Complexity in the Language Classroom

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Abstract

"Immense" implications of the "new science" of complexity for the human disciplines were predicted by Waldrop in 1992. Since then, Larson-Freeman (1997) has commented on complexity and language learning, and Van Lier (1996) has referred to the importance of interactions in the complex dynamic system that is the classroom. Applied linguists are thus beginning to examine this way of describing the learning environment that promises to explain many of its inconsistencies through an alternative paradigm in which interaction (connectivity) and emergence (the generation of new higher levels of structure from the interactions of the parts that comprise them) comprise the learning content. This paper gives an overview of complexity theory and briefly describes an attempt to apply it in language classrooms in a Korean university.

1. Introduction

Van Lier (1996) suggests that: "it is useful to regard the classroom as a complex adaptive system" (1996:38) in which "details are all that matters" (Gould 1993) and that "it is fruitless to search for causal relations" (Van Lier 1996:38). Larsen-Freeman also draws a number of chaos/complexity parallels in the language class: "languages go through periods of chaos and order as do other living systems. Furthermore, their creative growth occurs at the border between these two" (1997:158). This borderline between "order" and "chaos", or the point at which the system is about to become chaotic (e.g. just before an avalanche) has been termed "the edge of chaos" by Waldrop (1992:198), who also coined the term "life at the edge of chaos" to describe the capacity for learning that complex adaptive systems have when they are neither settled nor chaotic - a concept with various implications for the language classroom:

> The educational context, with the classroom at its center, is viewed as a complex system in which events do not occur in linear causal fashion, but in which a multitude of forces interact in complex, self-organizing ways, and create changes and patterns that are part predictable, part unpredictable. Such changes must be analyzed from the bottom up. (Van Lier 1996:148)

Larsen-Freeman sees "many striking similarities between the new science of chaos/complexity and second language acquisition" (1997:141). One of the major tenets of complexity theory is that it is "a science of process rather than state, of becoming rather than being" (Gleick 1987:5), offering an "alternative to the linear, reductionist thinking that has dominated science since Newton" (Larsen-Freeman 1997:142), and has been responsible for the "scientific" dissection of linguistics into static constituent parts (morphology, syntax, phonology, etc.), despite the fact that language *use* involves

an active process (cf. Saussure's "parole" and Chomsky's "performance") and is "undeniably dynamic" (Larsen-Freeman 1997:147). Complexity theory allows us to view SLA as a dynamic, complex[1] non-linear process that is open[2], self-organising[3], adaptive[4], unpredictable, and sensitive to initial conditions and feedback:

> A contingent view of language and language-education negates the causal determination of both, but is compatible with a view of development as chaos-with feedback, and a view of organisms as not self-contained but complemented by other organisms, in the way that genetic information is distributed across different genes which complement one another. (Dawkins 1976)

> … we can neither claim that learning is caused by environmental stimuli (the behaviorist position) nor that it is genetically determined (the innatist position). Rather, learning is the result of complex (and contingent) interactions between individual and environment. (Van Lier 1996:170)

2. Overview

A popular causalist view in the 19th century was that if observers knew the position and velocity of every particle in the universe, it would be possible to predict every future event. However, in the 20th century, quantum physics demonstrated that: i) it is not possible to determine both the position and velocity of an electron (at the same time); and ii) that the very act of observing the atom changes its properties (Heisenberg 1958). Another blow to previously unchallenged scientific "truths" came in the 1930s, when The mathematician Godel showed that every mathematical system contains propositions that cannot be solved within that system (Godel 1931). Thus in propositional logic it is possible to derive "G => not-G" ("The statement ‘G' implies the statement ‘not-G'"), just as "rules" of grammar can produce a grammatically correct but illogical proposition:

> "This sentence is false".

