CHAOS IN THE CLASSROOM AND THE ECOLOGY OF ENGLISH LANGUAGE TEACHING

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Abstract

Ideas found in Chaos Theory already exist in Buddhist and Taoist cultures. These deep ideas are actually some of the most powerful initial conditions in the minds of the students and teachers here in Asia. While such ways of thinking may not be easily accepted by teachers who have too much dependence on Western models of teaching and learning, or who come to teaching with a pre-determined idea that teaching is what they think of as a science, the teacher in Asia may sense that much of what is offered in these Western models is flawed insofar as these models assume initial conditions that don't exist in Asia. If Chaos Theory holds any water, then we should be careful not to ignore the power of our sensitive dependence on initial conditions in any system we try to implement. If the initial conditions are different in Asia, then the results of any system will also be different here when compared to results obtained in the West.

As the ideas of Chaos Theory are already being accepted by scientists in Asia and in the West, there is a possibility that by using such a model in our English Language Teaching (ELT), we can develop, at last, a sound scientific framework for our thinking and practices which recognizes the contributions of ideas from Asia and sets them in the context of a more truly liberal arts model of education.

Until we recognize the need for such changes, the current turbulent state of ELT theory will continue to be misunderstood or ignored. Throughout this essay, certain humanistic values have acted as strange attractors to

reorganize and emphasize the ways we see and think about what we do in the ELT classroom. But the real benefits of this chaos will remain underdeveloped while we fail to reformulate what we do in ways that reject the old science of order as a given. The current state of ELT thinking that still struggles to choose categorically between the acts of teaching as a science or as a humanistic art produces more confusion and less order than it should. Perhaps, if we start to think in terms of Chaos Theory, we may eventually come to terms with what we actually do, and not just go on talking about what we think we are doing. A model of science that denies the presence of such humanistic concerns in teaching may be becoming outmoded.

One of the attractions of Chaos Theory for English teachers is that it can accommodate much of what we are already doing, and offers a way of making simple what has become confusing and over-complicated in our field. Instead of trying to write how-to manuals or to prove truths once and for all, we can get on with the business of teaching in ways that give the Asian teacher and student possibilities that are not imposed from the West, but are more amenable to ways of thinking that have shaped societies in the East.

Keywords: ecology, chaos theory, reading, classroom research, syllabus

Introduction

But tho' education be disclaim 'd by philosophy, as a fallacious ground of assent to any opinion, it prevails nevertheless in the world, and is the cause why all systems are apt to be rejected at first as new and unusual. (Hume: I: III: X)

When we train English language teachers in carefully designed courses with clearly organized packets of information which have usually been developed by writers working elsewhere to where we are training teachers, we often think that if our course and materials are "clearly presented" and contain a lot of "useful information" which is organized in what we call a "methodical way", then we are preparing the teacher to apply what has been learned in an effective manner. Often, the packets of information are meant to be applied sequentially, in an orderly fashion, to facilitate the learner processing the infor-

mation being offered so that the learner will have a clear "understanding" of what should be done to learn how to remember and use the language being taught in the class. By testing the student in one or more ways, the teacher will determine whether or not the student has mastered what has been taught in the lesson. Then the teacher can either move onto the next step in the process which is spelt out in the syllabus, or design remedial lessons or exercises for the student. If the teacher-trainer sits in on one of these classes and sees that the teacher proceeds in a clear and orderly way, then the perception is that the teacher is in control of the materials and the methodology of teaching, and that learning is occurring.

What has just been described is a linear deterministic system with periodic occurrences of actions and results that are meant to be predictable. (See Capra: 75-156 for an explanation of the terms related to Chaos Theory used in this article.) As seems fitting in such a well-ordered system, the certainties and confidence created by the application of the principles and practices taught by the teacher-trainer are adequate to ensure that learning takes place in an orderly and reproducible manner that can be proven to work because of the predictable results specified by the system in which the teacher's methods and the syllabus exist in equilibrium with each other, and the student's learning develops through the student's participation in the lessons.

