one side (such as cold, wind, and fatigue) against instructional controls (terrain selection, corrections, and examples) on the other. Unfortunately, he apparently got discouraged and abandoned it: "This isn't playing out quite the way I thought it would." he wrote, to which Dr. Boyd wrote back "Well keep going – it is a start in a good direction". Instead, Jason concluded by writing about his snowboard instruction, which would be fine if not for the fact that he had abandoned relating any of it to cybernetics. He received a 5 on 10.

Session 11: Stella Lab

With time running out in the semester, I quickly commandeered Dr. Boyd's laptop to present my latest brainchild.

"What are *you* up to?" asked Dr. Boyd in a very cognizant tone of voice.

"I thought I'd introduce a motivational tool inspired from my work. It's a project status report. At work, I frequently build files that visualize where each contributor of a project is at. I thought I'd do the same here, but with a touch more fun. I was thinking of this journey to the end of the project reminded me… of a game of Donkey Kong!"

With that I displayed an image of the classic video game's environment.

"Note how the game has five levels, similar to the five phases of questions in the project. With that in mind, allow me to demonstrate where everyone is at, using the Donkey Kong metaphor."

This alone brought laughs of anticipation.

"First and foremost, at the top of the game we don't have Donkey Kong himself, but we have Gary, waiting for your projects with baited breath and open arms. Look at how welcoming and how anxious he is to receive them!"

One by one, using PowerPoint, I added likenesses of each of the students to indicate their relative progress to in their projects.

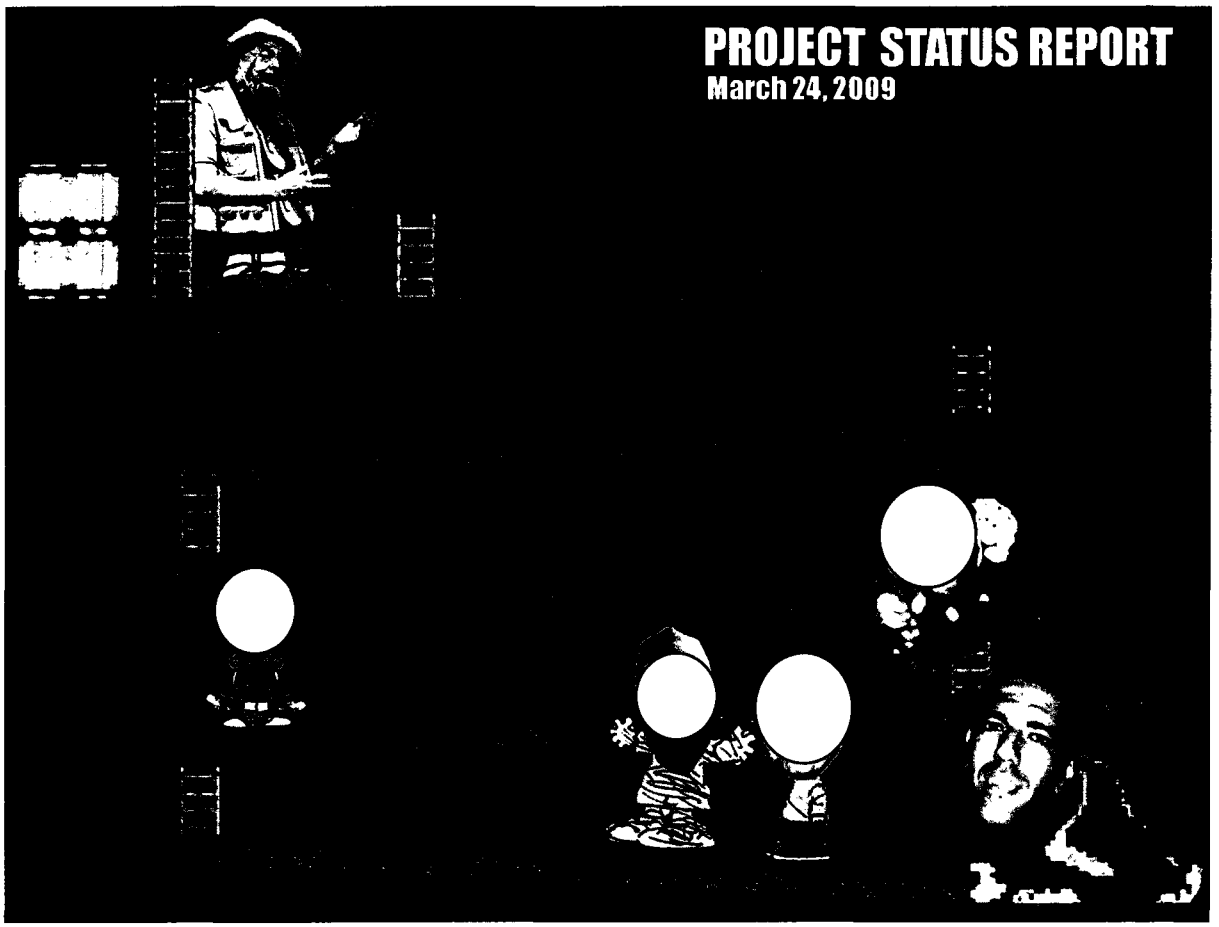


Figure 5: Donkey Kong Status Report

"In eleven weeks, you have managed to come this far. The fact of the matter is, ladies and gentlemen, is that you have three more weeks to ascend the remaining levels. Part of my role is to be a motivator, and push everyone to move their butts up to the fifth level where they can hand their projects to Gary."

I told them I would have this diagram available on First Class, and moved on to announce to them that a consultation class would be taking place the following week. Dr. Boyd asked them to prepare a diagram of their system interacting with its surrounding environment. Mitchell took the opportunity to express the difficulties he experienced in depicting his system at that level, which led Dr. Boyd to consult with him on the spot, asking him real-world questions and using his answers to point out the cybernetic concepts present within.

Once done, Dr. Boyd proceeded with one of the interventions we had agreed upon in our last debriefing. Given the success of the practice phase thus far, we figured they would benefit greatly from practicing with Stella, a software application for cybernetic modelling. He began by showing online simulations featured on the company's website. The first simulation demonstrated the effects of shrimping (on a shrimp population) over time. This intrigued Mitchell enough to ask questions on the components being used in the diagram, which allowed Dr. Boyd to revisit the "tap notation" that he introduced during Catherine's lecture. He also played with the values of the variables in the simulation, producing amusing results, and took the opportunity to enlighten the class on the fact that such simulations were once actually used by the Mexican government to study the trends of its own population.

Dr. Boyd would repeat this exercise with another scenario before sending the class to the computer lab, but not before asking them to explore whether there were ways that their focal system could make use of such a simulation. To my surprise, they were very taken by this proposition. Mitchell, Catherine and Stan (Jason was absent that session) sat together, coached each other, and read through the tutorials. More

impressive still, they had all begun using Stella to produce system diagrams in their projects.

Session 12: Consultation Class

Session 12 was completely invested in having students advance their projects. Believing that connecting the project questions to the course lectures would facilitate progress, I prepared a PowerPoint medley of slides from previous sessions, and added excerpts from my work the previous year. Given that they were only four, each student would receive half an hour's worth of consulting, wherein they would discuss their project informally while everyone else could comment or ask questions.

Before this began, I started the course with a follow-up on the Donkey Kong slides. In order to visually demonstrate student progress, I dragged each student's avatar up the game levels, as if moving pieces in a board game. It seemed like my playful way of delivering accountability possibly paid off, for Mitchell, Catherine, and Stan had all advanced significantly in their projects from the week before.

As we began examining diagrams of systems, I put up a slide consisting of concentric circles (Appendix C), which the students were now seeing for the third time. "You are here, I said. What is surrounding you?"

"The tricky thing here, added Dr. Boyd, is that if your own focal system is more complicated, like Catherine's, the suprasystems don't just surround it, they interpenetrate it to some extent."

Mitchell's project was examined first. Dr. Boyd talked his way through it meticulously, toggling between cybernetic syntax and the corresponding details of Mitchell's experiences, asking questions and making corrections along the way:

Mitchell:
"I was trying to show (here) one of the (problems) we had in getting the system going was recruiting people, and that was hurting our system, so that was creating a reinforcing loop, where it would get worse and worse, and while I was having trouble recruiting. Because of policy questions I couldn't answer, I would call the board and ask what's going on. Putting the pressure on them forced them to increase them or make some up, so that then that decreased the amount of difficulty of recruiting staff."