Such findings were indicative and symptomatic of the shift away from reductionist thinking in the 20th century. The mechanistic view of the universe which had predominated till then, was found to be an inadequate descriptor of events at quantum, cosmic, and even "down-to-earth" levels (e.g. forecasting the weather, explaining the "flocking" of birds [Waldrop 1992:239] and the "shoaling" of fish), causing scientists to search for new ways of defining reality. The new sciences of complexity, systems and networks represent such attempts, and offer exciting perspectives on our environment and the way in which we inhabit it. Recognizing that the universe is integrated and yet incomprehensible in terms of mechanistic or linear thinking, these disciplines deal with emergence[5], innovation, learning and adaptation. Systems-thinking tells us that relationships are more important than isolated entities (Wheatley 2001) and complexity amplifies this, pointing to connectivity[6] as the essential characteristic of complex systems, the parts interacting to produce

self-organisation, from which unpredictable higher-order structures emerge. Thus Von Helmholtz's prediction in 1854 that the entire universe would run down (based on the second law of thermodynamics, i.e. that systems tend towards entropy), was shown by Prigogine to apply only to closed systems (without any input of energy). Systems open to new matter and energy (e.g. clouds of star-forming gases, or autonomous learning environments!) in fact tend to shift from disorder to order, with spontaneous large-scale restructuring (Smith & Gemmill 1991). Closed systems do indeed come to rest at a predictable point (the attractor) when the energy equalises out (e.g. a pendulum), but in complex, non-linear, open systems (with continual energy input), the number of interactants in the system and the amount of energy being inputted causes "strange attractors" to appear, these being potential resting points for the system, which continues to follow similar (but never identical) cycles approaching infinite thinness, "but still constrained within the limits of the attractors." (Taylor 1994:203). In this way a global pattern can emerge, despite the "chaos" and unpredictability of local details (Mohanan 1992:650). Increasing the number of interactants and the input of energy causes the system to become more complex and "chaotic", but decreasing the number of variables makes it possible to have a small number of attractors, and to contain the chaotic behaviour of the system within strict boundaries (still unpredictable on the local level).

