A QUALITATIVE MODEL OF THE INTEGRATIVE LEARNING PROCESS

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The liberal arts undergraduate, through the process of post-secondary education, has become increasingly differentiated and specialized. His or her knowledge base has been increased through an incremental process in which the units of delivery are organized into discrete units called "courses," "minors," and "majors." For many these units appear to remain discrete, disconnected elements. The major program is usually designed with a particular constellation of courses intended to deepen one's knowledge within a discipline by piling one unit of learning upon another. In other words, this process is characterized by the acquisition of knowledge within a discipline rather than the attainment of understanding both within and, more especially, across disciplines (transdiscipiinarity). Russell Ackoff[1] refers to the former, knowledge acquisition, as an example of a "growth" process, while the attainment of a greater degree of wholistic understanding would be characteristic of "development."

There are, of course, notable exceptions to these generalizations about post-secondary education. The great books approach pioneered at the University of Chicago and implemented at St. John's College, Annapolis, Maryland, at which there are no majors, is one example of an attempt at an integrative liberal arts education. The uniqueness of this approach is, however, suggested by the fact that St. John's requires all matriculants to begin as freshmen and will not award credit for courses taken at other colleges.

A second example of an attempt at integrative education at the undergraduate level is provided by institutions which offer an interdisciplinary studies focus spanning the full four years of college. Western College at Miami University, Oxford, Ohio, exemplifies this approach. Again, that this approach is not widely accepted is suggested by the fact that less than 3% of Miami's undergraduates are enrolled at Western.

A third increasingly popular way of responding to students'

expressed interests in applying classroom knowledge is reflected in the recent increase in directed field studies, internships, or experiential programs available to liberal arts students. Based on the model established for pre-professional training in health-care, psychology and social work, field study programs attempt to integrate academic knowledge through "real world" experience off campus. Whether or not these programs are effective as integrative mechanisms and the generalizability of this approach to other disciplines is a subject of considerable debate on campus. A second question that is frequently raised is "whether or not the 'integration of learning' is the proper venue of the college and university?" In doing so, integration is often contrasted to the "acquisition of knowledge," about which there seems to be less concern as an appropriate goal of higher education.

In the following discussion, it is my assumption that the development of a capacity to integrate knowledge and thereby attain understanding is a legitimate goal of higher education, although it is, admittedly, more difficult to measure its achievement than it is for a goal of knowledge acquisition. This assumption allows me to proceed to address the first question -- the effectiveness of experiential programs for integrative learning.

This discussion is clearly in the nature of a "thought experiment," rather than an empirical analysis. This approach is, I believe, warranted by the subject matter of the investigation. The outcome, therefore, will represent a qualitative model of the integrative learning process, rather than a quantitative one--that is, it purports to describe how integrative learning occurs rather than to predict what or how much will be learned.

The attributes by which to develop a generic description of the integrative learning process are derived from a review of the literature of General Systems Thinking (GST), particularly in regard to its descriptive applications of interactions within social systems.[2] The appropriateness of this use of GST rests on its acceptance as a methodology for morphological analysis -- the study of the form and structure of systems; in this case, a social learning system.

The second and third columns in Table I represent two different models of learning: (a) "Growth," characterized by knowledge acquisition, elements of knowledge; and (b) "Development," associated with insight and the attainment of understanding of the relationships between elements.

Table I: Attributes of the Learning Processes

	GROWTH	DEVELOPMENT
Goal	Knowledge acquisition	Attaining Understanding
Process	Differentiation and Specialization	Integration
Arena	Physical	Meta-Physical
Elements	Facts, sense	Intuition, non-sense
Outcomes	Growth	Development
Philosophical Bases	Empiricism, Logical Positivism	Phenomenology, Humanism
Orientation	Individualistic	Wholistic
Source of Authority	External	Internal
Strategy	Vicarious experience	Direct experience

The terms in the right-most column in Table I are, thus, the descriptors of a "developmental" learning process. Given this description, the next question to be answered is "Are there any programs of which you are aware to which this description applies in whole or in part?"

To me, the answer to this question that seems most obvious is "programs whose professed purpose is the attainment of a whoiistic world view." Such programs are frequently concerned with the development of a monistic cosmology. By necessity, they attempt to deal with teleological and ontological issues. This suggestion may lead to some discomfort on the reader's part, which I hope will be resolved shortly. I do not intend to pursue the teleological or ontological issues beyond this brief acknowledgement of their importance. Instead, I intend to focus more narrowly on methodological issues and leave resolution of the philosophical issues associated with the application of the methodology to each prospective user.

In attempting to restrict this discussion to pragmatic issues, it seems useful to develop a working definition of what constitutes development"--the attainment of understanding. With such a definition, it is possible to develop an evaluation

schema for programs which purport to be "developmental"--i.e. to answer the question, "to what extent did the program contribute to the attainment of wholistic understanding?"

Lewis Beck's translation of Immanuel Kant's essay "What Is Enlightenment?" offers a useful answer, if we equate the attainment of understanding with an an "enlightened" viewpoint:

> Enlightenment is man's release from his self-incurred tutelage. Tutelage is man's inability to make use of his understanding without direction from another.[3]

This definition is also remarkable for its similarity to Russell Ackoff's description of the effective problem solver who has developed the ability to transcend "self-imposed constraints,"[4] If these notions are accepted as characterizing success in "development," the reader can readily see that there are a considerable number of existing constructs which could be used as indicators of attainment.

Personality and self-concept theory provide a rich source of possibilities. Various standardized measures of independence, ego strength, internal v. external directedness, and introversion v. extroversion are readily available in such forms as the Personal Orientation Inventory,[5] The Adjective Check List,[6] and the Strong-Campbell Interest Inventory.[6] Readers interested in pursuing this aspect more closely are referred to the literature on the affective and connotative aspects of learning.[8]

There are, in my experience, at least two generic classes of programs which share the idealized goal of attaining a wholistic world view and which can be described by the terms in the right-hand column of Table I: (1) Humanistic psychotherapeutic modalities; and (2) monistic religions. The former set includes, for example, Gestalt Therapy, Carl Roger's Client Centered Therapy, Abraham Maslow's approach to self-actualization, or certain so-called transpersonal approaches. Zen Buddhism is a prominent example of the latter group.

