Complexity Theory, Visible and Invisible Pedagogies in a Kindergarten Classroom

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Abstract: Complexity theory suggests that classroom processes may be better planned in terms of emergent order rather than imposed control. 'Order' is ambiguous in kindergartens, being both imposed control ('keeping order') and emergent self-organization, and kindergarten children inhabit the dual worlds of control and order. By examining communicative interactions to achieve order in a kindergarten, this paper indicates relationships between emergent order and imposed control in a kindergarten classroom. The large kindergarten class presents the teacher with issues of classroom control, premising classroom processes on control rather than emergent order, e.g. by according asymmetrical communicative language rights to students and by controlling their communicative exchanges. Control also influences much kindergarten pedagogy, leading to, and being perpetuated by, traditional, teacher-centred teaching, with minimal student engagement and explicit hierarchical teacher-student relations. Teachers plan lessons that restrict students' freedom and control the context in which they learn, recapitulating Bernstein's 'visible pedagogy', in which the control of the teacher over the students is manifest. Pedagogy may be 'invisible' in kindergarten classrooms: the teacher structures the classroom but then stands back and allows the children to learn through self-organized discovery, experience and practical activity; there is a greater semblance of freedom, choice, and implicit control. The emergent order of the kindergarten classroom, modelled on invisible pedagogies, demonstrates the benefits of replacing conceptions of classroom control with those of creating the conditions for learning, emergent order and children's self-organized learning, i.e. aspects of complexity theory. Illustrative episodes of this in a kindergarten class are presented.
Keywords: complexity theory; schooling; education; Macau; kindergarten; pedagogy

Introduction

This paper presents three scenarios and then examines them through the lens of complexity theory. The paper also examines the British sociologist Basil Bernstein's theory of 'visible' and 'invisible' pedagogies which is interpreted through complexity theory. Bernstein differentiates between two orientations of visible (explicit) invisible (implicit) pedagogies; this is addressed through examples of a teacher in a large kindergarten classroom. This paper takes this exploration further and indicates how the theory of visible and invisible pedagogies coincides with the theory of self-organization and emergence derived from complexity theory. This paper will discuss the benefits of replacing conceptions of classroom control with attributes of complexity theory. The paper suggests that complexity theory may be largely a reworking of Bernstein's views of visible and invisible pedagogies.

Complexity Theory

For some, the study of complexity stands for nothing less than a major revolution in science. This view, however, has been increasingly challenged by complexity theorists, who suggest alternative ways of looking at the world in ways that move beyond simple cause-and effect models, with their ground rules of linear predictability, and replace them with non-linear and holistic systems (Santonus, 1998). Morrison (2002: 5) defines the notion of complexity as an

organism that dynamically connects and influences its environment and, in turn is influenced by the environment. According to Stacey (2000) complexity theory should encourage creativity and efficiency to emerge spontaneously within organizations rather than solutions being imposed and decisions on the boundaries being fixed. From an educational perspective, as Tosey (2002) reports, complexity refers to the condition of the universe that is integrated and too complex to comprehend in simple linear ways. Battram (1996) remarks that complexity does not only include a number of the components but how these components are interconnected.

Complexity theory can be seen as a complex system that consists of a collection of interacting parts that function as a whole, with no fixed boundaries. As such, a complex system consists of independent elements that act together to bring forward organized behavior in the system as a whole. Kauffman (1995) examines complexity theory as 'complex adaptive systems', with components at a certain level acting as pillars for other components at another level. In more general terms, complexity theory is a conceptual framework used to analyze the behavior of systems of a large number of interrelating components. Morrison suggests that 'a central pillar of complexity theory is self-organization; it contains several features: adaptability, open systems, learning, feedback, communication and emergence' (Morrison, 2002:15). A system in complexity theory can be described as a collection of interacting parts which function together as one unit and causes new elements to forms, new structures, new phenomena and new rules of behavior to arise (Morrison, 2002). Its explanatory framework and concepts, which include emergence, evolution, self-organization and embodiment, have been adopted by many thinkers in humanity.