Dr. Boyd:
"So you figure that's a balancing loop up above do you? The reason that you out an 'o' there is that you put difficulty as your thing, and so the policies the policies reduce the difficulty."

Mitchell:
"So as policies go up, difficulty goes down"

Dr. Boyd:
Difficulty goes down, the coordinator is going to put less pressure on the system and isn't going to change the policies much more, so that's going to stabilize. Whereas down below, you got more difficulty, poor morale, more difficulty, and so you got a reinforcing loop."

While discussing payoff tables, I once again displayed the examples I created for the game theory lecture (fighting, dating, and salaries). To my delight, Mitchell stated that he had actually reviewed those slides himself to try to figure out how to make his own. Dr. Boyd conducted another learning conversation with him to correct inaccuracies.

Dr. Boyd:
Why is intrinsic reward the opposite of increased workload?

Mitchell:
I guess what I was trying to say from my point of view there were two things to look at – one there was a new program coming in, and ....

Dr. Boyd:
From a game point of view what choice do you have? It's not set up as a game right now. You don't have the coordinator's choice on one's side and the school board's choice as the other. If you think of it as a game, the school board must have 2 moves. In this case, the school board only has one move and you could have a move take on more workload or refuse for instance, so that's got to be restructured. The game model assumes that there are players, and that the players have choices, and you want to compare what the outcomes would be depending upon which choice they make.

As the conversation continued, it became evident that this sort of immediate, interactive, and incisive inspection ferreted out misconceptions that Mitchell had developed.

Stan was next to present his system. Despite his 33 years of experience in education, he amusingly displayed the disposition of a tentative young student: "If I draw it on the board, are you guys going to help me?"

While Stan was, to no surprise, very capable of describing, both factually and metaphorically, the environment he knew so well, he showed doubt in modelling it correctly.

Stan:
"There's the school board, who gives us the curriculum and policy, then there's parents, the community, they have high expectations. Out here in the suprasystem the ministry oversees the school board. This feeds into this which feeds into this...The problem with this is nothing is clear."

By remaining encouraging, and continuing to skilfully connect cybernetic syntax to Stan's schemata, Dr. Boyd gradually engaged him in a learning conversation as well.

Dr. Boyd:
"You're just getting a rough feel for this, so that's OK. It's a great start, but I would specify new teachers going in and new students going in. Now draw the outside, students who are socialized, students who are educated, and students who are qualified. The students then give back to the community. And then you have another output, students who fail"

Stan:
"The difficulty is maintaining a calm, safe, viable environment, given all the noise. The aquarium gets moved around, the water is shaking, but we need to keep things calm, so we can do this, but they're all connected."

Dr. Boyd:
"OK so one of the main internal variables when you get to Part 3 is the calmness of your school, but from this point of view I would say the main input output variable is pupils in to students out."

Stan:
"And citizens, that's the trick with student reform."

Once his learning inhibitions seceded, Stan was able to talk extensively with Dr. Boyd in a conversation that spanned many more project questions.

As the consultations continued with Catherine, Dr. Boyd's insistence on examining every student's diagram of their system proved to be very well-founded. Even she, the most experienced and the most inquisitive of students, had some adjustments to make.

George:
So, do you feel like you have clarified your system yet?

Catherine:
It makes more sense that they are part of each other but do I have to identify the relationships?

Dr. Boyd:
Maybe identify the main relationships that were life and death. Your focal system was here in Montreal but it involved partners from in West Africa, partners in Canada. The resources came from various places...

Catherine:
Yeah, I'm missing (a resource organization), I forgot about that.

Once her system was clarified, I changed the topic to conversation theory, using slides from my own presentation the previous year. What rapidly became clear was that the digression from Jason's intended class activity on the topic cost others a grasp of even the most basic of concepts. Dr. Boyd and I needed to re-explain to bring them up to speed.

Stan:
What do the 'p' and the 'm' stand for again?

Dr. Boyd
Originally, the m-individual was a machine and the p-individual a program

George:
In this case, there is one (girl), but two m-individuals.

Mitchell:
Why wouldn't there be 2 m-individuals?

GS:
There's only one (girl), there's only one container.

Mitchell:
OK, (the girl) is like a machine with 2 programs

George:

Catherine, your p-individuals, I'm wondering if you can lump them all together, or would you consider them separate?

Catherine:
I would consider them separate because many of them have different goals.

From the outset, Jason's consultation would potentially be more challenging, as he had only reached the third question of the first phase. Dr. Boyd engaged him in a more granular conversation than the others; meticulously covering various details of the latter's snowboard instruction system. Apparently, the simplicity the granularity caused might have made the conversation the most appealing to other students, who embarked in it as well.

Catherine:
"What about the attitude of the snowboard instructors or ski instructors affecting the reputation of the program as an output? I was part of a different ski instructor program, and we had a noticeably different trip than the YMCA. I don't know where it would fit in there."

Dr. Boyd:
"Well, you can look at competition with other classes at some point, games they are playing with each other."

Catherine:
"I just mean a lot of the ski instructors were considered irresponsible, so that whole program has a different reputation."

Jason: In the last 2 years they had busses flipping over... There's something that comes back to the YMCA from you in particular, like a feedback

Stan:
"And that applies to (my project) as well, because as good as the perception is of your class to your school, it's a reinforcing loop. For us it's the same thing."

Ironically, the simple beginnings culminated in the most advanced learning conversation of the session to involve the other students.

George:
"The only things we haven't seen are Stan's Viable System Levels. The primary function would be teaching students how to snowboard. As for regulation and coordination, is that where Jason comes in, or is that the Y?

Jason:
"At this level, if you're looking at the classroom, yeah, there's regulation and coordination, so I have to interact with the y because sometimes I have to move students around. For adapting,

planning and simulation, I don't know where simulation would fit in, but I think the Y does it because we have training days, come to think of it."

Dr. Boyd:
4 and 5 is in the Y...

Stan:
"But I would argue that 4 and 5 would also be in the class. In your class you're a closed loop, depending on the number of students that you have, there's a process to regulate your control, depending on the ability, the cooperation, they're quick learners, you're adapting your planning you're doing your stuff with that particular class, and you could be adjusting your goals with that particular class"

Dr. Boyd:
"In that case, you'd be 3 and probably 4 as far as your class is concerned."

Stan:
"And I would argue even 5, which a Master teacher does whether it's skiing or in the classroom and then the Y would take the same model for each class and receive the whole thing."

Dr. Boyd:
"That's certainly Stafford Beer's model, that you have this self-similarity for any for any of the models in a system."

Jason:
"Yes, the 3, 4, and 5 would be repeated by the YMCA."

By session's end, it appeared that students made significant gains in learning, as witnessed by a brief exchange that was captured on my digital recorder:

Jason:
"There's so much information!"

Stan:
"In my head I know my model relatively well, but in the meantime, some of your stuff is beginning to make sense, you know what I mean?, It's funny."

Session 13: Game Show and Peer Consultations

Session 13 was a tale of two interventions that further pushed the AL envelope. I kicked off the class by announcing that we were playing a game show, to exclamations of interest. To heighten the mood, I had created slides of each student (using Photoshop) in the context of their project. Since Stan, for instance, called his project "Calm Waters", I placed his likeness against the backdrop of an aquarium. They seemed amused with this idea, along with my next revelation that I had also picked, based on what I knew about

them or their project, a theme song for each participant. During player introductions, each student was to get up and walk around to their theme song and make gestures, like professional wrestlers do when walking to the ring, to "get psyched up". With the atmosphere established, I invited everyone to get the show on the road.

"Goodness gracious", muttered Dr. Boyd.

"First up, contestant number one, bringing cultural diversity and a new lease on life to native teens in Quebec, please give a warm hand of applause for Mitchell!"

With his MAXCAC photo in mind, I played Joan Jett's guitar-heavy *I Love Rock 'n Roll.* To my relief, Mitchell obliged and walked around the class pumping his fist.

"That was actually a good choice for me, George!" he said, as he sat back down.

"Bringing unity through technology in Africa, contestant number two, Catherine!"

She walked around the class to *Hakuna Matata* (from *The Lion* King) arms open in gestures of love and warmth.