When these examples are examined more carefully, based on my understanding of the theories and their application in practice, the Gestalt and Client Centered approaches both appear to be consistent with the descriptors in the development columns except for "Arena: Meta-physical" and even this is an arguable exception, Zen Buddhism is wholly consistent, including enactment within a meta-physical arena.

Although unfamiliar to most Westerners, Mahayana Buddhism, of which Zen practice is a form, is being advanced for its novelty, consistency, and utility for interpreting several areas of contemporary Western thought; for example, Quantum Physics, Process Philosophy, psychotherapy, and general systems thinking.[9] The elements which appear in discussions of Zen practice, in contrast to Zen which is not something discussed,

provide many excellent examples of specific programmatic elements for study by designers of integrative educational activities.

By looking at the Gestalt and Client Centered approaches, both of which have been extensively documented, we should by inference be able to develop a list of common characteristics useful in creating a model of wholistfc developmental processes. Four possibilities are suggested. They are:

(1) Both are based on Humanism, as a philosophy, rather than Behaviorism.

(2) Both recognize the importance of a group process to each member's individual experience and progress toward his or her developmental goals.

(3) Both depend upon the development of an authentic relationship between the learner (client) and the facilitator (therapist).

(4) In both, frustration accompanied by anxiety at a level sufficiently high to be perceived by the learner as a "life problem" is present.

Of these four, the last probably requires the most explanation in relation to the design of an educational program. In most formal educational environments, programmatic emphasis is given to reducing the levels of frustration and anxiety, rather than increasing them. This is also the case in a psychotherapeutic setting when the client's latent or manifest anxiety levels are so high that effective interpersonal communication is blocked. It is however generally recognized that some anxiety and/or frustration is necessary and desirable for its motivational potential, as inferred from interpretation of Maslow's "hierarchy of needs" or of Atkinson's concept of "cognitive dissonance." Gerald Weinberg[10] in discussing General Systems Thinking, refers to this phenomenon as an example of the "Used Car Law" and its corollaries, to wit:

> A system that is doing a good job need not adapt.
>
> A system may adapt in order to simplify its job of regulating.
>
> A way of looking at the world that is not putting stress on an observer need not be changed.
>
> A way of looking at the world may be changed in order to reduce stress on the observer.

Formal education may be thought of as a means of attempting to teach a variety of ways of looking at and interpreting the world. "Stress" is the element, the absence of which leads

to unquestioned repetition of method and the presence of which leads to adaptation--i.e. development. Indeed, all three of the methods referred to above, Gestalt, Client Centered Therapy, and Zen practice, employ specific strategies to inject stress into the learning process: confrontational techniques in Gestalt; "silence" in Rogerian practice; and the koan of Zen. Traditional educational methods also have their anxiety producers, quizzes, exams and deadlines which, as any college professor will attest, have motivational potential. There is, however, a significant difference between the anxiety evoked during a therapeutic process and the test-related anxiety of the college student. The former is intrapersonal anxiety which tends to motivate long term development. The latter is situational anxiety which motivates short term growth (i.e. to collect more data to be memorized for the test and, unfortunately, frequently forgotten shortly thereafter).

THE QUALITATIVE MODEL

Relatively recently, a class of descriptive or qualitative models known collectively as "catastrophe theory" models has been advanced by its originator, Rene Thom,[11] as characterizing certain human behaviors. In elaborating on Thom's work, E.C. Zeeman says:

> ...we may expect the elementary catastrophes to be typical models of brain activity, especially of those parts of the brain such as the limbic system....it is in the limbic system that emotions and moods are generated.... Therefore, we might expect catastrophe theory to be the mathematical language with which to describe emotion and mood....it is not unreasonable to assume that (the elementary cusp catastrophe) is not only a model of the observed behavior of aggression, but also a model of the underlying neural mechanism.[12]

From these remarks, by extrapolation, a reasonable inference is that the elementary cusp catastrophe appears as a likely candidate for modelling the integrative learning process. Rather than aggression, as cited above, manifest anxiety or frustration is the emotion, and we are seeking the underlying neural mechanisms associated with anxiety and learning behaviors.

As a class, catastrophe models are used to describe situations in which one or more of the controlled variables is associated with a discontinuous change in an endogenous (dependent) variable. The success of qualitative modelling, which is descriptive rather than predictive, depends on the ability:

> ...to choose coordinates In such a way that the kinds of discontinuity that occur are one of a standard list of seven elementary catastrophes.[13]

In this instance, it is our desire to model "learning" as a discontinuous developmental process.

For ease of interpretation and graphic representation, a three dimensional learning model in which there is one endogenous variable, L (learning) and two controlled variables, T and P (time and program) is proposed. As a working hypothesis, it does not seem unreasonable to postulate that learning (L) is a function of the amount of time (T) that the learner is involved, the planned program (P), and the learner's initial attitude toward learning or mind set (S). Thus:

$$L = f(T,P,S)$$

Both P and S are understood to represent complex sets of variables, while T may be interpreted as either objective (clock) timet t_o, or subjective (perceived) time, t_s. A model which attempted to deal with the inter-relationships between the associated variables, assuming we could identify them, would be extremely complex. Fortunately, we do not have to deal with each and every variable in order to obtain a usable interpretation, since we are not trying to predict how much would be learned, but to develop some insights into how learning may occur.

A further simplifying assumption is that at the macro-system level, the variables P and S are independent. This is tantamount to suggesting that a learning process can be designed without regard to the mind set of the learner for whom the program is being designed. In practice, this is often the case for higher education. Despite admissions criteria intended to screen out or attract right-minded students, research on the prediction of academic success has been able to identify relationships between variables by which to explain less than 30% of the variance in prediction vs. actual performance.

These assumptions allow the model of the learning process to be expressed as two functions which may be dealt with independently :

(1) $L = g(T,P)$

(2) $L = h(T,S)$

The former is, for our purposes here, the more interesting because both T and P are controllable from the point of view of the program designer; whereas, S rather clearly is not. Equation (1) may also be looked at as two equations:

(la) $L = j(t_o,P)$

(1b) $L = k(t_S, P)$

The interpretation of the model varies somewhat based on whether we see "time" as an objective phenomenon or a subjective one, as we shall see shortly.