Self-organization

Self-organization is a key characteristic of complex systems. Self-organization as Stacey, 1992: 183-4) suggests is a process through which teams and groups spontaneously structure themselves around issues and making decisions for themselves, without any fixed boundaries from management hierarchies. Stuart Kauffman (1995) referred to self-organization as 'order for free', where order arises naturally and unexpectedly. It is suggested that emerging sciences of complexity theory implies that 'order is not all accidental but that the vast veins of spontaneous order lie at hand,' (Kauffman, 1995: 8).

Stacey suggests that:

> A complex system produces order of a changeable and diverse kind that comes about in a spontaneous, emergent way. It has not been programmed and there is no blueprint, grand design or plan. Furthermore, this spontaneous self-organizing activity, with its emergent order, is vital for the continuing evolution of the system and its ability to produce novelty. However, what form that order takes – that is, the global pattern of behavior, the system-wide strategies – cannot be predicted from the rules driving individual agent behavior' (Stacey, 2000: 290).

Thus, order can be referred to as a global pattern of behavior that emerges and that is unpredictable. Kauffman (1995) believes that such order emerges naturally and spontaneously and that the order in organisms as they evolve has the ability to evolve of itself. Controlled behavior, on the other hand is the opposite of unrestrained unstable, self-organized behavior. In

a kindergarten class, order would be indicated by harmonious pupil-teacher student interactions, whereas imposed control (keeping order) would be indicated by what is or is not thinkable within the frames of a discipline. Controlled behavior is defined as '…some overall coherence or pattern; that is, it is internally connected and constrained' (Stacey, 1992: 157). It is imposed, bounded, and stems from an outside agency.

One of the pillars of self-organization is emergence (Morrison, 2002). As Morrison (2002) suggests, the 'universe' is creative, unstable and emergent, whereby order is not entirely prearranged and fixed. It emerges spontaneously and through self-organization. Even in the precursor of complexity, which is chaos theory, order emerges in the 'strange attractors' configured through multiple iterations of simple equations.

Emergence

Emergence is the essence of self-organization. 'Emergence over time brings new states; old forms die and new forms proliferate' (Morrison, 2002: 10). In other words, if an old system is unable to adapt, it will die and a new system will, therefore, emerge spontaneously, which then creates a new environment. This notion of emergence implies that, given an adequate degree of complexity in a particular environment, new and to some extent unexpected properties and behaviors emerge in the environment. According to (Tosey, 2002:1) 'emergence refers to the way that the behavior and qualities of systems emerge from local, unco-ordinated interactions.' Emergence can create diversity and new opportunities.

Emergence is the partner to 'self-organized criticality' (Bak, 1996. Complexity theory suggests that organisms that are seeking to survive in changing environments, many of which may not be conducive to survival, they differentiate themselves increasingly, to find their own niche in which they can survive. They self-organize to find such a niche; as their external environment changes so they have to change themselves in order to find a new, unique niche. Not only do they change themselves, but, in so doing, they change the environment. This, in turn, rebounds back on the organism, which has to change again, and so on. The process is one of co-evolution (Stewart, 1991). In this never-ending process, the move towards finding a unique niche bring greater differentiation into the nature of the organism. To be able to change constantly requires much creativity on the part of the organism. As organisms and their environments change themselves and each other, moving towards greater differentiation is marked by a necessary move towards the organism becoming more inventive and creative. Such self-organized change and differentiation leads the organism to the 'edge of chaos' – that point beyond simple linear behavior and yet before total chaos. Moving to, and remaining at the edge of chaos is to stand at a critical point – between linearity and chaos – which is 'self-organized criticality'. The emergent diversity mentioned in the previous paragraph is marked by creativity and emergent, self-organized order rather than imposed, fixed and externally mandated uniformity.

Emergence cannot be predetermined. As Morrison states, it is not possible to predict the results of that emergence as systems emerge over a period of time (Morrison, 2002: 9). Morrison writes:

> As new systems and structures emerge, often in unpredictable way, so they themselves generate new environments. The argument for emergence here is that innovations and changes rarely happen in isolation, but in tandem (Morrison, 2002: 25).