When we think like this, we overlook or forget that the image of order we make in our own mind does not necessarily pre-exist in the world we experience and live in. Bacon (1994: Aphorism 45) and Kant (2007: Introduction: VIII), have pointed out that because one can form such an image of order does not mean that one should argue that this order must exist in the world outside the mind. Theories and models are not pictures of the world, but symbolic simplifications of it. A theoretical image of order may comfort and even reassure us that there is a meaningful shape or structure to what we experience, but, as Karl Popper (1963: 1: II: III) suggests, we would be wrong if we were to confuse such images of a-priori order with what actually happens. These images are not meant to fulfill such a function. Our psychological predilection for or tendency to want order may explain why we need these images. But we grant them more than they should have when we substitute such images for the world we think they describe. M.A.K. Halliday explains the danger of this quest for order in terms of the distortion of language into an unnatural thing:

> Language, unlike mathematics, is not clear cut or precise. It is a natural human creation, and like many other natural human creations, it is inherently messy. Anyone who formalizes natural language does so at the cost of idealizing it to such an extent that it is hardly recognizable as language any more, and bears little likeness to the way people actually interact with one another by talking. (Halliday, 1978: 203)

Theories and models are starting points for understanding the world, not explanations that replace the world. There is an element of paranoia in such projections which should caution us against making claims for a theory or model as an explanation or an accurate representation of what is happening in our empirically perceived environment. If we remember that such mental pictures are our own creations, not the world we experience, we may check any dogmatism that usually follows when we confuse our image for the world.

When criticizing or testing our models and theories, we have to go to the world they represent to check how accurate or powerful they are. We can only do this while we remain skeptical of them. All theories seem to be testament to our belief that there is a hidden structure or order to the cosmos which we can and must discern in order to understand the world and our place or role in it. A healthy skepticism may prevent us from seeing hidden structures that may not be there.

Another way of demonstrating that a system which presents its material in such rigorous order is erroneously conceived is to see that what actually happens in the classroom is not what the theory or principles predict. For all the promises of order offered by teacher-trainers, the student more often than not learns despite the system rather than because of it. If this is granted, even tentatively, then we need to ask of our system whether or not it can explain this phenomenon. If it cannot, then we should ask whether that system is explaining very much at all. If the students learn despite or apart from our system, and our system is unaware of how this learning occurs, are we justified in doubting the scientific validity of our system?

Empirically observed, the teacher may not be so interested in the linguistic theory or learning model on which a new set of grammar exercises are based, or on the possibility that one set of exercises may counteract or modify the effectiveness of another set. What interests the teacher is what the students may or may not be able to do. This magpie approach is not usually advocated

in teacher-training courses. It seems to run counter to the inculcation of orderly principles and practices so often advocated as the foundation of a scientific teaching methodology. Teachers scouring grammar books looking for more exercises that might work in their classroom suggests the teachers realize that the reality met with in the classroom is not the order envisaged in their training courses or prescribed in their syllabuses.

One weakness of the assumption of a fixed order in the teaching system which makes it scientific is that there is not a single universally accepted definition of what is scientific. To judge whether an exercise is scientific or logical by the way it visually appears as a well-ordered thing that is understood as meaningful, measurable, achievable and actionable may appear to be a scientific response. But the problem is that no scientific method would advocate such a way of judging its method as scientific. By using exercises or activities sanctioned by one or other of the methodologies we assume are scientific because they are presented in the guise of science, we are not necessarily proceeding in a scientific way. If we remain unaware of this problem, we will continue to do things that are inconsistent with the scientific approach we may say we are implementing or following.

Instead of trying to follow what may be an outmoded form of social science which a develops closed linear systems that only recognize order as a sign of science it may be argued that we can develop an approach that would advocate eclectic behaviour.

In making this claim we should recognise that the chaos produced by the teacher is part of an approach the chaos inherent in the acts of teaching and learning. By contributing to this chaos, the teacher is going with the flow. That the material drawn on to feed this process of chaos is developed at present by a linear deterministic system that finds such chaos anathema only goes to illustrate that despite our best laid plans, the attempts we make to impose more order on our world and our systems actually often produce forces that undermine that order and subvert our original intentions. This should not come as a surprise to anyone who has had a lot of experience of teaching. Chaos is a more common force in the classroom than order. In fact, a case could be made that too much order imposed on a class is unhealthy and will actually produce yet more unwanted chaos or failed learners.

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Chaos as a force which is understood as loose-structured, amorphous, resistant to description, in flux, and disruptive can be imagined in each of the areas which are studied in a fashion in English Language Teaching. At the risk of appearing too ordered, we will discuss how chaos may work in the following places: the brain, language, teachers, students, the classroom, and the syllabus.