"Bringing the gift of wintertime exhilaration to thrill-seeking adolescents..."

"I like that!" remarked Jason

"... contestant number three, Jason!"

Since Jason had entitled his project Mountain Surfing, I had selected the Beach Boys' *Surfin' USA* for him. He played along extremely well, mock-surfing his way around the class to another round of laughs.

"Last but not least, bringing education, socialization, and qualification to the young minds of Calm Waters, our resident *paisan*, Stan!"

For Stan I had chosen Dean Martin's *That's Amore* , simply because hewas Italian and the song had a calm and pleasant feel to it. He walked around the room blowing kisses to the crowd.

With the class thoroughly entertained, I began Round 1 of the game show, in which I would ask each student quick questions worth one point. For additional amusement, I incorporated a behaviourist technique of rewarding right answers by playing a snippet of the student's theme song. When a contestant couldn't think of the answer, Dr. Boyd would give with hints, but otherwise, other students had a chance to "go for the steal" and obtain extra points. At the end of the first round, Mitchell and Catherine were tied for the lead, having both stolen points from Stan and Jason.

Round 2 resembled Round 1, except that it was a "free-for-all round" where the points went to the student who could hit the game show button I had brought first. After five such questions, question difficulty increased and answers were worth two points. Thankfully, Stan and Jason had managed to get on the board. Mitchell and Catherine however continued to dominate.

By the final round, questions were worth three points and began demanding more CT skills. The first question asked to find Nash's equilibrium on a problem prepared on the whiteboard. As people were guessing incorrectly, it was, to my surprise, Jason who was able to reason through the answer without even writing out the calculations. The second question asked for the payoff table for a game of rock paper scissors. Catherine braved it, but made several mistakes. Jason had again distinguished himself by helping to correct her. When all was said and done however, the game ended with the top score tied between Catherine and Mitchell. Before the class went to break, Dr. Boyd covered a

project question related to his Frank-Boyd star. I thought it a symbolic of the study's progress when contrary to Session 1, he was adamant about having the students fill it out in class themselves.

Upon their return, the students were greeted with a room rearranged. I had cleared the passageways for my second intervention, a round robin of peer consultations on their projects. For each student, I had prepared a Bristol board with a printout of their personal slide for the game show taped at the top. Below I had drawn a table pulled from one of the project's biggest questions, which asked for a requisite variety chart for each of the emergent levels. To "pollinate" each other's projects as richly as possible, the students were paired up and given the roles of host and guest. For five minutes, the guest would visit the host at their Bristol board, and together, they would try to fill out the table as much as possible. Students would then switch roles, and later switch partners, such that each student would receive a consultation from all of their classmates.

Dr. Boyd and I stood back during this activity, letting the students construct their knowledge entirely on their own. This led us to engage in some chitchat that I found quite significant:

Dr. Boyd:
"Good exercise"

George:
"Yeah, I'm applying all these things I've learned in Learning Theories: collaborative learning, constructivism...I'm bringing them to life!."

Dr. Boyd:
"Yeah, I know all about those things but I haven't gotten the habit to actually use them."

George:
"That's why I'm here...to fill the gap"

Dr. Boyd:
"Yeah, you're good at keeping things moving and organized."

Dr. Boyd would not be the only one pleased with the session. At the end students told me that I "had gone all out", and asked excitedly if they could keep the Bristol boards, which of course was my intention. Amongst the last words captured on my digital recorder that week were some by Jason which I found very fitting to sum up the session:

"This stuff is making a lot more sense the second time through!"

Session 14: Nutshell and Wrap-Up

Session 14 was unscheduled, but added to the consensus of the class. Being the last, I thought I would indulge myself once more and commemorate the occasion. Using a PowerPoint slide with an Olympic games closing ceremony as a background, I animated everyone's avatar to enter the slide to the Olympic theme song, complete with Canadian flags on their clothes. This too generated laughs all around.

With everyone engaged, I unveiled my "Cybernetic Nutshell" exercise (Appendix E), in which the whole class was to create a summary of the course to encourage them to use its principles in their own lives (the whole point of the performance phase). For each topic, the class brainstormed names and terms and determined its practical value. Originally, I intended this exercise to be a rapid warm-up, but it lasted over an hour. Although the students were filling some of the fields, Dr. Boyd had to step in and provide clues to jog their memory. Interestingly, in keeping track of who made each contribution to the sheet, I found that the ratios of the students' contribution to the summary were very similar to the results they displayed during the game show; with Mitchell and Catherine

leading the way in providing the majority of the answers, although Stan and Jason had contributed more than in the game show.

During the break, Stan was discussing the exercise with Dr. Boyd and brought up comments worthy of later discussion:

Stan:
"(The exercise was) too quick. This would have been good over the whole semester every second week, because it's only now that I ... looked at the presentations, reread the readings, and then internalized it because we've seen the end, going backwards... then I read yours, then it clicked, AHA! Whereas class 5, when we're doing that it's just like introduction, there's so many terms, it's not embedded or ingrained... But you know what would be good ... if you could get a team of grad students with you guiding, almost to do an intro to cybernetics in a very formalized low level overview, with guiding questions, the Cybernetics for Dummies version."

Dr. Boyd:
"I got many false starts to that."

Stan:
"That would make it more accessible."

Dr. Boyd:
"It's an overwhelming amount of material, but the problem is to have enough of an organizing framework to make some sense out of it."

Stan:
"Some of this stuff would be useful for some real world problems"

Dr. Boyd:
"I think **all** of it would!"

With little more than half an hour remaining in the final session, it was time for a wrap-up chat. I started off by reiterating the mission I declared in Session 1, to bring value and enjoyment to education. Dr. Boyd confirmed that it was quite obvious that I enjoyed working with them. The floor was then opened for people's general impressions. For the purposes of the upcoming discussion, I found many comments very valuable, and worthy of direct quoting. The following are highlights of what they had to say.

Stan:
"The first exchange I had with (George) was 'I've been waiting a couple for years to take Gary's course because of word of mouth, and one of his strengths is his knowledge, which kind of goes off in all kinds of ways or patterns ... I want to make sure that this is still Gary's course, so that we

go off in...whichever way Gary's thinking takes us, and I don't want him to be stifled with trying to put structure in a very unstructured course.'"

George:
"I believe you used the word 'ruined'..."

Stan:
"In my day to day, everybody wants a piece of me and I have to be everything to everybody, so when I come here, I like to unwind, relax, and go with the flow, and that was the original purpose. Towards the end, and behind in my major assignment, I'm thinking I should have stuck to some of (your) guidelines. You kept telling us Week 3, Week 4, to get cracking! Somewhere between the two, I think it's worked out well. Certainly, the organizers that you've provided, and now that I'm actually doing the project, the feedback is well appreciated and the organizers, well, I didn't appreciate them at first, now that I actually have to do something, they're well-appreciated and well-used. I still think you kept that part of the process where you said you wouldn't interfere, putting your structure on his structure ...so that's a good thing. The only suggestion, if you were to do this again in the future, is when you do the tasks, to ensure that (the learning is about the journey and not the destination). In some of the exercises I could see that you wanted us to get the answer and to get to it, and for me I would rather have a discussion ...than the end results."

Jason:
"More discovery"

Stan:
"More in the process"

Catherine:
"It's good to keep us on task, but not if it's going to destroy (our discovery)"

Mitchell:
"It might help rather than have a hard deadline, to have a soft deadline. Maybe Phase 1 has to be done by this date, and then give formative feedback. You can always go back and revisit it before the final."

Dr. Boyd:
"I have done this in the past, I've said you've got 2 weeks for each of these phases and it worked out fairly well, but I had more people, ... there's more interaction pushing forward because each of the people in the pair pushes the other somewhat. However I think this had more useful structure than I sometimes provided. I do have a tendency to wander and part of that's fun, but in my opinion these are all potentially valuable tools and techniques, and what amazes is me so little of this is taught"

Mitchell:
"This whole course for me has been a complete eye opener. I wrote in my MAXCAW that I'd like to read more in the future. I remember the coup in Chile. I had no idea that Beer was related. If I get some time I will look that up. Stan, I had a similar sort of thing when George first e-mailed me, thinking 'oh, is this course going in a different direction?' But I think it was nicely balanced actually; Gary would often go off the board and I found it interesting to hear him talking about all his experiences."