This concept holds that systems comprise many interacting elements that are often intricate and which cannot be predicted; because of these interacting elements, new structures and new rules of behavior occur. Each element influences another element and *vice versa*, which then gives rise to emergent new forms. According to Cohen and Stewart (1995), order emerges instinctively and is not imposed by external constriction. For instance, children can transform ideas, resources, actions and behaviors from one thing into something else; thus they can create original meanings and interpretations, as a result can go beyond what is presented in a classroom. Similarly, emergent systems create new opportunities where diversity, variety and heterogeneity are clearly possible (Morrison, 2002). Lewin (1999) refers to emergence as something that occurs in systems that have only some simple rules that direct the interaction of the component parts. Some components and principles of complexity theory i.e. emergence and self-organization can also influence much kindergarten pedagogy, which can be seen through Bernstein's 'visible' and 'invisible' pedagogies.

Visible and invisible pedagogies

Bernstein's earlier works were on *classification* and *framing* of educational knowledge (Bernstein, 1971), then later on *visible* and *invisible* pedagogies (Bernstein, 1975). He described the concepts of classification and framing and related them to structuralist theory of curriculum and pedagogic theory (Sadovnik, 1991). Bernstein (1971) described classification as the degree of maintenance between boundaries and curricula contents (areas of knowledge and subject). The notion of framing refers to the structure of relationship, for example, the location of control over the rules of communication and the degree of control that students and teachers exert over the curriculum and its pedagogy. As Bernstein writes, 'framing refers to interaction, to the power relationships of interaction; that is, framing refers us to communication' (Bernstein, 1975: 153). Thus, classification refers to the nature of differentiation and boundary maintenance between contents; whether content is strong or weak, framing refers to the degree of control over the transmission of knowledge in pedagogic practices. This means that strong framing can be referred to as a limited degree of options between a teacher and students and weak framing implies greater freedom. Later Bernstein extended his work and developed a model of pedagogic practices that examined the inner logic of pedagogic relationships. Bernstein characterized this pedagogy as visible and invisible pedagogy.

According to Bernstein (1975), basic differences between visible and invisible pedagogies in early childhood education concern the manner and degree of specificity in which criteria are transmitted. Visible pedagogies are transmissions that are regulated by explicit hierarchy, explicit hierarchy and explicit criteria. Visible and invisible pedagogies are created by explicit or implicit hierarchy, explicit or implicit sequencing rules and explicit or implicit criteria. As Bernstein writes, 'The more implicit the manner of transmission and the more diffuse the criteria then the more invisible the pedagogy,' (Bernstein, 1975: 116). By contrast, the more specific the manner of transmission, the more the pedagogy is visible (Bernstein, 1975). Visible pedagogies are recognized through strong classification and strong framing, and invisible pedagogies are

recognized through weak classification and weak framing. Bernstein (1975) suggests that invisible pedagogy has at least the following characteristics (Bernstein, 1975: 116):

1. Where the control of the teacher over the child is implicit rather explicit.
2. Where, ideally, the teacher arranges the context which the child is expected to re-arrange and explore.
3. Where within this arranged context, the child apparently has wide powers over what he selects, over how he structures, and over the time-scale of his activities.
4. Where the child apparently regulates his won movements and social relationships.
5. Where there is a reduced emphasis upon the transmission and acquisition of specific skills.
6. Where the criteria for evaluating the pedagogy are multiple and diffuse and so not easily measured.

Visible and invisible pedagogies refer to the transmission from point of view of the *acquirer* rather than that of the transmitter. The differences between visible and invisible pedagogies lie in how overt discipline, structure and control are demonstrated in a classroom. In visible pedagogies the teacher controls the structure in which students communicate, and there is one-way transfer of information directly from the teacher to the students with minimum or no student discussion. On the other hand, invisible pedagogies involve less overt instructor participation and more student action. Students are encouraged to seek their own knowledge sources to deepen and enrich their learning experiences. Visible pedagogy is created by explicit hierarchy, explicit sequencing rules and explicit and specific criteria, whereas invisible pedagogy is created by implicit hierarchy, implicit sequencing rules and implicit criteria. This is not to deny the role of the teacher, but the teacher acts as a facilitator rather than a controller. The teacher facilitates emergent order rather that imposed control.