The discussion which follows is an attempt to describe certain aspects of experience that lead me to think that the force of self-organizing systems (which are characterized by a-periodic and apparently random events which interact in ways as yet undetermined to shape the system in operation) is applicable to the various aspects of the learning process. This process is made up of forces in the brain, language, teachers and students, and is shaped by the requirements of a syllabus and the realities of the classroom. The operation of these self-organizing systems has not been adequately recognized in ELT, and may explain how many of the theories, not conjectures, offered in ELT are made false. When these forces are adequately explained, be develop that will explain what happens and so may an approach may foster the development of other theories that could lead to more effective learning.

If we can understand the classroom environment systemically, we may have the foundations of an ecology of ELT. In what follows, the environment of the classroom is understood as a systemic whole in which the processes of the brain, the students, the teacher and the syllabus form their own inter-related feedback systems which work ecologically together to shape the overall environment which also shapes each of the micro-systems within it.

In making a case for an ecological view of the environment of learning, we are seeing that thought itself is "a part of reality as a whole" (Bohm, 1980: xi). Bohm (1980: xiii) points out that when we think of reality as fragmented, "that is how the mind will tend to operate" and this mode of thinking influences the way we use language in a fragmented way to represent that fragmentation. But if we think of the world as a whole then our language will "move in a similar way, and from this will flow an orderly action within the whole" (Bohm: xiii). For Bohm, thought and language are part of the implicate order of the whole, not separate from that whole (Bohm: 23). By thinking in this organic way, we can restore harmony and balance to our world and so make our environment more healthy (Bohm: 32). For him, this way of seeing our environment has the added advantage of blending Eastern, Taoist and Buddhist views of nature

with Western ways of thinking. In *Great Souls: Socrates, Jesus, Confucius, Lao Tzu and the Buddha as Teachers* (Conlon, 2008: Chapter 7) I have tried to demonstrate the ways that we can see the teacher's role in the classroom in terms of accepting Chaos as a necessary condition for creating harmony for the students in their learning.

In what follows, we need to remember the roots of ecological ways of thinking in the concern for the health of the organism voiced by writers such as Halliday and Bohm. Gregory Bateson has put the case that:

> If an organism or aggregate of organisms sets to work with a focus on its own survival and thinks that is the way to select its adaptive moves, its "progress" ends up with a destroyed environment (Bateson, 2000: 457).

Bateson argues that we should move away from what he terms "our philosophy of control" (2000: 485) and recognize that in systems theory things control themselves much better than we as fragmented individuals control them by trying to understand the parts of what we study as differences rather than as wholes. For Bateson, the "Mind" is "an ecology of ideas" (2000: 519). In his ecology:

> Ideas may support or contradict each other; they may combine more or less readily. They may influence each other in complex unknown ways in polarized systems (2000: 510).

In a systemic approach, the ecology of learning language is understood in terms of the ways our thoughts and language are part of the environment in which we learn; not separate to that environment.

The Brain

What we conjecture is that the brain seems to be a complex non-linear system that works at least partly through generating and receiving feedback from its various cells as well as from the world. As such it is fluid in its organization. A change in one cell may produce changes in other cells. Sometimes, a change in one cell produces far-ranging changes in many other cells which in turn feedback to the original stimulus or change the cell that originated the change in the flow. When we say that the consciousness is active or develops, we do not

know that it functions in a predictable or linear way. As Hume (1969: I: III: I-XV) makes clear, we cannot predict what behaviour will be in the future. Nor can we predict that understanding will occur, memory will be activated, or that intelligence will be enhanced. We cannot as yet explain how the development in any of these ways is determined.

It may be suggested that the path of such modes of thought and action is chaotic. Sometimes what we do works, and sometimes it doesn't. This is another way of saying sometimes we are right and sometimes we are wrong. In turn, this suggests that we lack any valid theory of the brain which justifies a view of it as a place in which stable periodic behaviour occurs in a deterministic linear path within a static environment.

In the absence of enough data or observations to suggest that the brain works in the ways we have in the past hypothesized it works, are we justified in continuing to think along these lines? It could be suggested that we need to rethink our observations of any of the types of behaviour we have focused on to at least check whether such behaviour is more fluid, in flux, non-linear, unpredictable, a-periodic, and reliant on feedback than the current models we still seem to rely on would allow. If the current models cannot explain or allow for these features, then they should be abandoned.