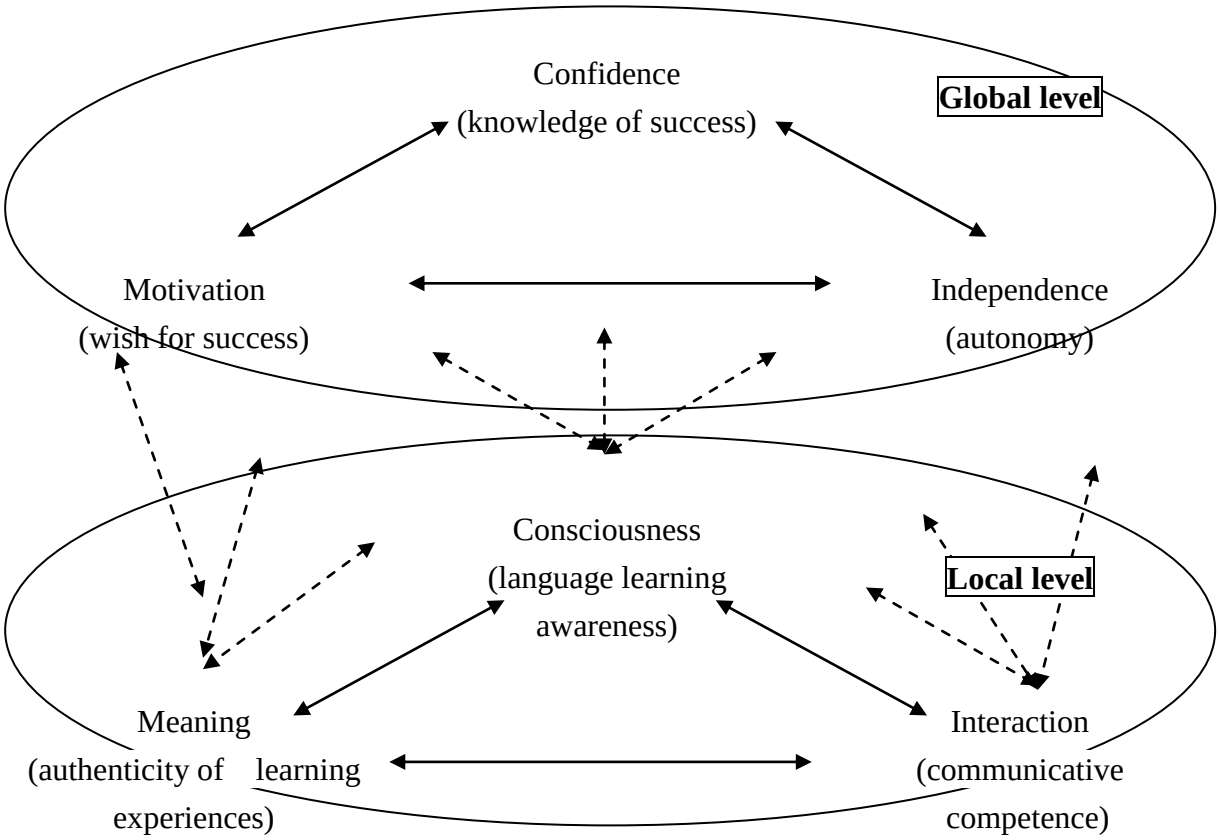
3. The curriculum and complexity theory

The concept of a classroom "on the edge of chaos" (i.e. in a maximum state of learning), sensitive to every variation in input (e.g the difference between a smile and a shrug of the shoulders on the part of the teacher), "open" to new input (interactional, linguistic, affective, socio-cultural), "adaptive" to changing learning needs and preferences, and with new learning structures "emerging" from the "connectivities" between participants, was inherent in a "CMI curriculum" recently developed and trialed by the author in a conversation programme for university students, in the Republic of Korea. In view of the importance of interactions, relationships, trust and intuition (Wheatley 2001) in the new sciences (cf. recent literature on autonomy, affect and perceptions in SLA studies), this curriculum viewed the goal of communicative competence as secondary, and concentrated rather on the promotion of Confidence, Motivation, and Independence (CMI) at a global level, and Consciousness, Meaning and Interaction at a local level.

Starting from Allwright's (1984) premise that students do not learn what the teacher teaches, and building on studies into autonomy (Pemberton *et al.* 1997) and affect in the classroom (Arnold 1999), it was acknowledged that each student reacts differently to all the academic, affective and ecological (Van Lier 2000) stimuli in the classroom, and that every lesson is a totally different learning event, with multiple, unpredictable learning outcomes. Viewing the classroom as a complex, dynamic, open system, provided a means of approaching this situation, through awareness (on the part of the teachers), and through the use of the two CMI triads (figure 1, above) as attractors (relatively stable reference points) for assessment and evaluation purposes. As Waldrop observes (1992:279), "complex behavior need not have complex roots", and "even some very simple systems could produce astonishingly rich patterns of behaviour" (1992:66). Focusing on

these two triads ("Were my students more confident, motivated and independent as a result of today's lesson?" "Did today's lesson contain more awareness [consciousness], meaning and interaction?") therefore provided teachers with non-linear benchmarks for their classes, these "learning-signposts" being conducive to the promotion and emergence of autonomy, self-directed learning, learner-training, and facilitative teaching (the teacher as language resource).

As can be seen in figure 1 (below), the curriculum was viewed on global (long term) and local (classroom) levels, with each constituent part free to interact with every other part, the six principles being attractors (see above) that provided reference points for and catalysed the sort of emergent learning behaviour that would result. Just as the weather cannot be predicted locally (e.g. in a school playing field), though the climate and the weather over a large area (e.g. a county/province/state) can be quite successfully predicted, conditions in any given classroom will not necessarily conform to the defined syllabus (whether negotiated with the students or not), as unforeseen interactions and inputs cause changes of emphasis. A course of study can, however, follow a defined direction in the long term. Applying this concept to the two triads in the CMI curriculum (figure 1, above), local results (Consciousness, Meaning, Interaction) could be observed and discussed in the classroom (teacher as counsellor), and global results (Confidence, Motivation, Independence) aimed for and evaluated in the longer term.



*dotted lines represent various interactions between levels.

FIGURE 1: THE CMI CURRICULUM

4. New classroom roles

A feature of complex dynamic systems is that continuing energy input can result in exponentially expanding interactions, and minor differences in initial conditions can result in completely different outcomes (e.g. the "butterfly"[7], "camel's back"[8] and "avalanche"[9] analogies; cf. Kirshbaum 1998). Thus seemingly insignificant interactions in the classroom are part of the whole process of growth, setting off further interactions and learning experiences, and learning outcomes can diverge enormously (Gleick 1987:8):

Different perspectives, knowledge and strategies create cognitive conflict in the participants, and in the resolution of such conflict, in the context of social interaction, new perspectives, knowledge, and strategies are created. (Van Lier 1996:191)