Dr. Boyd:
"I feel that George added useful structure. Sometimes it seemed to me a little bit juvenile, but you guys really seemed to enjoy some of it."

Catherine:

"I did find the stuff that was meant to be entertaining enjoyable, but at times it was a little oversimplified, and I don't feel like I need help understanding the material that's given to us, it's more that I want to talk about, explore it, and so on and so forth, I think that we can be given the responsibility to a certain degree of learning the material on our own and then let's go from there."

Dr. Boyd:
"Yeah, you really need to do modeling exercises on your own to see where confusion still lies and where you can find somebody or something to clear it up. If you want to make use of this approach in your internship report or in your research it's possible, ; these questions, in my form or George's could be use for building a case study or as part of your write-up of your internship or part of an internship portfolio.

Catherine:
"I'm OK with getting structure from literature...it's just my preference."

Dr. Boyd:
"What I'm hearing, if I give it again next year, is that I should keep a lot of George's exercises ... and the Donkey Kong."

Stan:
It'd be good to have a lab component...an exercise lab. The exercises that George made us to internalize the reading... I don't know if you could make us do it online, in a small group, almost an hour of week of 'OK let's practice'"

Catherine:
"And for some of the topics there aren't just readings, there are just PowerPoints"

Stan:
"I'm a visual learner, and in some of the weeks we had 2-3 PowerPoints....I guess variety is good, but I'm not sure it helped me. In some topics my only source was the PowerPoints There has to be seminal reading even if they're hard, a quick ...snippet of different readings.
One thing is interesting, in all the leadership courses we've done outside of here, we define the role of the leader. After this course, I'm much more careful in being a leader. You are part of the machine anyway. One of the things I've learned is that the machine expels the loose cogs."

Dr. Boyd: wrapped up the discussion by stating how much he enjoyed the class. The course itself technically was still not over for most students though, as everyone but Mitchell still had their projects to finish.

Given the slow progress of the project to date, it was obvious that this last cycle would yield the most amount of work in First Class. Be that as it may, it can be seen that students had profited from the continuous revisions of the material, for they began to answer Dr. Boyd's increasingly technical questions with equally increasing expertise. An excerpt from Mitchell's project illustrates this below.

4.4 REQUISITE VARIETY AUDIT CHART
Please use this scheme. Make a C-V/ D-V double column ten-level audit chart looking at each of the basic communicontrol levels:

Level of Communicontrol	Disturbance Variety	Control Variety
Sustenantial	The Runabout was often missing and hard to get in touch with. This made communication difficult.	We could use bush radio to get in contact with the camp if needed but it was complicated to do. I would call the runabouts wife at work to see if she knew where he was.
Viral	1) Negative attitude towards learning academic subjects spread among the students. 2) A rumor went around the school that the runabout was making nasty comments to a couple of students in the school (who were not in the program) when he would see them in the halls. It seemed to be an extensive of a feud between the families.	1) We did not have much control over this. 2) We investigated the complaints and spoke with the Runabout encouraging him to keep his comments to himself.
Negotiative	The Foster Parents felt, at times, that it was too difficult to be with the students 24/7. They wanted to negotiate for more money.	We built breaks into their schedule. For example, they might have the students for ten days straight but then they would have 5 or 6 days in a row break. The number of workdays was reduced from what a regular (in school) teacher would do.

Table 23: Portion of Mitchell's Requisite Variety Table

Aside from being able to relate to the terminology, Catherine, Mitchell, and Stan harnessed their enthusiasm for Stella to create rather sophisticated Stella diagrams, such as Stan's below:

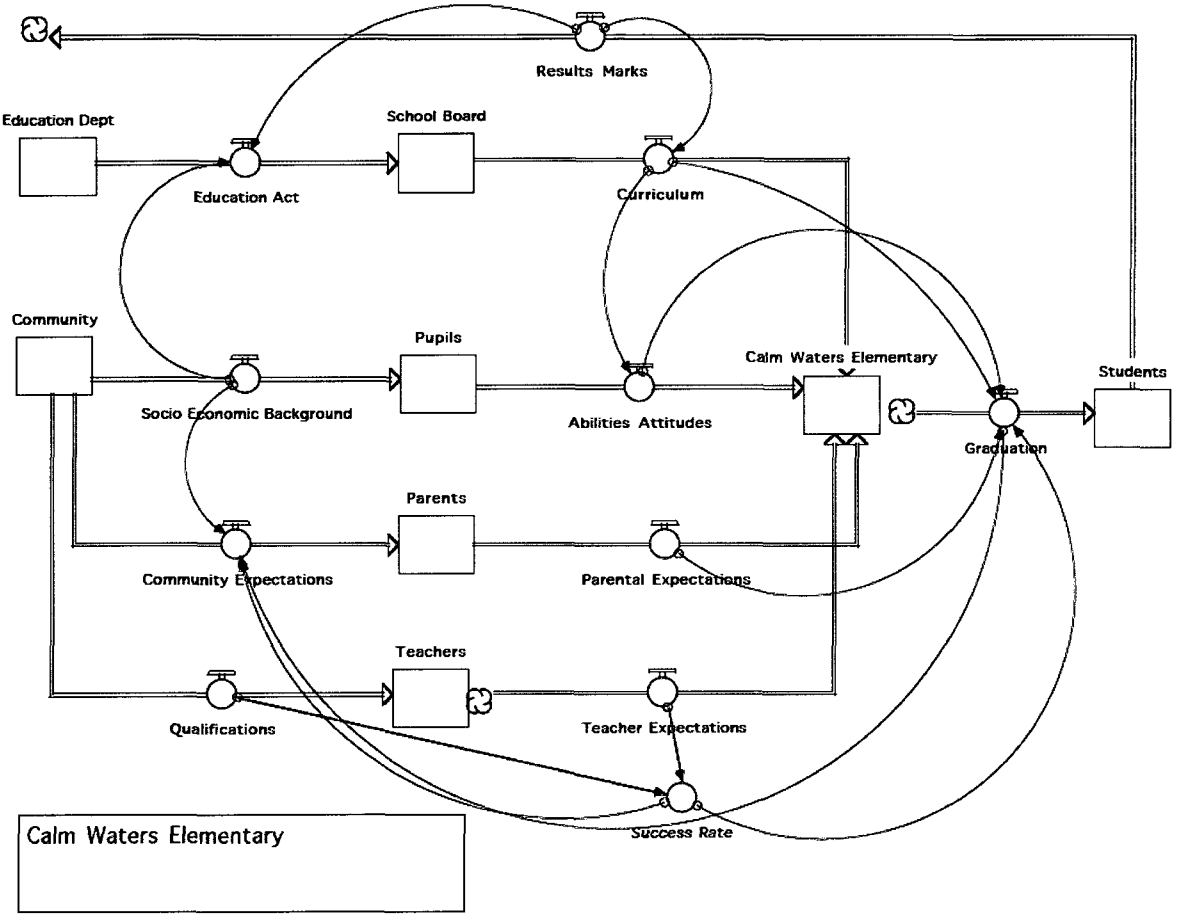


Figure 6: Stan's Stella Drawing of his System

On the flipside of the worthy achievements, there were conceded disappointments, mostly with the project itself. At semesters' end, only Mitchell and Catherine had submitted it finalized. Jason, who seemed so ambitious before the course began, had not gone beyond the three questions he answered weeks before. He was a source of growing frustration for me, a fact that I never betrayed in class, but shared in my debriefings. Fortunately, Dr. Boyd quelled my discontent midway through the

semester by informing me that Jason had matters outside of school that were preoccupying him. He would finally resume work his project work in the summer, having been granted an extension, and as of this writing needs only to make revisions to his final report to complete the course. In what came as a minor shock to me, Stan, who had reached the third set of questions, would leave his work incomplete.

These hurried and incomplete performances deprived the students of one of the intended elements of the course, ongoing, online, peer discussions. With everyone behind schedule, student comments about each other's projects were relatively sparse, which was ironic, given how much they reportedly enjoyed the live peer consultations with the Bristol boards. Consequently, the few exchanges that took place (not surprisingly, between Mitchell and Catherine) remained rather elementary in nature.

(Mitchell)
Everyone involved in the program took great pride in the fact that we were attempting to do something new and of benefit to students. We were all conscious of the potential this program had to reach out and affect the lives of the young people in the program. Perhaps more conscious even than the students themselves.