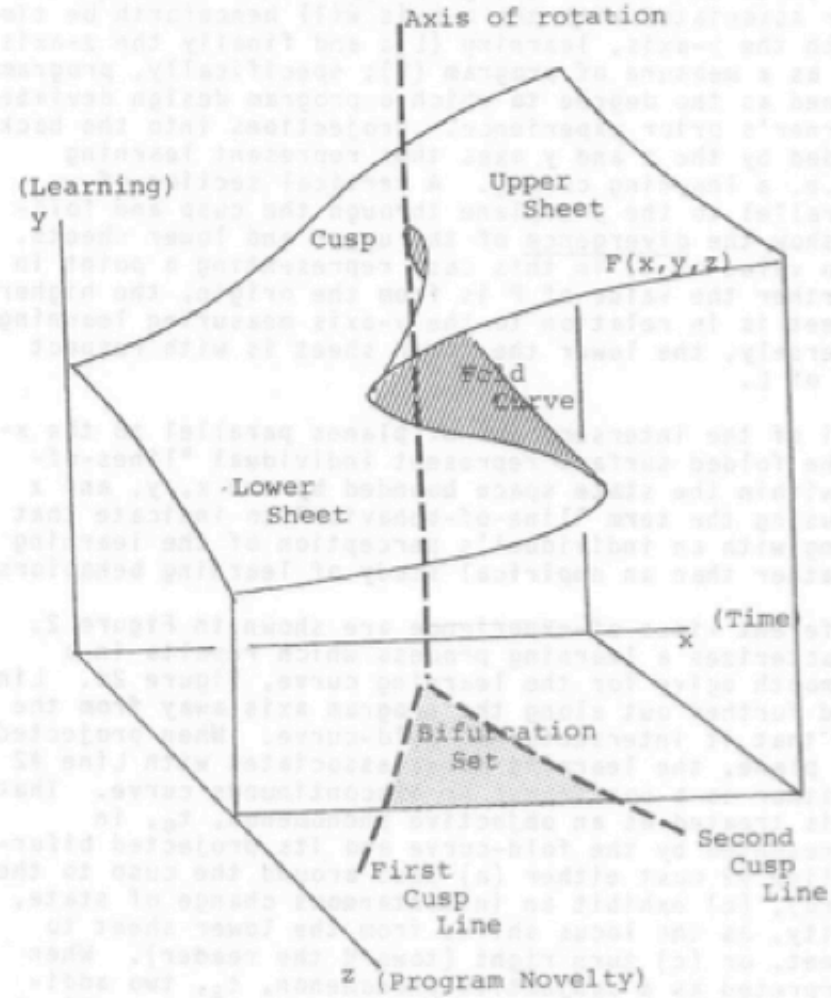
With one endogenous and two controlled variables, the relationships may be modelled using the three dimensional cusp catastrophe model, the general form of which is depicted in Figure 1. The graphic form of the cusp catastrophe in three dimensions is a folded plane surface, the fold of which does not extend through the full width of the plane, but terminates on its surface as a wrinkle or "cusp." The upper and lower sheets of the plane on either side of the fold area represent most likely behavior while the middle sheet, shaded in Figure 1, generally represents least likely behavior.

> The curve on the surface where the upper and lower sheets fold over into the middle sheet is called the fold-curve, and the projection of this down into the horizontal plane C is called the bifurcation set. Although the fold-curve is a smooth curve, the bifurcation set has a sharp point, forming a cusp, and this is the reason for the name cusp-catastrophe. The cusp lines form the main thresholds for sudden behavior change....[14]

A further property of this model is that the orientation of the model, hence its interpretation, may be changed by rotating it around a line perpendicular to the horizontal plane C which passes through the cusp. In this instance, we will begin our modelling process with the model oriented so that a line perpendicular to the x-axis bisects the bifurcation set. Under this condition, with the two control variables, T and P, measured on the x and z axes, the variable on the x-axis is called the normal factor and the variable on the z-axis is called the splitting factor. As the model is rotated away from this position around the vertical through the cusp, the factors are interpreted as conflicting factors. Both orientations are relevant to our discussion; however, we shall begin with the non-conflict state.

The appropriateness of this model is based on how well the model describes the process under consideration. Zeeman suggests[15] that the model is appropriate in situations exhibiting five qualitative features: (1) bimodality, (2) inaccessibility, (3) sudden jumps, (4) hysteresis, and (5) divergence. Education is, according to Zeeman, one such situation.[16] Rather than demonstrating its appropriateness, a priori, I will let the justification of this specific application grow out of the interpretation by reference to the five features listed above.

Figure 1: The Cusp Catastrophe Model



(Zeeman, E. C. *Catastrophe Theory: Selected Papers, 1972-1977.* Reading, MA: Addison-Wesley, 1977)