When a certain area of the brain is activated, there may be a complex network of chemical signals sent from cell to cell which, depending on the paths followed by these forces, creates different outcomes (see Bono, 1990: 67-74). Each activated or deactivated cell provides feedback to other cells, some near to it and some apparently not connected in proximity. Whether a cell is activated or not and the degree to which it may be activated make the action of each cell an independent variable which interacts with all the other independent variables. This gives the system the appearance of a turbulent flow that balances these cells depending on each cell's receptivity to the forces passing through or over it. The complexity of the diversity of cells allows the cells to self-organize spontaneously. Flows of chemical actions create this patterning in ways that cannot be predicted, as each independent variable is changed by the other independent variables. All the cells are related to each other and transform whatever is happening in the flows to the brain's advantage. This makes the brain a dynamic non-linear system which seems serendipitously to produce an order out of the chaos suggested by the turbulence and unpredictability of the flows.

Language

We change words by using them, and we often use them in ways other than the ways conventionally accepted by others.

While it may be possible to influence how we use words by using them ourselves in new ways that are either accepted or rejected by others, this is not the same thing as being able to predict exactly what words or meanings will be used in future. To my knowledge no one has been able to predict how any language will develop by specifying what usage will be practiced in that language in future. The assumption that there exist rules for how a language changes or develops can only be based on what has been done in that language in the past. Such descriptions are necessarily partial and incomplete. Insofar as we admit social, political and economic conditions into our predictive mechanism, we are introducing variables that are well beyond the competence claimed by most linguists. By ignoring this limitation, we simplify our rules to the point of banality or meaninglessness.

My point is that language in general and words in particular change as much despite our conscious efforts to control them as by our deliberate attempts to shape them in meaningful ways. Once I use a word in collocation with any other words in a sentence or passage, that word takes on a life of its own. It also affects the meaning of the other words in its syntactic, semantic or phonological environment.

By choosing one word, I am also limiting my choice of other words, at least stylistically. How I choose that word or respond to it by choosing other words that go with it in what I say or write depends on many variables: my grammatical knowledge or proficiency, my familiarity with each word's lexical depth or history, my aesthetic sense of how the words sound or mean something when put together, my consideration for the listener or reader, etc. I don't necessarily consciously consider all these factors before I make a choice to use a word or pattern. Once I decide to use one word or pattern, I may often find myself having to modify my intentions and use of words. This makes me think of my words as in a non-linear, a-periodic, unpredictable feedback system that exists in a constant state of flux - much as the chemicals in the brain exist. That this flux also seems to apparent in the history of the language I am using, makes me think that there is more chaos in my language than is dreamed of in the science of psycho-linguistics as it is presently constituted. We don't know

how the brain handles all of these variables, but it does seem to manage to work in a way that helps me to express myself in words that others find comprehensible.

If there is sense to these arguments then we need a model of language that recognizes this chaos as a reality to be embraced. When we can accept that we acquire words and structures as much by accident as design, then we may get away from the prescriptive practices we currently seem to favour in our studies of language. While we continue to employ models that suggest the operation of linear and periodic orders to language that determine our use of that language, we will be trying to force the square peg in the round hole by forcing our perceptions to fit our a-priori theory.

But if we start with the assumption that there is a principle of chaos and flux in words, we may hope to develop a different model of how language works, changes, or develops in our brain and in our practices.

Teachers/ Course Designers

In speaking of teachers as a force of chaos, many teachers will not recognize my arguments. Most English teachers are controlled in syllabuses that appear to be very ordered, and which employ standard textbooks that are accepted by the conventional wisdom of the profession as leading to desired results that are predictable, achievable, meaningful, actionable and measurable. While such a world may be possible, it does not necessarily follow that it is the best of all possible worlds envisaged by Voltaire's Pangloss.

It could be suggested with some conviction that a teacher as a source of chaos is implicitly recognized by any syllabus maker who seeks to remove the teacher as an independent variable in the process by tightly controlling how and what that teacher teaches. Lock-step courses, which require or demand that a student must learn X and then Y by a certain time and demonstrate this knowledge in a standardized format or examination, seek to control the teacher's performance by limiting what can be taught. Such courses usually limit what is learned by imposing examinations and criteria that tell the student to ignore all else in the course the teacher may introduce, as such "extraneous" knowledge will not be on the examination and is not sanctioned in the course outline.