(Catherine)
What happens to pride (of students, community members, and program staff) when the program is canceled? Do they feel jaded, or helpless, perhaps unwilling to pursue something similar in the future if offered another opportunity?

Implications of the outcomes of the study with respect to the research purpose will be elaborated in the Discussion section, which follows the tabular resume of Cycle 6 below.

ACT (Implement) - AL

PREPARATION

Donkey Kong status report (Session 11 & 12)
Stella simulations (to arouse curiosity, Session 11)
Game show context (Session 13)
Customized intros, graphics and theme songs (Session 13)
Closing ceremony (Session 14)
Wrap-up (open environment, Session 14)

PRESENTATION

Demonstration of Stella simulations(Session 11)
Recycling of slides to reinforce and deepen knowledge (Session 12)
Attaching meaning between project and course content (Session 12)
Game show context (Session 13)

PRACTICE

Mid-term (Session 10)
Stella lab (Session 11)
Consultation class (Session 12)
Game show (Session 13)
Nutshell exercise (Session 14)

PERFORMANCE

Continued online support for student projects

Table 24: Implementation Phase for Cycle 6

LOOK - Preliminary Observations

Catherine

- Explained the value of the law of requisite variety (Session 10)
- Tied the LoRV to information theory (Session 10)
- Related the LoRV to her job (Session 10)
- Modelled her project with Stella (Session 11 onwards)
- Elaborated her project in class (Session 12)
- Asked questions during Jason's consultation (Session 12)
- Created a payoff table for rock-paper-scissors (Session 13)
- Consulted on everyone else's project (Session 13)
- Identified value of course content (Nutshell, Session 14)
- Described her system (First Class, 26 questions)
- Commented on classmates' projects (First Class, 6 times)

Jason

- Related the LoRV to his hobby (Session 10)
- Elaborated his project in class (Session 12)
- Found Nash's equilibrium...in his head (Session 13)
- Corrected Catherine's payoff table (Session 13)
- Consulted on everyone else's project (Session 13)
- Identified value of course content (Nutshell, Session 14)
- Commented on classmates' projects (First Class, 4 times)

Stan

- Discussed an application of emergence (Session 10)
- Modelled his project with Stella (Session 11 onwards)
- Elaborated his project in class (Session 12)
- Comparing his project to Jason's (Session 12)
- Consulted on everyone else's project (Session 13)
- Identified value of course content (Nutshell, Session 14)
- Described her system (First Class, 18 questions)

Mitchell

- Enumerated game theory contributors and strategies (Session 10)
- Compared game theory strategies (Session 10)
- Gave real-world example of tit-for-tat (Session 10)
- Modelled his project with Stella (Session 11 onwards)
- Elaborated his project in class (Session 12)
- Consulted on everyone else's project (Session 13)
- Identified value of course content (Nutshell, Session 14)
- Described her system (First Class, 47 questions, with revisions)
- Commented on classmates' projects (First Class, 5 times)

Table 25: Implementation Phase for Cycle 6

THINK - CT Assessments

Catherine

Interpretation
- Categorization (Stella lab, project, mid-term)
- Decoding significance (consultations, Stella lab, game show, project)
- Clarifying meaning (consultations, project, mid-term)

Analysis
- Examining ideas (consultations, mid-term)

Evaluation
- Assessing claims (consultations)
- Assessing arguments (consultations)

Inference
- Querying evidence (consultations)
- Drawing conclusions (consultations)

Explanation
- Stating results (consultations, project)
- Presenting arguments (project, mid-term, game show, nutshell))

Self-regulation
- Self-correction (project)
- Self-examination (mid-term)

Jason

Interpretation
- Categorization (mid-term)
- Decoding significance (consultations, mid-term)
- Clarifying meaning (project, mid-term)

Analysis
- Examining ideas (consultations)

Evaluation
- Assessing claims (consultations)
- Assessing arguments (consultations)

Inference
- Querying evidence (consultations)
- Drawing conclusions (consultations)

Explanation
- Stating results (consultations)
- Presenting arguments

Self-regulation
- Self-examination (mid-term)

Table 26 – Think Phase for Cycle 6, Part 1

Stan

Interpretation
- Categorization (Stella lab, project, mid-term)
- Decoding significance (consultations, Stella lab, game show, project)
- Clarifying meaning (consultations, project, mid-term)

Analysis
- Examining ideas (consultations, mid-term)

Evaluation
- Assessing claims (consultations)
- Assessing arguments (consultations)

Inference
- Querying evidence (consultations)
- Drawing conclusions (consultations)

Explanation
- Stating results (consultations, project)
- Presenting arguments (project, mid-term, game show, nutshell))

Self-regulation
- Self-correction (project)
- Self-examination (mid-term)

Mitchell

Interpretation
- Categorization (Stella lab, project, mid-term)
- Decoding significance (consultations, Stella lab, game show, project)
- Clarifying meaning (consultations, project, mid-term)

Analysis
- Examining ideas (consultations, mid-term)

Evaluation
- Assessing claims (consultations)
- Assessing arguments (consultations)

Inference
- Querying evidence (consultations)
- Drawing conclusions (consultations)

Explanation
- Stating results (consultations, project)
- Presenting arguments (project, mid-term, game show, nutshell))

Self-regulation
- Self-correction (project)
- Self-examination (mid-term)

Table 27 – Think Phase for Cycle 6, Part 2

Discussion and Recommendations

Given the need to integrate the separate constructs of critical thinking, accelerated learning, and action research to develop a viable research method, and then to coordinate the results such that all three were properly represented, it is not surprising to discover that there is a similar complexity to overcome in order to suitably discuss the conclusions of the study. At this point, conventionally answering the questions of the research purpose one by one would not do the study justice; for the answers would permeate into each other to such an extent that the discussion would be riddled with redundancy. Rather, in the spirit of cybernetics itself, it is preferable to seize awareness of the emergence at play and observe the study at a higher and more powerful level.

The First Super-Level

On that level, there are two themes that succeed at driving both the results that transpired and the conclusions to be drawn. The first of those themes is interconnectedness. Its first reported occurrence was in the research method, when it was described how, for instance, when the course took place, the act and look phases of action research were happening simultaneously. Similar overlaps could be found in the use of accelerated learning; For example, as an activity, the game show would logically fall under the practice phase. And yet, its multiple uses of attention-grabbing, emotionally engaging techniques make it also venture into the preparation phase. More confusing still, the peer consultations were also technically a practice phase activity, but were structured in a meaningful and interesting manner (presentation) so as to inspire students

(preparation) to apply cybernetics to one way or another enhance their lives (performance).

Complicated as this is, it doesn't hold a candle to the travails of attempting to document incidences of critical thinking. Not even Facione's masterfully and meticulously co-constructed rubric could spare one of the arduousness of trying to categorize the skills and sub-skills of student activity. While a valiant attempt was made nonetheless, it is admitted that to add accuracy, the exercise could have easily gone far deeper. To do so it would take no less than the rigor and precision of information display expert Edward Tufte. Granularity of the assessments would have to be increased, and a new order of visual representation would have to be ascended to for the sake of discerning nuances, such as frequency of sub-skill usage and degree of skill complexity, with proper proportionality. Sadly, even at that, results would not be spared from the uncertainty caused by the subjectivity of personal interpretation and the interconnectedness of the terminology.

Last but not least, let us not lose sight of the issue at hand, the need to meet the demands of the corporate workplace. The road to this goal was not exactly a straight path, for on the path to adhering to the interests of the workplace, the study tried to adhere to the interests of the students, the interest of the instructors, and the interests of the accelerated learning method itself along the way. Hence, the interconnectedness phenomenon even exists on a macroscopic level as well.

At this juncture, there are two ways of reacting: one can become overwhelmed at the complexity, or transcend it by embracing it. Fortunately, the research points to a way of doing the latter. The presence of interconnectedness is prominent in Duffy and

Cunninghams's mind-as-rhizome metaphor (1997), as well as Spiro et al's recommendation of multiple passes of a complex topic to add richness to it (1991). Actually, they had a metaphor of their own, crisscrossing landscapes, which is strikingly similar.