Hierarchy: explicit and implicit

Hierarchical rules may be explicit or implicit. The rules of hierarchy define the interactional relationship between a teacher and a student and thus determine the rules of order and manner of the students which were established by the teacher. If the hierarchical rules are explicit, the power basis of the relationship between the teacher and student is apparent (Bernstein, 1975). This is very clear in a visible pedagogy. In an invisible pedagogy, as its name suggests, this power is unseen.

Sequencing rules: explicit and implicit

As Bernstein states, the sequencing rules that regulate the transmission may be explicit or implicit. If the sequencing rules are explicit, then (if we are considering a classroom) then those rules control what the students should be able to do in the class. Explicit sequencing and pacing rules are exemplified in syllabi, in a school's curricula and in how and when both the teacher and student should proceed in the teaching and learning process (i.e. strong classification and framing). Bernstein argues that hierarchical rules are regulative rules, that is, how students should behave and act, whilst sequencing-pacing are criterial rules, which are methods of instruction or teaching (Bernstein, 1975). Strong classification and framing, fixed and overt hierarchies from a controlling teacher, are the stuff of a visible hierarchy, whereas weak classification and framing, mutable and emergent order is the stuff of an invisible hierarchy.

Criteria: explicit and implicit

In explicit criteria, expectations are specific, thus the child will always know what is expected of him or her (Sadovnik, 1991). The rules of legitimate expectations are made clear by the transmitter (teacher). For example, the transmitter gives the acquirer continuous comments on his or her performance so that the child is aware of what are missing in the production. This means that emphasis is given to the performance and to the degree to which it meets the criteria. An example that Bernstein gives is of infant school in which the students are given a small piece of paper, some paint and a paint brush. The children are asked to paint something. While the children are painting, the teacher walks around and looks at the paintings and the teacher might say, 'That's a very good house, but *where* is the chimney?', or 'There are no windows in your house' (Bernstein, 1975: 119). Here the child is aware of what is missing and the teacher acts more as a facilitator than a transmitter; it is an invisible pedagogy in that the teacher is not directing and forcing, but structuring suggesting, and facilitating; there is choice and self-organized order emerges (the final picture). In implicit criteria, the teacher is more likely to do this indirectly, where the acquirer creates the criteria. For instance, the teacher will probably say, 'What's this?', in this case, the student is aware but vaguely of what is missing from his or her product. Thus, the expectations are multiple and diffuse (Bernstein, 1975: 119). In this way the student has more freedom to create his or her individualized criteria for appraisal (Sadovnik, 1991).

With regard to control, Bernstein suggests that there are strong boundaries between space, times, act and communication in visible pedagogy (strong classification and framing). The hierarchy is therefore, explicit whereby time is regulated by explicit principles. Here strong boundaries are elemental techniques of power. If a child learns these rules then he/she acquires the classification: the degree of boundary maintenance between contents. As Bernstein writes 'the language of social order control is relatively restricted, and the relationships of control, explicitly hierarchical' (Bernstein, 1975: 135).

However, if the pedagogy is invisible then there is weak classification of space and time. In invisible pedagogy, the hierarchy is implicit, with an absence of regulation of a child's act, communication, space, time and progression. Hierarchal power is realized by strong boundaries and distinctiveness between subjects and power. Control lies in the process of interpersonal communication where there is weak classification (Bernstein, 1975). This means that the relations of the authority and conduct are immediately apparent to the student. Invisible pedagogy therefore requires self-regulation, which means that there is a relative absence of strongly marked control (regulation) of a child's act and communication. Therefore, common attributes associated with self-regulation can be heightened by students' keenness to participate, while visible pedagogy calls for external control in this case, a teacher. Hierarchical rules are put into effect not tacitly, but through control of boundary relations in teaching, for example, when students are only allowed to speak to the teacher after requesting permission to do so, usually by raising a hand and waiting for the teacher to respond. This makes teaching a prospectively asymmetrical power relationship between a teacher and a student.