Other factors that shape teachers' impact are the linguistic and pedagogical capacities of each teacher. Every teacher has been taught to be a teacher and to use language in different ways and by different teacher-trainers or experience. The teacher's social, economic, political, and cultural background must come through in how that teacher works in the classroom. As every teacher is different in these respects, so every teacher will relate to the students differently. That some teachers may use English in better ways than other teachers, or may teach in better ways, means that every teacher will be different as users of the language.

When we also recognize that every student will have different experiences with every teacher of English they have ever had, we may see that the previous teachers of a student are still present in the new teacher's classroom as limiting or enabling factors that shape how a student responds to what is being taught. No teacher can ever know exactly what each student in the class brings to the room as prior knowledge, skill or experience. By ignoring such input, the teacher does not make his or her job necessarily easier. It more often means that the teacher is operating in a chaotic environment where such background is assumed not to exist insofar as it is assumed to be uncontrollable and un-understandable, and therefore irrelevant.

The outcomes of the course, expressed as test scores and grades are a silent admission that every student learns different things in that class and learns them probably in different ways. The teacher who inherits those students in the next class has no control over what they have already learned or how they have been evaluated. Even if all the students in the class begin from a starting point that is expressed as one standard deviation or band on a standardized test, that doesn't necessarily mean that the actual knowledge, experience or expectations of those students also falls within such a homogeneous statistical norm. How the student's previous teachers got the student to that point will not be the same for every student. How the students reached that level of conformity will be a factor in what the students do in future in the next class. That the teacher cannot really know what that norm means in linguistic terms seems to be reflected in the ignorance of most teachers of the significance of that statistical data. This lack of predictability seems to be recognized by the currently accepted TOEFL and IELTS tests which disclaim any predictive power as to how the student will progress from the point measured in the test.

When a teacher employs a particular method such as Suggestopedia or the

Direct Method, he or she is trying to appeal to the learning styles of the students. But each student has a different style and will respond differently. The teacher will also implement such methods in different ways to other teachers. And as a teacher forms a liking or dislike for particular students, or dresses differently, or comes from a country attractive or unattractive to different students, that teacher will be influencing every student in different and unseen ways. If a teacher is in a good or bad mood during the class, or looks at one student more or less than another, or provides feedback as marks or comments that each student may or may not accept, or uses a tone of voice or speaking style that is attractive or unattractive to each student, then that teacher will be stimulating and motivating some students but not others. In every minute of each lesson, some students will be turned on while others are turned off by what the teacher does or says as much as by what the syllabus tries to dictate. In this response, there seems to be a similarity to the ways the brain cells influence each other which has been discussed above.

But we often ignore this unpredictability or explain it away as something that is recognized or remedied by testing so as to identify the "good" student from the "weak" one. If the student is good enough, he or she will get over any obstacles created by the teacher. While this may be a necessary fiction, it is not necessarily the case in practice. If a teacher is trying to teach a rule pertaining to the past tense at a specified time, that does not mean that every student in the class will be ready for that lesson at that time or will have the same background knowledge to enable them to understand and use that rule in future. When the teacher then marks each student's performance of that rule, the teacher is giving feedback that often, and in unpredictable ways, fails to account for much in the student's experience. Such feedback will change the way each student responds in future to that teacher's efforts. And such responses will make the teacher's job easier or more difficult accordingly.

When the idea that we mis-communicate far more often than we communicate successfully is factored into the teacher's performance, we have another variable that is accepted in general practice but usually ignored or dismissed as a real factor in the evaluation of the teacher.

Such factors may justify an assumption that a-periodic and seemingly random affects on the students make much of what they actually do or achieve in the classroom meaningful only if the classroom is a self-organizing system that is largely beyond anyone's conscious control. The non-linearity of the actual

learning process, as distinguished from the linear process promised by the course outline and syllabus, creates factors which are unaccountable in terms of the syllabus or the teacher's lesson plans. This could suggest that the forces of chaos are always operational in every classroom and that the teacher is a major factor in the development of this chaos.

Much of what is new in evaluation methods offers a possibility of taking such variables more into account by developing ways of evaluating each student independently. But advocates of such a student-centered approach have yet to enunciate clearly the assumptions of chaos that could underpin one-on-one ways of evaluating and teaching, say, in a fractal approach to evaluation. In so far as testing approaches are usually grafted onto very rigid and pre-determined existing syllabuses, the incommensurability of, or incompatibility between, the two sets of assumptions and expectations will create disorder and inconsistencies in the classroom. This too may be a form of chaos, but it would seem to offer more conflict than stimulation in the classroom as the teacher will be doing contradictory things that will only confuse the students.