Allowing for such instances and being ready to accommodate for and discuss them are examples of the role-change inherent in this complex approach to the language classroom. The recognition that every learner was different, with differing learning needs, preferences and perceptions, also implied that they should take on responsibilities previously "owned" by the teacher, and led to a view of teachers as "helpers", counsellors, "learning advisors" and learning resources ("knowers") (Carver 1982; Littlejohn 1983:595; Dickinson 1987; Hunt *et al.* 1989; Kelly 1996), extending the controller/facilitator continuum (Harmer 1983). In this view, the teacher becomes a skilled manager of human beings with access to a body of language and learning knowledge (Hunt *et al.* 1989:211):

> The ideal helper is warm and loving. He accepts and cares about the learner and about his problems, and takes them seriously. He is willing to spend time helping. He is approving, supportive, encouraging and friendly; and he regards the learner as an equal. As a result of these characteristics, the learner feels free to approach him and can talk freely and easily with him in a warm and relaxed atmosphere. (Dickinson 1987:122)

Kelly (1996:95/96) describes the macro- and micro-skills needed by this newly-defined teacher, and thus describes the new roles in the "complex" classroom (table 1 & 2):

TABLE 1: THE MACRO-SKILLS OF LANGUAGE COUNSELLING (KELLY 1996:95),

Macro Skills	Description	Purpose
Initiating	introducing new directions and options	to promote learner focus and reduce uncertainty
Goal-setting	helping the learner to formulate specific goals and objectives	to enable the learner to focus on a manageable goal
Guiding	offering advice and information, direction and ideas, suggesting	to help the learner develop alternative strategies
Modelling	demonstrating target behaviour	to provide examples of knowledge and skills that the learner desires
Supporting	providing encouragement and reinforcement	to help the learner persist; create trust; acknowledge and encourage effort
Giving feedback	expressing a constructive reaction to the learner's efforts	to assist the learner's self-awareness and capacity for self-appraisal
Evaluating	appraising the learner's progress and achievement	to acknowledge the significance of the learner's effort and achievement
Linking	connecting the learner's goals and tasks to wider issues	to help establish the relevance and value of the learner's project
Concluding	bringing a sequence of work to a conclusion	to help the learner establish boundaries and define achievement

TABLE 2: THE MICRO-SKILLS OF LANGUAGE COUNSELLING (KELLY 1996:96).

Micro Skills	Description	Purpose
Attending	Giving the learner your undivided attention	to show respect and interest; to focus on the person
Restating	Repeating in your own words what the learner says	to check your understanding and to confirm the learner's meaning
Paraphrasing	Simplifying the learner's statements by focusing on the essence of the message	to clarify the message and to sort our conflicting or confused meanings
Summarising	bringing together the main elements of a message	to create focus and direction
Questioning	using open questions to encourage self-exploration	to elicit and to stimulate learner disclosure and self-definition
Interpreting	offering explanations for learner experiences	to provide new perspectives; to help self-understanding
Reflecting feelings	surfacing the emotional content of learner statements	to show that the whole person has been understood
Empathizing	identifying with the learner's experience	to create a bond of shared

	and perception	understanding
Confronting	surfacing discrepancies and contradictions in the learner's communication	to deepen self-awareness, particularly of self-defeating behaviour

From these tables, it can be seen that this redefined teacher's role is not an abdication of responsibility, but requires professional knowledge and skills in every aspect of learning. Thus, in the study carried out at Andong University, Korea, teacher-training was an integral part of the whole, helping teachers to view the relationships and interactions in their classes as the most important events, indeed as the "learning content". A major challenge for many teachers was the facilitative nature of this approach, so that the topic of learning "how to relinquish power, as well as how to provide useful information and advice to learners" (Skehan 1998:262), was a common one in teachers' meetings and informal teacher/teacher conversations especially in the first two years of implementation (1997, 1998).

5.Results

As already mentioned, complexity is a science of process, and evaluation of the programme focused on the process of learning and of attitude change – were the students (and teachers) becoming more confident, motivated and independent, and did they perceive themselves as such? This evaluation was carried out through six triangulated research instruments (appendices A – E), one of which (appendix E) involved interviewing the teachers on the programme, in three sessions, each six months apart (Finch 2000). When asked "Have you noticed any attitude changes in yourself during the programme?" (Appendix E, question 5), not only did teachers notice their opinions and attitudes changing in favour of the programme ethos, but they were happy to acknowledge this[10]:

> I think my role as a teacher has certainly changed from controller to the other side of the spectrum.

> I think I'm more positive towards letting the students make decisions in class. … It's been really weird for me to do that. … Sometimes I feel bad because I'm not standing in front of the class talking to them. … I'm still working on that paradigm shift in my head.