The work of Eisner (1985) resonates with Bernstein's visible and invisible pedagogy in his notion of instructional and expressive objectives. With an instructional objective the focal point

of the teacher and the children is to attain a specific behavior or range of behaviors. Here the teacher knows what to expect as an indication of achievement, as the children's behaviors are unambiguously defined. By contrast, an expressive objective does not specify the behavior of the children but rather to that which they can encounter through various learning activities. With expressive objective both the teacher and the student can explore, defer, or focus on interesting and important issues that are meaningful to the enquirer. Furthermore, as Eisner reports, an expressive objective is the 'outcome of an encounter or learning activity which is planned to provide the student with an opportunity to personalize learning' (Eisner, 185: 69). Expressive objectives can create an environment for where skills and understandings can be expanded. An instructional objective sits comfortably with a visible pedagogy, whilst an expressive objective sits more comfortably with an invisible pedagogy. Both expressive objectives and invisible pedagogies create diversified learning contexts whereas in instructional objectives and visible pedagogies create homogeneous learning contexts.

Teachers can plan lessons in such a way that can restrict students' freedom and control and the context in which they learn, recapitulating Bernstein's 'visible pedagogy', in which the control of the teacher over the students is manifest. Pedagogy may be 'invisible' in kindergarten classrooms: the teacher structures the classroom but then stands back and focuses on child-initiated activities rather than teacher-student interactions. This conceptual framework can be used to model everyday classroom practice and will be exemplified and considered in more detail through this paper.

Scenario 1

A kindergarten in Macau had recently appointed a part-time English teacher to teach English as a second language to a class of 36 students. The teacher had decided to use interactive discussion and 'hands-on' approaches to help students learn and apply concepts in English. The teacher used 'props' or 'manipulatives' to help children further language and vocabulary development. Because of the large kindergarten class, the teacher had to plan the lessons to set conditions so that there would be full *control* of the class. One particular activity was designed to help the children learn mainly through play and interactive activities. This specific activity was to have a small group of students participate in a role-play. They were asked, therefore, to stand in front of the class and take part in the role-play. While the teacher was focusing on the actions and roles of the students in front of the class, the rest of the children started forming small groups where they started chatting and what would seem to many, to become a class out of control. In order to gain control (keep order) of the class during this activity, the teacher yelled and asked everyone to be quiet and to focus on the role-play. The teacher wanted to pupils to maintain attention and sit quietly while concentrating on the activity.

After a few failed attempts, the teacher decided to stand back and observe what was actually happening, she learnt that order emerged through self-organized discovery. Here the students spontaneously structured themselves into groups and created their own learning environments. What the teacher did not realize at first was that the children were actually engaging themselves in the activity and, in fact, were talking amongst themselves about the activity. The teacher had planned a lesson that was built up on closed boundaries, giving the students very little freedom, i.e. a visible pedagogy with strong teacher framing. But when the teacher stood back, the boundaries weakened and the principles of learning became tacit – invisible.

This example demonstrates how a teacher plans lessons that deliberately restrict students' freedom, and control the environment in which they learn, reiterating Bernstein's (1975) work on 'visible pedagogy', where the control of the teacher over the students is apparent. The teacher's role in learning is central and becomes the transmitter of knowledge and controller of the activity. The teacher accorded asymmetrical communication rights – that is, the relations and conduct of communication were immediately clear to the students, so that control could be imposed. If a teacher frames transmission strongly, then the learner is placed in a subordinate power position to the teacher's super-ordinate position. Consequently, the order emerged through self-organization. The students interacted in a way they thought fit, as Stacey (2000) suggest, agents in a self-organizing environment respond to others according to their own capability to respond; they formed themselves into groups and arranged their own learning.

The way in which the teacher tried to maintain discipline was more a way of controlling the students rather than enhancing their learning and development; it was overt and imposed control. The danger here is that teachers might be tempted to have control over the students to gain order which may not entirely be appropriate to young pre-schoolers. Children's curiosity may run the risk of being damaged when they are constantly being told what to do and how to behave.