Students

The word "class" imposes a pattern of uniformity on the students who are in that class. They are in the same class. What this usually implies is that all the students in that class are at the same level of proficiency. We need this assumption to justify selecting a textbook that will work for all the students. This assumption also justifies the demands of the syllabus that by the end of the course the student will know or do particular things - recognize certain words, use certain tenses, perform certain tasks well, etc. This sounds very nice, but it isn't what happens in the real world. We have to remember and factor in the sensitive dependence on initial conditions for each student.

Even if we believe that some classes and teachers are able to satisfy all of these assumptions and goals, there would still be Alphas and Omegas in that class. This suggests that even in this conformity there are differences between each student. Positing such a homogenous result as ideal seems to me to be a strange thing to do. To want a class where all students learn the same thing in the same way at the same time is tacitly to want conformity and is basically more a technical outcome than a humanistic one. If there is a syllabus that sets such a goal, I have yet to see it explicitly written down on paper. The clones

that would be produced in such a class are not the human beings we say we want to develop in our institutions.

But what if it is precisely these variables identified above that are carried over into the next class? Won't these differences mean that the students are not the homogenous thing assumed by the next teacher or the syllabus? And won't these differences make it even less likely that the teacher of that next class will meet with the utopian success of the previous teacher? There seems to be, even in this best of all possible worlds, a principle of chaos in operation which subverts or disrupts what we do or wittingly/unwittingly achieve. Even if we accept as possible that the first teacher's class has worked like a well-oiled machine to produce homogeneity in all the learners, there is an inbuilt destabilizing factor that is carried over into the next class as the syllabus is progressively implemented.

Not that any teachers or course designers would ever realistically so hope for conformity. And that is my point. The logic of such a system is unacceptable, yet we continue to work in ways that assume such efficiency and effectiveness. The students' influence on each other is chaotic - unpredictable, non-linear and a-periodic. As soon as they role-play, do group work or work in pairs, they influence each other in observable ways. But they also influence each other in other ways through their personal interactions in and out of the classroom. Each of them knows different words, has a different voice, exhibits a different personality, brings into the class different external factors such as love troubles, family problems, personal likes and dislikes, tiredness, boredom, keenness, good moods, bad moods, prior experience in learning English, attitudes towards English, feelings for the teacher, acceptance of the material set in the course, needs, and countless other influences: different passions.

While we cannot describe empirically or prescribe exactly what students learn or say in activities such as role-play, we should be aware that the actual learning taking place is beyond the teacher's or the course designer's control. If such activities are effective, then it follows that depending on how we combine the students and activities in class we will find different results each time. A class that role-plays for fifteen minutes each period will learn something different to a class which does pair work for twenty minutes each period.

Inbuilt into textbooks may be the assumption that a variety of tasks is desir-

able because the textbook writer knows that some students will respond better to one type of activity than to another. Because of these differences, the results will be different for each and every student. When these students behave as chaotic attractors in their groups, the knowledge or skills they are developing will change. Such interaction is beyond the textbook's control. In their groups, the students form a self-organizing system which will last for as long as the task or activity they perform.

After the task or activity has been done, the students will continue to interact in new ways as a result of their experience in that task or activity. As such, each thing we do in class has an after-life which continues to affect every student in the class in different and unpredictable ways. The feedback every student gives and receives helps the student to regulate his or her own learning. This feedback will be different for every student because it will come from different students or be based on every student's own individual performance in a role-play or group.

When a teacher provides feedback, that teacher cannot hope to have one system or formula based on pre-set grammatical targets or errors etc. that fits all the students - if that teacher is basing the feedback on what is actually done by each student. The other kind of feedback is the feedback given by the student to himself or herself: "I like this", "I can't do this", "This is boring", "I like her", "What's the point?" This feedback is not usually accessible by the teacher, or if it is - say, in a journal or personal interview - it is easily misinterpreted or even unactionable.