INTERPRETATION

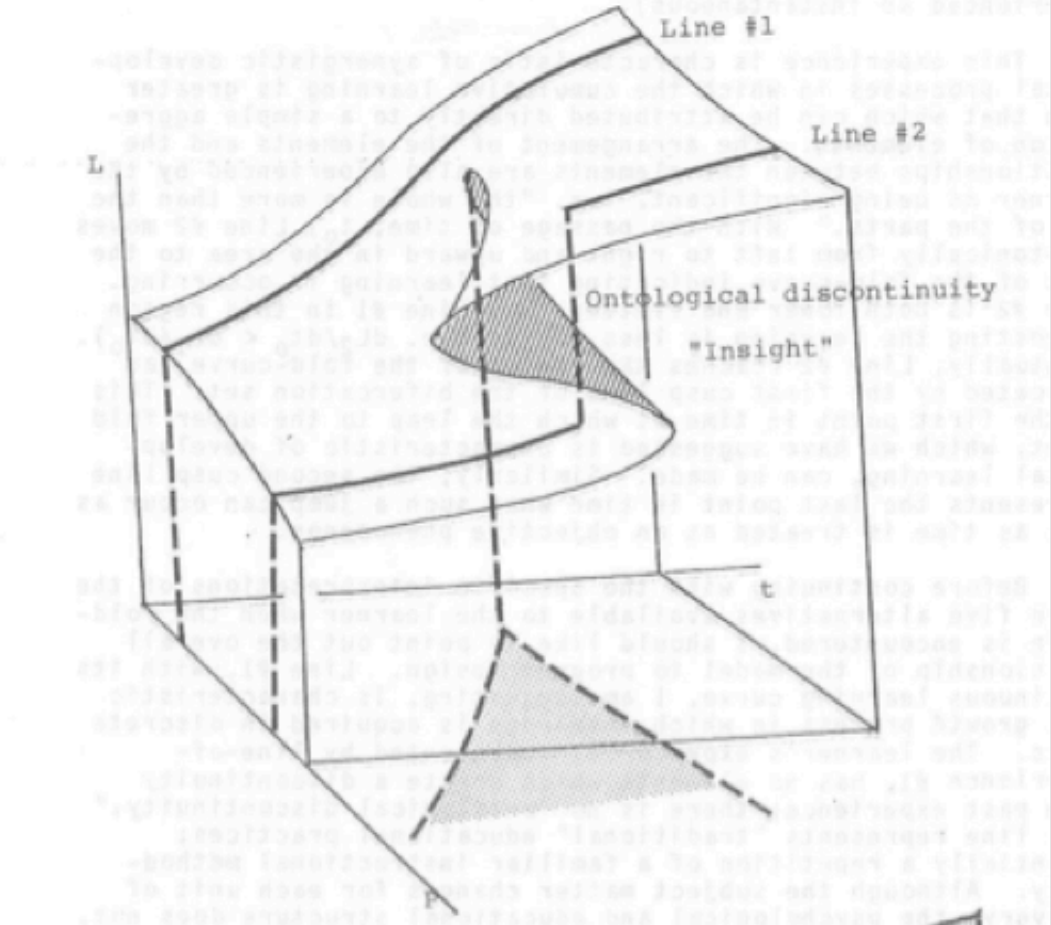
To apply this model to the learning process, it is first necessary to label the axes. Using the variabies from equation 1, the factor associated with the x-axis will henceforth be time (T); that with the y-axis, learning (L); and finally the z-axis will be used as a measure of program (P); specifically, program novelty defined as the degree to which a program design deviates from the learner's prior experience. Projections into the back plane A bounded by the x and y axes thus represent learning over time (i.e. a learning curve). A vertical section of the model parallel to the y-z plane through the cusp and fold-curve would show the divergence of the upper and lower sheets. For any given value of x, in this case representing a point in time, the further the value of P is from the origin, the higher the upper sheet is in relation to the y-axis measuring learning, L, and, conversely, the lower the lower sheet is with respect to the value of L.

The loci of the intersections of planes parallel to the x-y plane with the folded surface represent individual "lines-of-experience" within the state space bounded by the x, y, and z axes. I am using the term "line-of-behavior" to indicate that we are dealing with an individual's perception of the learning experience rather than an empirical study of learning behaviors.

Two different 1ines-of-experience are shown in Figure 2. Line #1 characterizes a learning process which results in a continuous smooth ogive for the learning curve, Figure 2a. Line #2 is located further out along the program axis away from the origin, such that it intersects the fold-curve. When projected onto the x-y plane, the learning curve associated with Line #2 may appear either as a continuous or discontinuous curve. That is, if time is treated as an objective phenomenon, t_o, in the area represented by the fold-curve and its projected bifurcation set, line #2 must either (a) pass around the cusp to the left (rearward), (b) exhibit an instantaneous change of state, a discontinuity, as the locus shifts from the lower sheet to the upper sheet, or (c) turn right (toward the reader). When time is interpreted as a subjective phenomenon, t_s, two additional alternatives are available: (d) hysteresis or cyclical behavior and (e) regression. These latter two alternatives will be discussed more fully later.

"Program" is, thus, the splitting factor that locates the 1-o-e with respect to the cusp, establishing the bi-modality of learning; "growth," represented by line #1, versus "development," indicated by line #2. The learning curve associated with the discontinuous state is graphed in Figure 2b. It is my contention that this is the curve descriptive of the attainment of understanding, represented in the model by the sudden jump of the learning curve in the region of the fold-curve--insight based on prior knowledge acquisition, the "aha" phenomenon.

Figure 2: Continuous and Discontinuous Learning



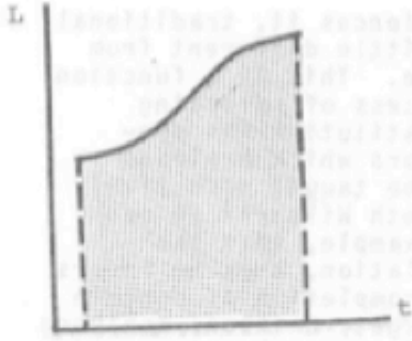


Fig. 2a: Line #1 Learning Curve

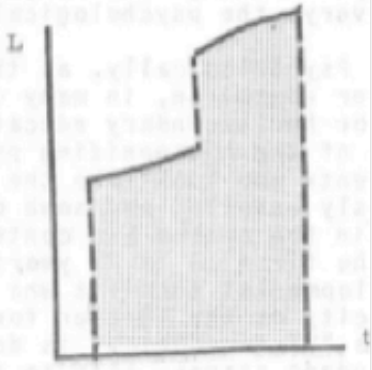


Fig. 2b: Line #2 Learning Curve

(Zeeman, E. C. *Catastrophe Theory: Selected Papers, 1972-1977*. Reading, MA: Addison-Wesley, 1977)

Demonstrable learning has occurred and time prior to and after the experience are measurable, but the time it took for experience of insight is not measurable (i.e. phenomenally it is experienced as instantaneous).

This experience is characteristic of synergistic developmental processes in which the cumulative learning is greater than that which can be attributed directly to a simple aggregation of elements. The arrangement of the elements and the relationships between the elements are also experienced by the learner as being significant, i.e. "the whole is more than the sum of the parts." With the passage of time, t_o, Line #2 moves monotonically from left to right and upward in the area to the left of the fold-curve indicating that learning is occurring. Line 12 is both lower and flatter than Line #1 in this region suggesting the learning is less rapid (i.e. $dL_2/dt_o < dL_1/dt_o$). Eventually, Line #2 reaches the region of the fold-curve, as indicated by the first cusp line of the bifurcation set. This is the first point in time at which the leap to the upper fold sheet, which we have suggested is characteristic of developmental learning, can be made. Similarly, the second cusp line represents the last point in time when such a jump can occur as long as time is treated as an objective phenomenon.