With this in mind, discussion can be advanced by revisiting the results for correlations. While the tracking of critical thinking was by no means perfect, it is still valuable for comparing results between cycles. In complete accordance with the premise of AL, it can easily be seen that the more the students were engaged in the practice and performance phase, the more they had registered instances of critical thinking. Combining this fact with the interconnectedness metaphor, it can be concluded that the increased activity of the students corresponds to the multiple passes of Spiro et al. Since critical thinking has such trouble being defined semantically (Halonen, 1995; Lee, 2007; Abrami, Bernard et al, 2008) it may very well be more useful to envision it metaphorically as a set of crisscrossing landscapes. After all, a picture is worth a thousand words.

The Critical Metaphor

That being said, let us explore this direction more vividly by using a concrete example of a crisscrossing landscape: the streets of a city. If critical thinking can be viewed as a dense network of crisscrossing streets in a city, then someone who can think critically in a given topic can be analogized as knowing the city of his topic very well. Enter Dr. Boyd.

With over 35 years of experience in the field of cybernetics, it can more appropriately be said that he knows his city *extremely* well, and people know it. Students past, as well as those in the study, have made multiple comments about how they were drawn to his wealth of knowledge. Many, including Stan, have been happy to sit and watch him navigate the streets of cybernetics with deftness and grace. However, Dr. Boyd's beautiful display has a catch: it is behind a window. In those instances, he teaches *about* the subject matter and not the subject matter itself (Maiorana, 1992). He has successfully extracted essential principles, concepts and facts from the authentic contexts that he has lived (Herrington and Oliver, 2000), but unfortunately, in terms of critical thinking, the student yield is generally low (Millard, 1997) because they remain passive (Small et al, 1996), and in doing so, do not know how to do it themselves (Paul, 1989). Enter George.

From past student feedback, as well as my own personal experience as Dr. Boyd's student the previous year, I entered the study hypothesizing that Dr. Boyd's course would likely benefit from an intermediary voice. When I would lecture, I would not make any excessive turns inside the cybernetic city; I took them down one street. It may have had some curves along the way, but it was very basic. Otherwise put, I was scaffolding them, figuring that once they knew how to go down the main roads in the cybernetic city, they could begin exploring cross streets as they wished.

Greatness Held Hostage

Even at that however, observations of their (operational) CT development over time were mixed. The lectures were generally well-received, and yet, the projects were not progressing. By the time Dr. Boyd and I intervened to have them work on the projects in class, many misperceptions were exposed and many fundamental elements forgotten. This points sharply to Kirschner's research on the failure of minimal guidance (2006), wherein he asserts that the aim of all instruction is to alter long-term memory. He furthermore cites Peterson and Peterson (1959) who found that all information stored in working memory and not rehearsed is lost within 30 seconds. This claim was validated very well in the Nutshell exercise in the course, where students needed much time and hinting to produce the very short, simple, and declarative results that were sought, much to both Dr. Boyd and I's disappointment. Apparently the students had traveled the road, but since they had not made enough passes, their tracks had faded.

The late flurry of practice interventions did however salvage some critical thinking development. Much deeper scaffolding took place and many more CT skills blossomed when students were led to draw upon their navigation abilities in cities that they knew well to learn how to steer themselves through the cybernetic one. Using the course project to leverage their pre-existing CT skills from their experience and form new CT skills in cybernetics was remarkably effective...when the students would actually do it. To paraphrase Stan, that's the way Gary did it.

Therefore, when prescribing recommendations for Dr. Boyd, it is beyond obvious that the practice and performance phases, where, as Dewey said, students learn by doing, (Millard, 1997) should be made prominent much earlier on. All the same, the students

were told over and over to "get cracking", but they had not. There is thus more at play, more elements that interconnect. It is at this point then, where it becomes useful to introduce the research questions into the discussion.

Attitude the Captor

The first question asked for the most appropriate ways for instructional designers to arouse interest in a Master's level university course before it begins, and then sustain it throughout. This question corresponded to the preparation phase, in which a few themes stick out. The first was the Beacon Statement, which described the benefits of the course and each topic. The second was my set of indulgent, curiosity-arousing, attention-grabbing slides, which used the students' likenesses to create moments of humour. The third was the integration of the students' experiences into the content. Much subtler, but worthy of mention was the friendly and open atmosphere Dr. Boyd and I had created.

Even with some mild variability in student feedback (which shall be discussed shortly), the first three elements were all enjoyed and appreciated to some extent. The fact remains however, that critical work was not performed when asked. This factors in an aspect of the Facione study that had not been mentioned in the literature review: affective disposition. According to Facione (1990), the topic of affective disposition caused the deepest division in his panel: two thirds considered it as part of the definition of CT, while the other third explicitly did not. For simplicity, this study opted to side with the latter, but in terms of results and end goals, would now agree with the former.

Observing the four students, it was evident that their affective dispositions played critical roles in their performance. In a summative evaluation of the course, Mitchell

revealed that his motto was "nothing ventured, nothing gained", and seized every opportunity he could to talk about his project for the purposes of acquiring valuable feedback. While he was the newest to the program, and ostensibly had the least amount of incoming CT ability for the program, he was arguably the best student of the class. Amongst Facione's affective dispositions, Mitchell figured prominently in many, namely inquisitiveness and diligence, to name but two.

His only equal in terms of overall performance was Catherine, the "elder stateswoman" of the program. Despite her incoming abilities, her output was dampened by her procrastination (which she confessed on many occasions, including her summative evaluation). As a result, her strengths and weakness neutralized each other, and she found herself in a neck and neck race with Mitchell all along the semester.

The most prevalent example of the importance of disposition was Stan. When called upon to teach, he assumed his professional disposition and gave the sharpest lecture of the four. Otherwise, as he said, he went with his own flow, ultimately at the cost of his project. As for Jason, his abilities were apparently sideswiped from the get-go by external distractions. With all due respect to him, he validates Facione's affective disposition of "persistence through difficulties".

Studying these four individuals, it was evident that affective disposition was a fulcrum to their performance. This falls into alignment with Beatty's description of the human mind "as a seamless blend of thinking and feeling" (2002), the reported power of emotions (Dunkin 1986; Csikszentmihalyi, 1990; Beatty, 2002; Park, 2004), as well as the recurrent theme of interconnectedness. Since performance is evidently an end goal of

the workplace, it should be factored into the conclusions to be drawn, perhaps even literally. From a mathematical standpoint, one might say that

incoming CT skills * affective disposition = CT outcomes.

Affective disposition, in turn, may be fostered by combining the preparation elements mentioned above, to begin. For better or worse, the factor that may be missing would be an old-fashioned behaviourist kick in the behind in the forms of evenly spread deadlines, so that learners can practice what they learned much sooner after they learned it. As regressive as it may sound, students conceded that earlier deadlines would have gotten them to perform, which would have suited the performance phase as well as the research on long term memory just fine.

The Second Super-Level

As it were, affective dispositions are not the only way personalities need to be considered in any proposed solution. Small as the class was, summative evaluations contained much discrepancy in the opinions of the four students: For example, Stan found my customized graphics fun; while Jason found them distracting. Mitchell was "impressed with quality and clarity of the presentations", while Catherine found some oversimplified. As they say in cybernetics, there was disturbance variety. As they say in laymen's terms, you can't please all of the people all of the time. Therefore, the best you can do is please all of the people, some of the time. This brings forth the second underlying theme of the study: balance.

The overarching need for balance in the study started with the literature review, in an examination of epistemological extremes. At the instructivist end, being "stuffed like a Peking duck" (Gong, 1997) via memorization doesn't develop CT because you are not

given the opportunity to think for yourself. At the constructivist end, being told next to nothing (minimal guidance) doesn't develop CT because you are not given a viable chance of successfully working with your cognitive architecture. Too much emotion by professors brought about riots; not enough emotion brought about this study. Balance then spilled over into this study when, depending on the student, my approach seemed too oversimplified and Dr. Boyd's approach mentioned earlier seemed too abstract. It also arose in the comments in the wrap-up chat when the students claimed they needed more "discovery time". From the instructor perspective I acknowledged the importance of discovery time, but had to also pay attention to the "closing time" of the course, at which time only one project was submitted complete.