In what has been described above, the interactions between the students and between each student and the teacher and the textbook are the sources of aperiodic, non-linear, apparently random, self-regulating feedback systems. As such they are sources of unstable conditions or turbulence. The Chaos theorists call the initial conditions in such systems "little devils" that produce the "butterfly effect" (Capra: 154); a small change in the initial conditions will produce far greater changes later that are unpredictable. Any one of the many factors so far mentioned can act as a little devil. Once a new variable is introduced as feedback into any system, then that system will become turbulent and produce chaos. Edward Lorenz (c.f. Capra: 154-155) argues that small initial changes in any system will produce widely varying and unpredictable results because such chaos is inherent in the system.

If a student learns a rule or word, either correctly or incorrectly, then that learning must eventually produce a result in that student's language. No two students will develop exactly the same way because there will always be imperceptible differences between what they start with or learn. Such differences will evolve or develop into two completely different states over time. Any mistake we make in measuring such factors, and such mistakes are inevitable, at the start or end of a course or during it will mean that predictions of how these factors will interact or develop in future is impossible. The more input there is in a course or class, the more will be the turbulence created or generated in each student. This is because each new item of input will affect every student differently, and every student will affect every other student at least partly based on what they are learning or already know.

Consequences for the Syllabus

The classroom described above in terms of the brain, language, the teacher and the student, is a dissipative system that is self-organizing. This system needs to be in a chaotic state if it is to transform all the input into an order which may, for a short time, be in equilibrium or balance. The system is dissipative because as it goes on it requires more and more energy to sustain its elements' interaction and self-organization. But much of this energy, defined as knowledge, time, effort, is beyond any teacher's teaching.

Each new input in any of the four areas actually dampens or slows down the process of creation through the effect of friction which is produced by the elements or factors interacting with each other. As each student reacts with his or her surroundings, he or she creates and experiences this friction. Such friction may also occur with every new word or word used in a new context, or with every new teacher or course. Every student has a sensitive dependence on the classroom environment (defined as the other students in the class, the textbooks, the teachers, the languages being used) which is different to the sensitive dependence of every other student in that class.

While the class itself may work as a self-organizing system, we can also see that each student in that class may be a self-organizing system which is open to change – in fact such change is usually expected by the teacher and the syllabus – and which yet is also dependent on the environment because each student is part of that environment. Like the class as a whole, each student has

the capacity to attain a state of mind or behaviour and maintain it in far-from-equilibrium conditions. Such openness and self-regulation is made possible by the continual flow of energy, thoughts, emotions, input. These flows make the student or the system he or she is, and participates in, creative. By creative, I mean that a new chaotic structure is being perpetually generated in the student and in the class, and that every student needs to find ways of existing and functioning in this perpetual generation of fluid/fluent states of mind and behaviour.

As all of this also holds true for every word in every brain and in every teacher, then what we seem to have is a complex network of chaotic systems that rely on each other in the learning and thinking process. We can never hope to enumerate all of the factors that go into this system, or describe how each of these factors interacts with all the other factors. This means that we can't satisfactorily describe all the causal relationships between them. This has implications for what we can research in the classroom environment.

The different factors or variables in the system that is the class not only generate needed turbulence; they also need resonance. This resonance between any two of the participants in the class creates an oscillating system of feedback which is thrown into turbulence once another factor or variable is introduced. Every student in the class is such a strange attractor.

While a perfect resonance may exist in a class of one student and one teacher, once other students are introduced into the class this resonance becomes turbulent. It becomes impossible to repeat exactly the resonance between the one student and the teacher. In this way, communication becomes quasi-periodic, non-linear and turbulent. This means that a state of equilibrium cannot really exist in any class. As any one variable is increased or decreased - and this occurs as soon as new material or a new activity is performed - there can be no settled point of equilibrium where optimal learning takes place. This is not to deny that there may be a series of equilibriums that may occur. But these states are impermanent and unpredictable. They should not be set as goals to be attained and maintained once and for all. Consequently, given the state of flux that actually exists in the classroom communications networks, it seems hard to conceive of there being any one-best-way to learn or teach in what we currently understand as orderly and controlled ways in that class.

While teacher-centered learning creates the illusion of there being a set of two

variables, the teacher and the students as a whole, and so encourages the fiction of attaining a desired state of equilibrium, the logic of chaos would suggest that the more we try to maintain such a false equilibrium, the more we actually are creating the chaos that will undermine our equilibrium. This chaos may not be the chaos that the students can learn in or work with. So, by trying too strenuously to regulate the flows or channels of communication and input and output, we may actually only be confusing the students, not helping them.