Before continuing with the specific interpretations of the above five alternatives available to the learner when the fold-curve is encountered, I should like to point out the overall relationship of the model to program design. Line #1, with its continuous learning curve, I am suggesting, is characteristic of a growth process in which knowledge is acquired in discrete units. The learner's experience, represented by line-of-experience #1, has no elements which create a discontinuity from past experience; there is no "ontological discontinuity." This line represents "traditional" educational practices; essentially a repetition of a familiar instructional methodology. Although the subject matter changes for each unit of delivery, the psychological and educational structure does not.

Psychologically, as the student experiences it, traditional higher education, in many cases, is very little different from his or her secondary educational experience. This is a function both of the homogenizing pre-admission process of selecting students who look like the students the institution has previously enrolled and some ontogenetic factors which may constrain the method and content of what can be taught effectively in the first 18 to 22 years of life. Kenneth Wilber[17] is one developmental theorist who suggests, for example, that the capacity of the learner for abstract speculation, what he refers to as "Vision-Logic," is dependent on the completion of certain precedent stages, akin to the stages of Piaget, Erikson, Kohlberg and others. Without debating the merits of stage theories as a whole, my interpretation of Wilber's remarks suggests that traditional education is traditional precisely because it is already doing that which is most do-able in the first 18 to 20 years of life--teaching analytic methodologies for dealing with

the world as though it is composed (solely) of objective, quantifiable phenomena.

This approach, in the West, is consistent with the deterministic, dualistic Cartesian-Newtonian philosophical foundation on which it rests. Pragmatically, non-analytical approaches cannot be taught, although they may be learned. It is, therefore, useful first to develop a solid foundation of analytic method on which to base an understanding of that which is non-analytical. The problem, and not all educators would agree that it is a problem, is that traditional educational practices frequently end with the acquisition of analytical methods, leaving the learner's world in parts.

While analysis has proven to be a very effective way of taking the world apart, it is not an effective means for attaining integration of disparate parts, particularly when the original analysis was not conducted by the person who is now seeking the synthesis, as is the case in higher education. The student's "world" has been divided into pieces called "courses," "minors," and "majors" by the program designers not by the students, often not even by the current faculty. It should not be surprising, therefore, that pulling the pieces together into a coherent whole is perceived to be a difficult undertaking; so difficult, it is frequently avoided. The subsequent relationship of the parts, Gestalt formation, the formation of wholes, integration of knowledge and experience, is left to the "college of hard knocks," psychotherapists, rabbis, pastors, priests, the neighborhood bartender and other gurus of contemporary society.

The model points out that there are processes at work which may be used productively to foster developmental learning as well as knowledge acquisition. If these processes are ignored, they remain as "uncontrolled variables," as Russell Ackoff would call them.[18] Recognition makes it possible to bring them into the realm of "controllable variables." If the characteristics of the planned program, shown as P_2 on the z-axis of the model, diverge significantly from our "traditional" program P_1 the associated line-of-experience #2 is "split" from that of traditional learner. As Line #2 is moved away from the origin along the z-axis by successively more "novel" programs, so also does the horizontal distance between the cusp lines and the vertical distance between the upper and lower sheets increase due to the divergence of the fold-curve.

The distance between the cusp lines may be interpreted as the time span during which the learner is "ripe": for the attainment of understanding. The distance between the upper and lower sheets may be thought of as representing the threshold to be overcome in order to attain understanding. The greater the divergence in program design from the traditional, the greater the time span during which the leap can occur, but also the greater the threshold and, therefore, the greater the effort required.

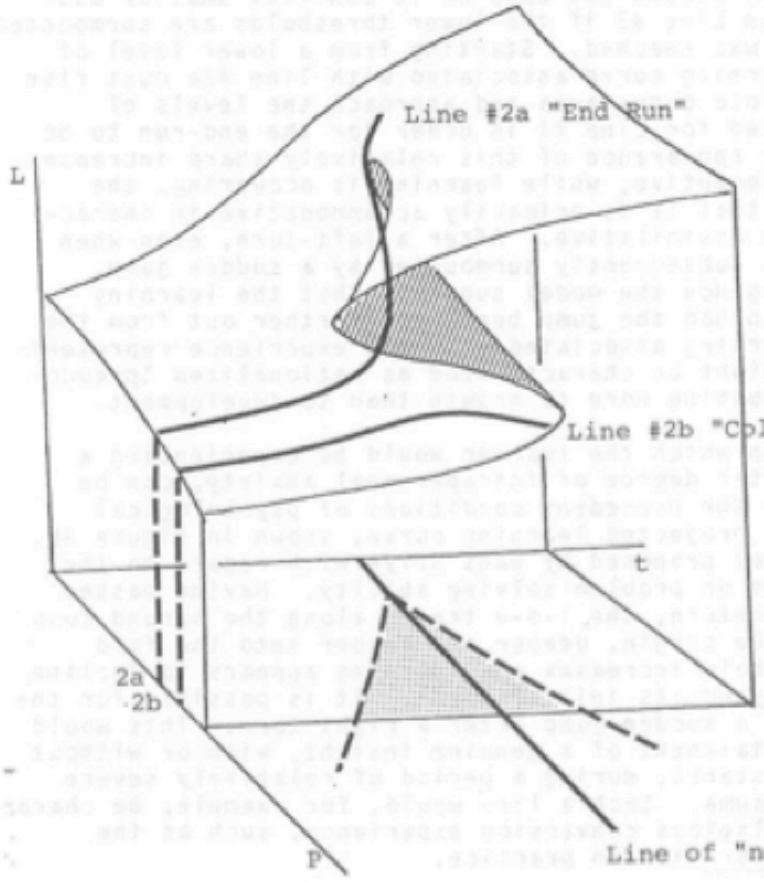
With respect to our problem of program design, the model suggests that we have two controllable variables: (1) time, and (2) program divergence or "novelty." Time, as a variable, has two aspects: (a) duration, and (b) timing of the discontinuity. With respect to the former, the planned program must be of sufficient duration for the line-of-experience to enter the fold-curve and resolution to occur. Timing refers to the placement of the discontinuity within the time frame of the program. Program diversity or novelty is important as the splitting factor which also mediates the point at which the line-of-experience enters the bifurcation set; thus the height of threshold and the time available to attain resolution.