Keeping things balanced, the research shows, will still not please everybody at once, but it's the best option available. According to Kirschner (2006), "the most effective components of treatments help less experienced learners by providing tool-specific learning strategies embedded in instructional presentations". This explains Mitchell's favorability. However, "more able learners have acquired implicit task-specific learning strategies that are more effective for them than those embedded in the structured versions of the course" (Kirschner 2006) This explains Catherine's disdain, who found some of my practices "too instructional-y". That being said, Tuovinen and Sweller (1999) point out that the less guidance you embed in instruction, the more you risk inflicting extraneous cognitive load on newcomers. Thus, catering more to Catherine would have impeded Mitchell, whereas catering more to Mitchell (without stuffing him like a duck) did little more than mildly annoy Catherine, who learned all the same.

The Prescription

With both themes having been considered, a holistic recommendation could be drawn from the study that would recognize both its interconnected nature and its need for balance. It would also answer the remaining research questions about providing meaning, integration, long-term value and AL adaptation in one fell swoop.

To successfully adapt accelerated learning to higher education in such a way as to eventually satisfy the critical thinking demands of the workplace, students must be predisposed as soon as possible to develop their CT skills of the course, which, at a larger level, is a scaffold for the student's future job. This predisposition is to be co-nurtured by the instructor, who makes the effort to identify the course's benefits, and by the learner, who then takes those benefits and examines how they would apply specifically to their lives. At this point, we would be one foot inside the preparation phase.

Nurturing the predisposition along would be a supportive instructor who would create a positive environment, which could be punctuated by brief moments of interesting, humorous, attention-grabbing techniques. These techniques could then be leveraged to segue into the presentation portion of a session, where the theme of real-world pertinence from the preparation phase is further explored by means of meaningful, relatable examples that scaffold new content, relatively speaking, from a beginner to an intermediate level, so as to ensure that even the newest of students can follow along and participate in any discussion.

With fresh new, meaningful, content present in students' working memory, the opportunity is seized to begin transferring it to long term memory and to develop CT skills by conducting in-class activities, the practice phase. Consideration is taken to

conduct an optimal number of exercises; only one or two if need be, and to do so in a guiding fashion, such that learners feel they have enough time and enough freedom to arrive at the answers with a relative amount of independence. Sessions conclude with the instructor briefly returning to the presentation phase to elaborate real-world implications of the topic before directing the learners to the performance activities they are to perform for the next class.

For higher education, the performance phase requires some adaptation. In a typical AL setting, the performance phase is invoked only once the other phases have completed. This is because workshops or courses using AL normally last anywhere from a day to two weeks. In higher education, it must occur between sessions of a course, as well as once the course is done. In continued accordance with the predisposition theme, the additional time between sessions is taken advantage of to further scaffold learners' working knowledge into assignments and discussions of a higher difficulty so as to more closely resemble the complexities of the workplace. To optimize the scaffolding, performance activities are assigned as soon as possible and as frequently as possible after sessions. To neutralize lagging predispositions that threaten CT development, deadlines are set.

In subsequent sessions, the proceedings are repeated, with a few provisions. To truly accelerate the learning, current topics are related to past ones in the presentation phase. Practice activities include brief review exercises to protect and reinforce what has already been learned and to couple it with the new material. In this respect, an ongoing collaboratively built organizer would be very helpful. Whenever possible, the

performance phase would challenge learners' ascending CT skills with increasingly difficult exercises. Case studies might be appropriate in some scenarios.

To further bolster effectiveness, Laurillard's *Rethinking University Thinking* (2002) tenets could be considered. Her interaction phase would have students and instructors negotiate learning goals, assuming that students are predisposed to the degree of having very specific goals for taking the course. If that is the case, the presentation and practice phases can be modified wherein possible, which would correspond to the Laurillard's adaptive phase. Her interactive phase, where students and instructors cause each other to evolve, can be embodied by weekly adjustments to the presentation and practice phase, whereas her reflective phase would be best served by journaling exercises of some sort in the performance phase.

As complete as this prescription seems, it is fatally flawed if it does not take into consideration one last condition from the literature review: feasibility. The rubber, after all, must still meet the road. AL was explored in part because of remarkable reports about drastic reductions in training time. The distinction realized during the course of the study was that large reductions in training time require large amounts of course preparation for someone doing the instructional design. In the words of the professors involved in the study, I *was* the instructional design. Without me, the modifications to Dr. Boyd's course would not have been possible, which according to the research, would be the case with many a professor.

This leaves two scenarios to explore. In Dr. Boyd's case, I may not be around for the next iteration of his course, but my materials will. The results and discussion suggest that the most important task left for him to undertake is to create multiple deadlines

evenly spaced out across the semester for instalments of the project to be handed in, and to rearrange the project questions such that the subject matter asked in them has been taught in a recent session. Aside from that, he could hand students the solutions prescribed herein to ensure that they maintain AL integrity when they lead lectures. With these relatively minor adjustments he could make significant gains.

As for other professors, they would inevitably need a teaching assistant as well to essentially replicate this study (without needing to try and track CT!) and cover the overhead work that would lead the professors "over the hump" to Dr. Boyd's current position, where he can leverage what has already been done. That being said, Dr. Boyd and any other professor would benefit, in the spirit of action research, from multiple iterations to bring about continuous improvement in their AL frameworks. To encourage students to enrol in such ventures, credits could be given, or as in my case, the experience could be considered as a short internship. To revisit one last metaphor, this would put a new twist to the Creation of Adam metaphor, where student and teacher would once again interconnect, but this time, with more at stake for the teacher: the opportunity to be helped in building a pedagogical infrastructure that will help develop the CT skills and hence increase the value of many more students for years to come. In a sense it is the Creation of Adam in reverse; with education moving forward all the same.

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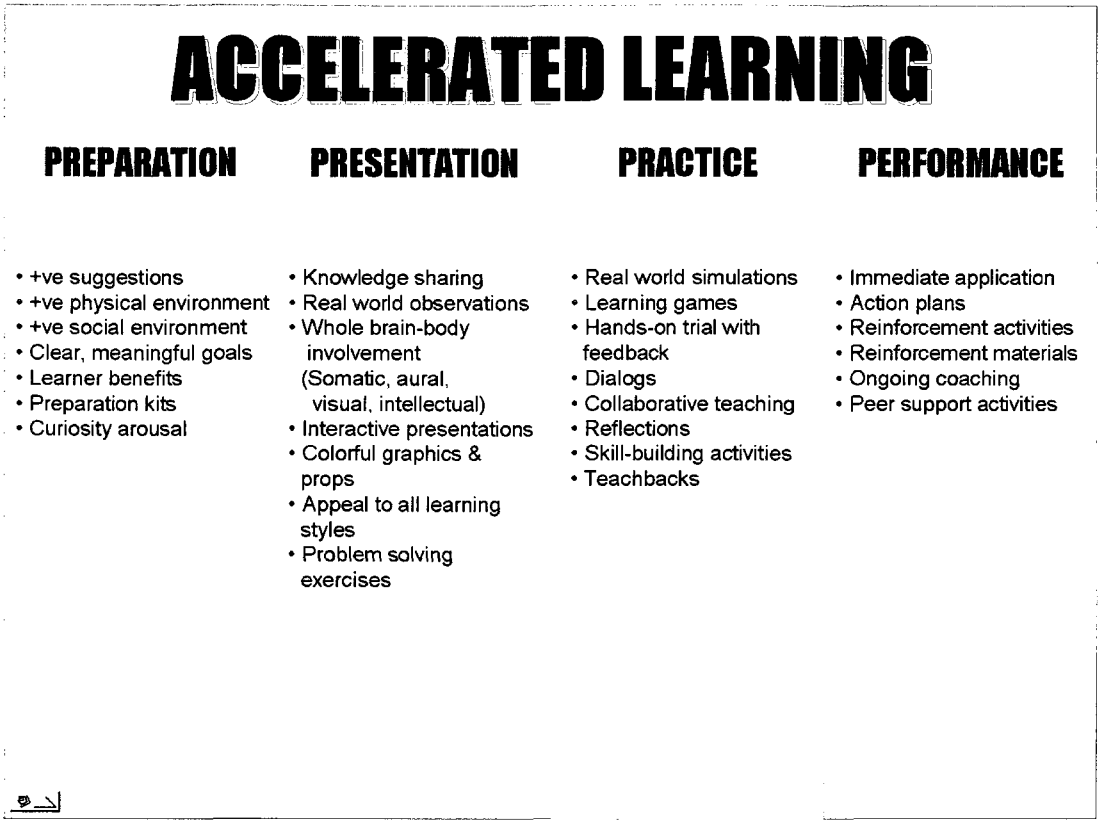
Appendix A: The Accelerated Learning Framework



Appendix B: Sample Preparation (Beacon Statement) Slide

WHAT FOR?