Environmental Implications

Together, the various aspects of the brain, language, students, teachers, textbooks, and the syllabus form the environment of a classroom.

If what has been argued or conjectured here makes sense, then certain consequences may follow for the syllabus in English language teaching. We need to understand the limitations that we artificially assume to exist in a given class where all the students are said to be of the same level of proficiency and so can equally benefit from a textbook that prescribes what they will learn and in what order they will learn it, so as to demonstrate specific verbal skills by the end of the course.

As students pick up words and structures in different ways, the idea that a textbook which sets these out in a linear fashion which is to be followed by all the students in a class in a fixed or rigid way seems unnecessary, if not irrelevant or harmful. What is needed is a text that allows each student to respond to what wants he or she to read in his or her own ways.

Literary texts such as novels, plays, and poems allow for this openness of response. Every student is free to see or hear different aspects of such texts and follow their thoughts which are stimulated by such input. Each student will be attracted to different words and patterns which he or she may like or need. Such experience in the students will be more amenable to the development of a state of creative chaos in which their learning can develop in ways that are commensurate to the ways their brains and their language work. Related to this point is the need to accept what is often labeled as "difficult" reading which opponents to open learning suggest de-stabilises the student-reader's confidence by dropping him or her in at the deep end. Such opponents, coming as they do from the school of controlled learning, often say that the reader

needs to be in control of the reading. But what they mean by "in control" leads to arguments that we start with control and order which posit confidence as a pre-existing factor. In fact, this isn't the case with real reading of demanding texts. Such attempts to provide comfortable reading for students actually may deprive the students of the truly chaotic experience they may need in order to learn in meaningful ecological ways.

The writing we should expect from the students will also have to be more open-ended. Journals that record their responses to the texts or ways they transform those texts offer a window through which the teacher can monitor the student's development. So would evaluation tasks which allow the students room to respond in their own ways to questions and materials. In-class activities such as role-plays and group work could also offer stimulation of and insights into the students' learning processes. But such activities cannot be too prescriptive. Perhaps, after reading the students' journals for a while, the teacher will be in a position to offer suggested small-group formations. Through in-class discussions, the students will already probably know what other students' ideas they are attracted to. So, leaving the formation of groups at least partly up to the students seems desirable. The self-organizing quality of the students' systems of thought, learning, and expression means that they should have an environment which encourages non-linear thought and language processes and which supports them in their far-from-equilibrium states of mind.

The flows of energy released by the students' interactions, writing, and discussions are the creative forces that allow such states to be experienced and maintained over the time of the course. The irregularity of such flows, the mark of Chaos, comes from opening the language-taps of input and output (reading, writing, and discussion) fully. The more the language and ideas flow, the more the students will experience turbulence. Such experience is not to be avoided. It is to be encouraged. By it, the mind and language are stimulated to shape themselves. When their minds are attaining their own structure of learning in such an environment, they are behaving as self-organizing systems.

Writing a journal on a regular basis helps the student to record and see this system taking its own shapes. In such writing, the student's previous or subsequent entries offer the feedback needed to continue the turbulent flows of words, ideas, and emotions through which learning occurs. Every student's particular system will be a novel structure. The more feedback loops there are in a student's experience of language, the more chance there is that the student

will develop his or her own particular structure of learning. The syllabus designer and the teacher need to have faith that this is for the best.

The teacher's role is to help the student to see how the various parts of what he or she is producing or creating are related to each other and to other students and texts in many different ways. If this can be done, then the class as a whole may develop its own dynamic as a Chaos system. When the teacher and syllabus designer realize that we cannot control what is happening in our students' learning in the ways we like to think we can and should, the teacher and syllabus designer may find ways of participating in the self-organizing system of the class, or going with the flow, instead of trying to control it.

This letting-go will also mean that the way we test students will have to change. And so the way we presently think of objectives or goals needs to change.

In the environment of the classroom seen from the perspective of Chaos Theory, the answers to research questions may change the thought processes that produced them as much as the answers will actually change the questions themselves. When we understand this environment as a natural organic thing, as an open, self-regulating, a-periodic, non-linear complex system that shapes and is shaped by the feedback relationships between its various elements, we have taken a step towards an ecology of language learning. As we develop an ecological perspective, the ways we teach and research what is occurring in the classroom will have to change as our definitions of learning and teaching must change in response to the ethical concerns such an approach implies, as these concerns apply to a wider social ecology already.

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