The more a program design, in the perception of the learner, diverges from the learner's expectations and experience, the greater the threshold and the greater the degree of intrapersonal anxiety present. Previously learned "rules-of-the-game" no longer seem to apply. Energy must be devoted to learning new rules and developing new coping strategies. This is one reason, the model suggests, that measurable learning appears to be less and at a lower rate in the early stages for Line #2 than for Line #1. The discontinuity experienced when the learner perceives himself to be entering the bifurcation set results in intrapersonal anxiety which is a source of energy to make the leap to the upper sheet (i.e. to attain understanding). This constitutes a necessary condition for the attainment of understanding, but it is not always sufficient.

In addition to the attainment of understanding represented by the vertical leap, the model suggests four other possibilities. With time interpreted objectively, a line-of-experience entering the bifurcation set cannot extend beyond the second cusp line, which would require the clock to run backward. Under this constraint, two alternatives to the discontinuous leap to the upper sheet are: (1) for the line-of-experience to bend leftward toward the cusp moving forward temporally by approximately paralleling the initial cusp line until the cusp is reached and can be passed around, an "end-run" strategy; or (2) turning to the right, continuing forward in time paralleling the second cusp line. These alternatives are depicted in Figure 3 as lines #2a and 2b respectively.

Line #2a implies that the learner is taking action to reduce the discontinuity, to move toward a region of the fold-curve where the threshold is lower or non-existent through restructuring the program along more familiar lines. This can occur physically, for example, by a "drop and add" program adjustment, or psychologically through a process of rationalization. The model suggests that the "end-run" strategy is available until a "point of no return," represented in the model by a line perpendicular to the x-axis passing through the cusp, is reached. In the case presented, the locus of the "points of no return" forms a line which bisects the bifurcation set. When this line is reached, it is no longer possible for the learner's l-o-e to bend to the left in the splitting

Figure 3: "End run" Rationalization and "Collapse"



(Zeeman, E. C. *Catastrophe Theory: Selected Papers, 1972-1977*. Reading, MA: Addison-Wesley, 1977)

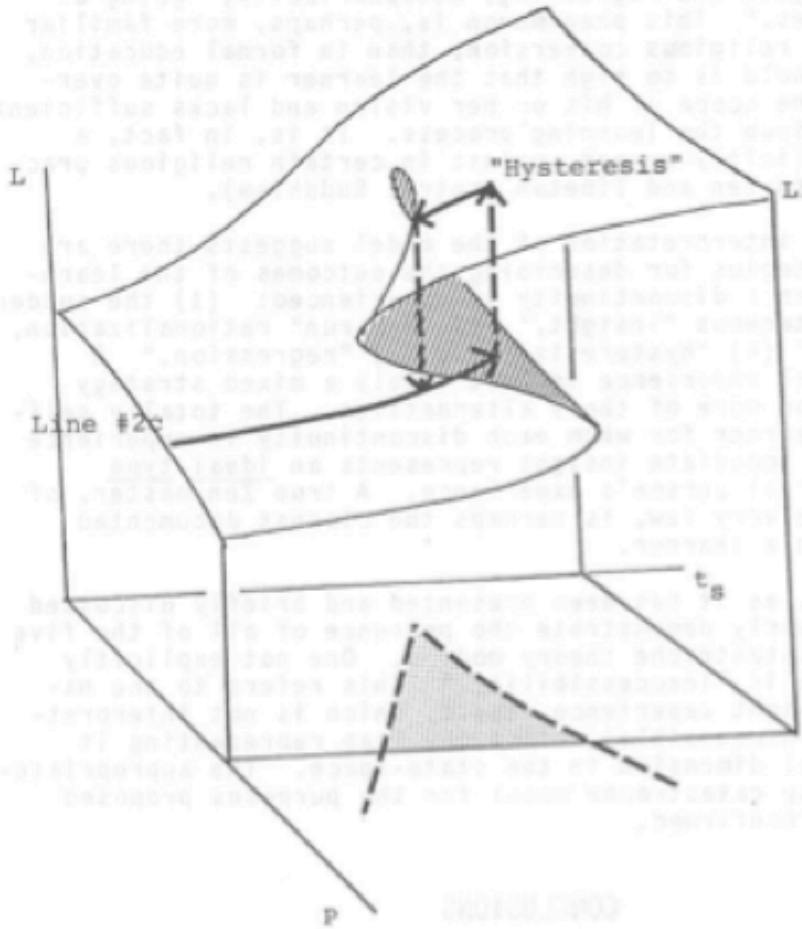
factor-objective time interpretation. This line metaphorically represents the condition in which the learner has invested so much energy into the effort that it is no longer possible to achieve resolution through rationalization.

The projection of Line #2a onto the rear plane, representing its associated learning curve shown in Figure 3a, looks similar to the continuous learning curve of Line #1 when it passes completely around the cusp or it exhibits smaller discontinuities than Line #2 if the lower thresholds are surmounted before the cusp was reached. Starting from a lower level of learning the learning curve associated with line #2a must rise rapidly in the fold curve area and approach the levels of learning indicated for Line #1 in order for the end-run to be successful. The appearance of this relatively sharp increase in learning is deceptive; while learning is occurring, the model suggests, that it is primarily accommodative in character, rather than assimilative. After a left-turn, even when the threshold is subsequently surmounted by a sudden jump, because of divergence the model suggests that the learning will be less than had the jump been made further out from the origin. The learning associated with the experience represented by Line #2a might be characterized as rationalized "pseudo-insight;" contributing more to growth than to development.

Line #2b, in which the learner would be experiencing a greater and greater degree of intrapersonal anxiety, can be characterized as the precedent conditions of psychological "collapse." The projected learning curve, shown in Figure 3b, is similar to that proposed by Hans Selye with regard to the effects of stress on problem solving ability. Having passed the point of no return, the 1-o-e tracks along the second cusp line away from the origin, deeper and deeper into the fold area. The threshold increases and learning appears to decline possibly even beyond its initial level. It is possible for the 1-o-e to exhibit a sudden jump after a right turn. This would represent the attainment of a genuine insight, with or without therapeutic assistance, during a period of relatively severe psychological trauma. Such a line would, for example, be characteristic of a religious conversion experience, such as the attainment of Satori in Zen practice.