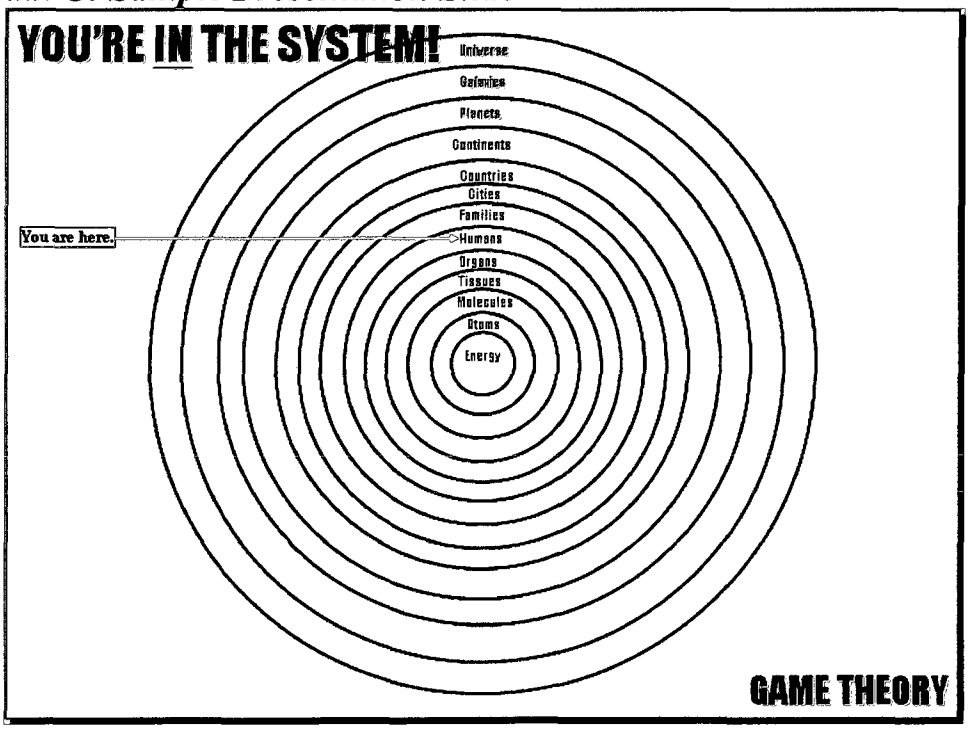
Educational Cybersystemics is about understanding
the co-controlled systems we are in, as well as those that are in us,
in order to improve our performance.

Games Theory is the systematic study among rational individuals looking to maximize their rewards.

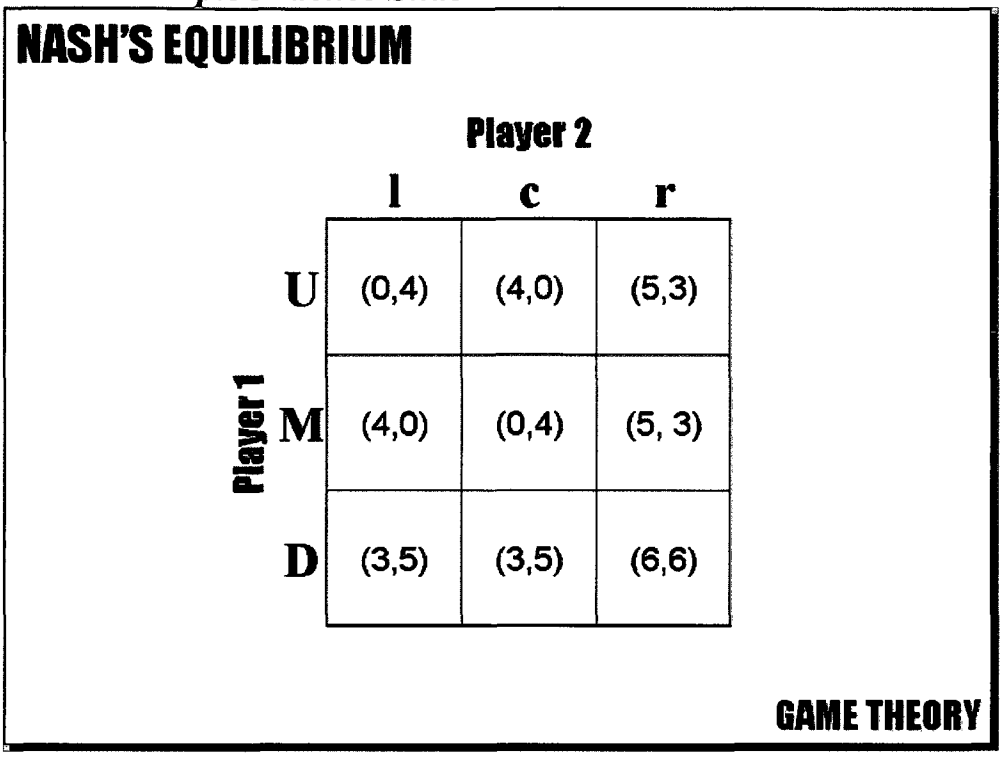
By thinking of your co-controlled system as a game, you can profit from this theory to derive the best possible strategies to have it deliver the performance you want.

SYSTEMS THEORY

Appendix C: Sample Presentation Slide



Appendix D: Sample Practice Slide



Appendix E: Cybernetic Nutshell Exercise

Cybernetic Nutshell

1. INFORMATION THEORY

Value: realizing that the info you get depends on you as receiver as well as the giver.

signal to noise ratio
disturbances
receiver uncertainty reduction
Shannon
channel capacity
modulation of carrier
coding
filtering
perception of messages
Vs intention

4. AUTOMATA

Value: allows you to understand the principles of automation, can model anything

gliders
states
input changes states
states change outputs
programs, functions
cellular
game of life
John Conway
Alan M. Turing - Turing machine
John Von Neumann
architecture (computer)
(non)deterministic-probabilistic

7. FEEDBACK LOOPS

Value: can diagnose systems and steer them, establish accountabilities

deviation limiting-balancing
open vs closed Guargjehfyhsydgft
deviation amplifying-reinforcing
simulation
system dynamics
Norbert Wiener et al
inputs - outputs
norms, standards
go no-go, limits
double loop learning
time delays

2. SYSTEMS THEORY

Value: you are able to visualize anything as a system so you can analyze it

relationships
components
behavior over time
big picture
patterns
loops
modeling
events
structure
embedding
paradigms

5. GAMES THEORY

Value: gives you a value (return) on decisions you make and predicts how others will act.

Prisoners' Dilemma
conflict,compromise,equilibrium
Anatol Rapoport
John Nash
Payoff tables
Zero-Sum, +ve sum, -ve sum
Minimax
Tit-for-tat
2-person, n-person (coalitions)

8. CONVERSATION THEORY

Value: design teaching systems, categorize points of view, discover views

p-individuals (ghosts)
m-individuals (hosts)
Gordon Pask
Gary
learning conversation
teachback
entailment meshes
hockey fans, religions..
subviduals, transviduals

3. EMERGENT LEVELS

Value: exploring how complexities emerge and using these for evaluation

L0: physical
L1: informational
L2: sustenantial
L3: viroidal
L4: autopoietic
L5: negotiative
L6: conjugative-reproductive
L7: liberative (emancipative)
L8: scientisophic
L9: existential (transcendental)
Maslow, Bloom, Boulding

6. REQUISITE VARIETY

Value: trouble-shoots ineffective situations & lets you know what to do

Ross Ashby
Control - Disturbance
Regulator - Disturber
Different perceptions of noise
Law of Requisite Variety
Ability to counteract
CV > DV
time constraints
costs of variety
efficiency vs variety tradeoff

9. VIABLE SYSTEM MODELS

Value: design viable systems and diagnose problematic ones.

Stafford Beer
L1: production level
L2: balancing-smoothing
L3: daily management-auditing
L4: liaison to outside
L5: policies, board, life & death
body metaphor
L1, L4, L5 connect to outside
L2, L3 work within the system
corporately adopted