Teachers also saw notable attitude change and improvement in CMI and communicative competence in most of their students (cf. Appendix E, question 4), and the holistic task-based format (used as a vehicle for CMI) was seen as an appropriate and facilitative means of giving the students the opportunity to use the target language in a non-threatening learning environment[11]:

> I see trust in the students. The trust inspires confidence, the confidence inspires motivation, and the motivation inspires learning.

> I noticed an extreme attitude change in some of my classes from the first semester to the second semester.
>
> I've seen noticeable increases in their willingness to have conversations in English, and some classes have gone from not being particularly interested … to being pretty hungry for it. Now they always come to class on time and are very enthusiastic and are rightfully proud of their accomplishments.
>
> [In the class I had for a whole year] they think themselves much better [with an] average 20% increase on the self-assessment instrument. In that class there are some attitude changes for the better.

6. A learning model

The formative nature of the study meant that feedback from regular student questionnaires and teacher meetings (and the research instruments) were inputted into the programme as it progressed, encouraging growth, self-organisation, and new emergent structures, as appropriate. Description, verification and representation are difficult in this situation, but it has been possible to derive a learning model (figure 2, below) based upon reviews of the literature, the results of the study, and the continuous feedback from students and teachers. This model attempts only to show the concepts involved, without attributing linear (causal, temporal), or comparative characteristics. Initial ingredients of this "learning soup" (figure 2) are shown as: i) a humanistic view of education; ii) a sensitive classroom environment; iii) attention to affect; iv) promotion of autonomy; v) atmosphere of trust; vi) formative feedback; and vii) recognition of the classroom as a complex system. There is no indication of any given order in which to add such ingredients (despite the numerical listing above), and no attempt to differentiate roles. Classrooms in which these factors were present were found to be ones in which the two CMI triads flourished, and complexities of learning facilitated.

Any of the factors depicted in figure 2 (below) and mentioned above (i – vii) can be seen as learning tools (components) or learning contexts (agents), both interacting with the others, and providing the means (context) whereby the interactions occur. "Attention to affect" (for example) can therefore be seen as working in the context of the sensitive classroom environment; the "atmosphere of trust" can be seen as an effective context for the humanistic view of language learning; or all of the ingredients can be seen as contexts for each other[12]. In the complex, adaptive world of the language classroom, these are all possibilities, and strict roles cannot be specified. These student-centred ingredient factors are shown in figure 2 as feeding into the task-based, problem-solving "melting-pot", which becomes the catalyst and the vehicle for the various complex interactions - flexible enough to allow unpredictable events to appear and play themselves out, yet sufficiently organised to provide a framework and a common direction for subsequent

"emergent" higher-order structures, which in this case are identified as: i) positive student/teacher attitude change (CMI); ii) communicative competence, and iii) "learning for life".