In Figure 4, the two additional alternatives associated with time interpreted subjectively are shown. The first, represented by Line #2c, shows the learner reaching the second cusp line, then continuing "backward" in time while remaining on the surface of the middle sheet of the fold-curve. This would represent "regression" as a psychological defense. The learner has restructured the temporal dimension psychologically, rather than restructuring the physical elements of the experience as is the case for the rationalized end-run. This allows the learner time to re-experience the event before assimilating the experience and attaining a new level of understanding represented by the learner's 1-o-e on the upper sheet. This accords very well with the interpretations of neurotic behaviors in the

Figure 4: "Hysteresis" and "Regression"



(Zeeman, E. C. *Catastrophe Theory: Selected Papers, 1972-1977.* Reading, MA: Addison-Wesley, 1977)

classical psychoanalytic model.

The second alternative, in which time is treated as subjective, seems to be a variant of the regressive experience. In this case, the line-of-experience is seen leaping to the upper sheet; however, rather than progressing forward in time, the line moves backwards dropping back to the lower sheet, a phenomenon known as "hysteresis." The learner cycles, alternately attaining insights and regressing; metaphorically, "going a-round in circles." This phenomenon is, perhaps, more familiar in episodes of religious conversion, than in formal education, when the threshold is so high that the learner is quite overwhelmed with the scope of his or her vision and lacks sufficient energy to continue the learning process. It is, in fact, a phenomenon explicitly warned against in certain religious practices (e.g. both Zen and Tibetan Tantric Buddhism).

Thus, the interpretation of the model suggests there are five pure strategies for describing the outcomes of the learning process when a discontinuity is experienced: (1) the sudden jump of instantaneous "insight," (2) "end-run" rationalization, (3) "collapse," (4) "hysteresis," and (5) "regression." A learner's actual experience is most likely a mixed strategy combining two or more of these alternatives. The totally self-transcendent learner for whom each discontinuity in experience contributes to immediate insight represents an ideal type rather than a real person's experience. A true Zen master, of which there are very few, is perhaps the closest documented example of such a learner.

The model, as it has been presented and briefly discussed above, does clearly demonstrate the presence of all of the five properties of catastrophe theory models. One not explicitly mentioned above is "inaccessibility." This refers to the nature of the insight experience itself, which is not interpretable (i.e. is inaccessible), since the leap representing it lacks a temporal dimension in the state-space. The appropriateness of the cusp catastrophe model for the purposes proposed herein is thus confirmed.

CONCLUSIONS

With this confirmation, we should now be able to make some inferences about the nature of the learning process on which to base the design of an integrative educational program. From the construction of the model itself, the effects and relationships of the controllable variables, program design (P) and time (T), upon learning (L) and with each other become clearer. Specifically, the significance of time duration is made manifest and its correlation to intrapersonal anxiety is highlighted. Intrapersonal anxiety, mediated by the novelty of program design, its degree of divergence from the learner's prior experiences becomes the linking factor relating time as an

objective element, hence also an element of program design, with the learner's subjective experience of the program.

Since by definition intrapersonal anxiety is an individualized phenomenon, this argues for the need to individualize the educational process. While this may not be an attractive proposal within the economic constraints of higher education, the model points out that maximization of individualization represents an important design goal.

Intrapersonal anxiety is injected into the learning process the model suggests, through designs which are perceived by the learner as "novel" in the sense intended by Alfred North Whitehead.[19] Novelty lends appetence to the learning process, generates energy, leading to divergence, the creation of negentropy counteracting the downward trend suggested by Line #2b associated with unresolved discontinuities. This implies that program designs should depart in one or more ways from the learner's prior experience. Three possibilities are suggested for consideration:

(1) The context or environment: Removing the program physically from the surroundings with which the learner is already familiar--off-campus rather than on; urban settings for suburban students, etc.

(2) The content: Selecting a subject for study with which the student is relatively unfamiliar--this is particularly important as a levelling mechanism if instruction is going to be in a group situation where learners' prior education may vary substantially, as is characteristic of upper level liberal arts students from different institutions.

(3) The structure or style: Again, departure from past experience in leadership style, organization, choice of materials, delivery mode and other structural elements will tend to exacerbate intrapersonal anxiety--using a dialogic seminar format ala Paolo Friere[20] for example, rather than the more familiar didactic mode.

The art of program design lies in combining these elements into a flexible program structure which allows for delivery in a group context, but may be adjusted at the individual level. The central issue is not only to be able to combine these elements but also to create an appropriate critical doubt-mass (in Chinese ti-yi-t'uan) for each individual. Many programs, deliberately or accidentally, contain one or more of these elements. Few of which I am aware are designed to keep the learner at critical mass throughout the learning experience.

Some programs do achieve the necessary levels of novelty in design so that the learner's initial experience splits from tradition (i.e. the projected 1-o-e approaches the region of the fold-curve). Frequently, this condition is viewed as undesir-

able and modifications encouraged such that the end-run results. In programs for which intrapersonal anxiety is not explicitly treated as a controllable variable, one can only speculate about which of the five outcomes is more likely. From a knowledge of the population as a whole, it might be argued that "rationalization" and either one of the forms of "regression" is more likely than "collapse." Where "insight" falls with respect to these other outcomes remains, sad]y, largely unknown. The literature relating to Maslow's self-transcendent stage seems to suggest that the proportion of "insight-full" individuals is small.

The attainment of a critical mass is, of course, only a necessary pre-condition for insight, or synergy in learning. While it is necessary, in this interpretation, to set the stage, it is the interaction of the elements within the program design that triggers the learning, not the mere presence of the elements themselves. In other words, it is not only novelty of context, content, or style, but the way the three work together to support and reinforce the goal of integration and developmental learning. For example, a course in counselling psychology would be not only novel in content, perhaps offering a structuralist interpretation, but also offered in an experiential rather than a didactic mode and presented within a mental health institution rather than a classroom on campus.

If the model is a valid interpretation of the process through which understanding is attained, it is now possible to list some of the attributes of an integrative educational design:

(1) An environment or context significantly different from that experienced previously by students--an urban environment for students from rural or suburban backgrounds; a foreign country for ethnocentric students; a small, intense group experience for only children and/or students from a large, amorphous institution, etc.

(2) Novel subject matter--a subject not readily available on the traditional campus, or a traditional subject presented in a non-traditional way--psychobiology rather than psychology and biology; general systems theory; phenomenology; linguistics; creative studies.

(3) A learning style that favors self-directed learning and self-discovery rather than dependence on external authority for direction.

(4) A structure that encourages intensive individual contact between faculty and students as well as a group learning experience.

(5) The use of direct experience to complement the vicarious experience of reading and observation to allow reality testing and validation of insight and understanding.

(6) Enough time for the experience to "ripen" and to be resolved. Since this is an individual issue, the time required is hard to predict for a group. Rather than to attempt to predict, it would be preferable to present the learning experience as one phase of an open-ended continuing process, time constrained as a matter of administrative convenience rather than educational program design.

(7) A program faculty with training and experience in group process facilitation as well as in-depth knowledge of an appropriate subject matter and the skill to present it in an integrative mode.

(8) A faculty that functions effectively in a relatively high risk, high stress, interpersonally intense situation, with an orientation toward problem solving, crisis management, and learning from experience rather than avoidance of it.

(9) A program management structure that allows for flexibility in program content and structure in order to accommodate changing circumstances in the environment in order to maximize opportunities for direct experience--i.e. an "open" system rather than a "closed" one.

(10) An environment rich in learning resources to facilitate access to the widest possible variety of opportunities for experience which can be related to the subject matter being studied, either deliberately or serendipitously.

(11) An evaluative process that provides continuing feedback throughout the learner's experience as well as a reasonably objective basis for determining a grade and/or academic credit at the end of the formal program.

(12) An evaluation process which includes consideration of both qualitative and quantitative aspects of learning.

Clarification of the last point may be needed. The qualitative aspects of learning are not well measured by available techniques based on analysis. The "quality" of a learning experience refers to the learner's ability to relate personally to the learning, to create a coherent whole of which the individual is an inseparable element, not what or how much is learned. This is a somewhat different use of the concept of "quality" which, in many institutions is treated as an objective phenomenon; for example, evaluating the quality of writing by the degree to which it conforms to a methodological ideal, rather than the degree to which the act of writing contributes to the writer's and reader's understanding of the subject.

A reality of the college curriculum, including that of the liberal arts institution, is that it tends to reflect the prevailing societal norms, interests and needs. Within our society, the analytic tools of technological development are more highly

valued than the synthetical approaches to interpreting experience. The physical sciences are among the most methodologically and technologically evolved disciplines. The social and behavioral sciences have, in many instances, been modelled on them. Analysis, "scientific methodology," has been and probably remains the prevailing mode of intellectual inquiry. Indeed, as Russell Ackoff presents it:

> …we use analysis and inquiry simultaneously. For example we speak of "analyzing a problem" and "trying to solve a problem" interchangeably. Most of us would be hard pressed if asked to identify an alternative to the analytical method.[21]

One reason for this difficulty, as I have asserted previously, is that methods of analysis can be taught, but a capacity for non-analytical thinking (synthesis) cannot. Having been taught a method, there is a tendency to over-generalize its application, to apply analytical techniques to problems which are non-analytical in character, such as the "evaluation of quality."

An immediate goal of program design is, therefore, to bring these two modes of thought into a better balance. As long as an analytic approach to problem solving is the sole or dominant mode, the learner's access to experience as a learning resource will be unnecessarily constrained. As Russell Ackoff has stated:

> These two approaches should not (but often do) yield contradictory or conflicting results; they are complementary. Development of this complementarity is (the) major task....[22]

The development of the complementarity between the analytic mode and the non-analytic mode permits the learner to understand not only the analytic view of structure but also the non-analytic interpretation of function. More importantly, we have the ingredients for a new expression of the learning equation:

"Learning" = [{F(analysis) + G(non-analysis)} +
{H(intrapersonal anxiety) + Experience}]
= SYNTHESIS

An individual's learning is a function of the application of both analytical and non-analytical modes to his or her experiences which are perceived to be important life problems, the results of which contribute to dialectical synthesis, Gestalt formation. A variety of authors have identified and labelled this type of learning: "self-actualized," "enlightened," "kensho," "Vision-Logic," and other terms connoting the formation of a wholistic world-view or weltanschauung.

The elements in the center of the equation form an inseparable whole. Analysis and non-analysis remain unrealized intellectual concepts until their dialectic complementarity is triggered by experience with which anxiety, "suffering" is associated. Without the non-analytic, we have a method for the analytic interpretation of experience from a Behavioristic viewpoint which may lack functionality--i.e. alleviating the symptoms without solving the problem. Without the analytic, our view may be "novel" but lacking in structure and therefore utility. Without suffering, there is little or no motivation for change. Finally, without direct experience, the outcome of the learning process lacks the authority of "the supremacy of fact over thought," as Alfred North Whitehead calls it, such that:

> ...the supreme verification of the speculative flight is that it issues in the establishment of practical techniques for well attested ends.... In this way there is the progress from thought to practice, the regress from practice to thought. The interplay of thought and practice is the supreme authority.[23]

By inference, off-campus, field study programs with a high experiential component appear to meet the majority of the criteria developed herein for the design of integrative educational programs. Such programs, not surprisingly, are characterized by Gordon Walter and Stephen Marks[24] as being "therapeutic." The model discussed here suggests that such programs could be made even more effective by giving more explicit consideration to the role of interpersonal anxiety as an underlying factor in the developmental learning process. The necessity to create a "critical mass" for each individual student within the constraints of time and resources appears to be essential, as does the existence of an administrative mechanism for mediating and adjusting the program components within a relatively short time frame. The program structure must, therefore, include adequate feedback mechanisms for both the qualitative and quantitative outcomes.

Success in the design of an integrative educational program would be indicated by individual learning curves which exhibit discontinuities associated with the attainment of understanding as well as growth in knowledge. An individual whose learning curve exhibits such a discontinuity, it is postulated, will score higher on measures of ego strength and other indicators of a positive self-concept. The model suggests that such an individual not only increases cumulative learning more rapidly over time, but also enters into the next learning experience with less inertia to be overcome as indicated by the slope of the learning curve; the steeper the slope, the less the inertia and the greater the momentum (accumulation of negentropy).

The result of such a process has been called "systems thinking" or "Vision-Logic." It is the result of integrative learning through which:

> ... the formal mind establishes higher relationships.... It is thus the beginning of a truly higher order synthesizing capacity, of making connections, relating truths, co-ordinating ideas, integrating concepts.[25]

Above all else, such a learner should display an increased capacity for independent thought emerging out of the dialectic which juxtaposes analysis and non-analysis to bring about a complementarity--a more complete world-view than can be obtained solely through either approach.

# # # # #

FOOTNOTES

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[22]Ibid, p. 17.

[23]Alfred N. Whitehead, op. cit., pp. 80-81.

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