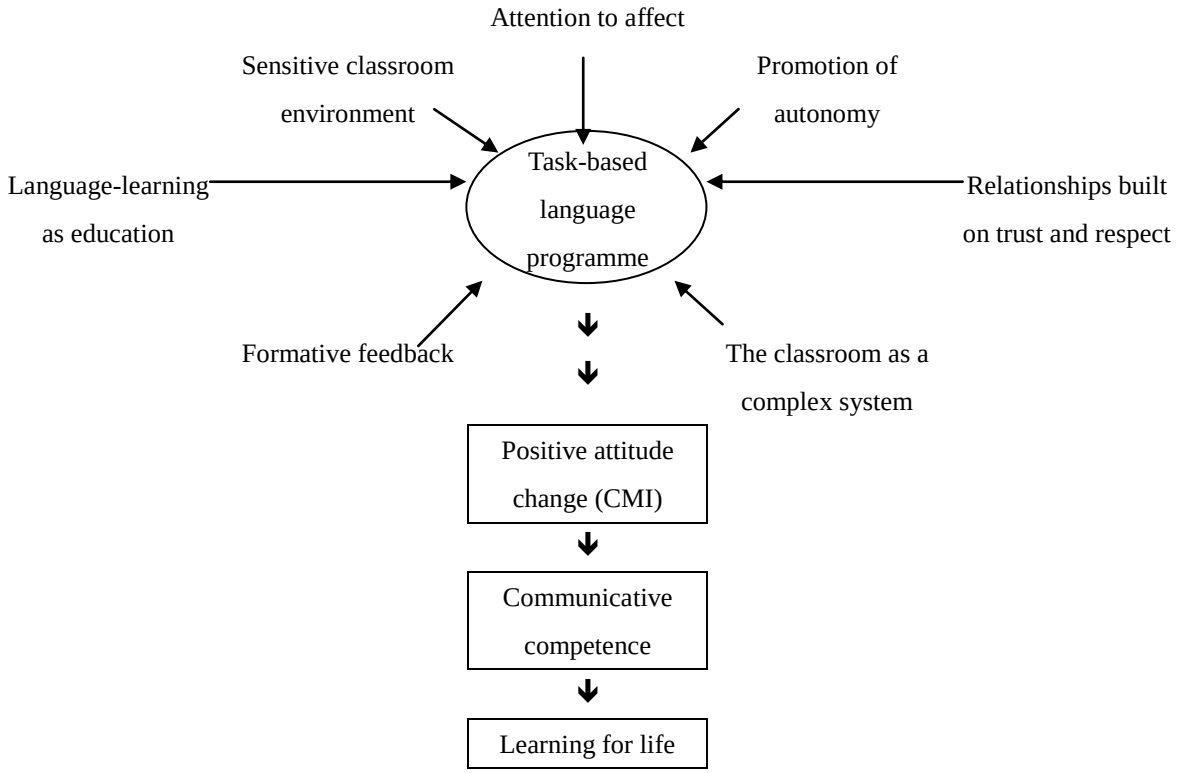


FIGURE 2: A FORMATIVE LEARNING PROCESS

The model therefore suggests a holistic task-based teaching/learning approach for the foreign- and second-language classroom, as a means of processing unpredictable constituent factors, which lead to more predictable global outcomes, themselves indicators of continuing internal processes. Just as the Paduk[13] (바둑) master balances "form" (technique), "shape" (pattern-recognition), "instinct" (lateral thinking), "influence" (long-term possibilities) and "territory" (short-term gains), when choosing the next move, the English teacher can provide the appropriate learning experience for the appropriate student at the appropriate time, by promoting awareness (and acquisition) of learning strategies, by encouraging learners to investigate the language through meaningful interaction (Vygotsky 1986:99) in a non-threatening environment, and by initiating reflective self-evaluation:

Teachers can achieve this kind of environment only through their efforts to establish informal and warm-hearted interaction between teachers and learners, as well as among learners themselves. This friendly interaction is, in our opinion, the most essential factor in successful language learning. (Sano *et al*. 1984:171)

What has "emerged" from this study is a new way of looking at the language classroom: not only an affective extension of the process paradigm described by Breen (1987), but also a complex, or "chaotic" extension of the education paradigm in general (cf. Houghton 1989). In this dual-extension, higher structures of learning (CMI) emerge in a dynamic, complex, trust-based learning

environment, in which linguistic aspects (accuracy, vocabulary, fluency, etc.) are important as media for acquisition of learning (and social) skills (Aoki 1999:154), and which are demonstrated in changing perceptions and beliefs regarding the nature of learning and of language.

There are no long-term results to indicate that the approach in this study was successful beyond the programme, and the best that can be said is that it worked in these conditions, at this point in time. If we ask to what extent this was generalisable (i.e. would another research team, dealing with similar students/teachers/conditions/etc. have similar results?), complexity theory tells us that minimal differences in input can produce large differences in outcome, and that the question, in this form, is meaningless. If we examine the question in broader terms, however, asking whether a similar approach would produce equivalent growth and positive attitude change, then observations, beliefs and perceptions over the period of research suggest an affirmative response – that a programme which recognises the special *process* nature of learning, which sees the language classroom as a dynamic complex learning environment, which sees "education-of-the-whole-person" as a valid goal of language learning (Finch 1999), which reflects upon and transforms itself through formative evaluation, *and* which fosters unconditional trusting relationships between participants, will be in continuous transition (growth), and will encourage attitude change (including beliefs and perceptions) in its participants. This change will be positive in terms of learning effectiveness (for the students) and in terms of professional practices (for the teachers), though outcomes will be unpredictable at the local level, and the changes in learner-teacher relationships will probably involve a politic reappraisal of "power of control in interpersonal relationships" (Rogers 1980:294; cf. Aoki 1999:154; Van Lier 1996:167) and of the hegemony of ideas that native speakers of English often take for granted (cf. Phillipson, 1992:72).

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