However, this simple vignette shows how self-organized order emerged that actually promoted more learning than the teacher could have planned. As Kauffman plainly puts it, 'under a vast range of different conditions, the order can barely help but express itself' (Kauffman, 1995: 18). In this scenario we can see how the lesson was intended to be more a visible than an invisible pedagogy. The traditional learning environment promoted more distance retention between the student and the teacher and discourage verbal communication by students. The teacher tried to predetermine the outcomes and to control the learning environment. In an attempt to gain control of the classroom, the lesson was planned to utilize didactic rather then child-centered approaches. However, through the lens of complexity theory we see how order emerged and how self-organization manifested itself. Order appeared spontaneously and naturally without any fixed boundaries; it was inevitable.

Scenario 2

A kindergarten teacher planned a lesson to achieve the program goals and specific objectives, such as students developing confidence in themselves and collaborating with others to solve problems. With these objectives in mind, the teacher decided to incorporate cooperative learning which would involve students working together to complete a task. Students were divided into small groups with five members in each. The task was structured in such a way that the involvement of each member contributed to the completion of the whole, shared task, a 'jigsaw' model of group work (Bennett and Dunne, 1992). The students were informed about what they were to do as a group: they were to listen to one another, support one another and share ideas. As suggested by (Cohen *et al*., 1996), children need to know what is involved in co-operation. This activity involved a small group (task-centred group) of students working together in a jigsaw model. The role of the teacher was implicit, and was characterized by low teacher dominance. This supports (Cohen's *et al.'s*, 1996) views that if a teacher has a role of a wise and experienced member of the group then the attitudes of the group members will tend to be more co-operative and consultative. The success of the task was based on the performance of the group

rather than on the performance of each individual. Through this activity, students were able to clarify and refine personal feelings, thoughts and understandings through sharing and discussion. Here the teacher provided opportunities for the students to clarify and expand their ideas and those of others. This time the teacher withdrew from the groups and allowed the children to learn through self-organized discovery. The children were given an opportunity to explore ideas, share and support ideas and were also provided with opportunity to explore their social, emotional and intellectual competence.

This episode reveals that if a teacher sets the appropriate *conditions* then self-organization will emerge, the teacher creating an environment in which students can learn and explore. Self-organization is an overall pattern of relationships where agents emerge together, simultaneously constraining and also being constrained by each other (Stacey, 2000). Here the teacher wanted to bring the class into a closer relation with its environment. Group work, here, is less about individual students completing a task; it is more about the students working co-operatively and encouraging joint decision-making. Cooperative learning stresses interdependence and promotes cooperation: the collectivity and networking, and internal connectedness of complexity theory. The teacher moved from a teacher-centred approach to a more student-centred approach. Group work development is an essential feature of self-organizing schools (Cohen *et al*,. 1996: 55), thus developing self-organizing groups for emergence to occur, i.e. characteristics of complexity theory. Establishing and maintaining cooperative group norms allows the children to learn through self-organized discovery and experience. It can be remembered that one cannot consider the organism without considering its environment. This is an invisible pedagogy at work, and one which restates the value of a complexity-driven approach to learning. Group work and complexity theory have strong affinities with each other.

Children who find themselves in a well-structured learning environment will know that they can follow their own interests. That is, an environment that provides welcoming and stimulating areas to promote the development of critical thinking skills, foster awareness and provide the support to strengthen, expand and deeper learning, and is clearly visible. Children take on the role of agents in their own learning, when there learning environment is well structured, affectionate, and stimulating. An environment like this may foster children's independence and promote learning. This is a good example of how order (controlled behavior) emerges through self-organization. The children interact with each other according to their own principles of interaction. In the example here, the teacher created an environment in which children could exercise leadership, share knowledge and understanding i.e. some aspects of self-organization. This shows that interactions and dialogues between members of the group can produce coherent behavior, even with the absence of authority imposed from outside. This episode also exemplifies Bernstein's invisible pedagogy. The hierarchical rules are implicit in which the teacher's power and authority was masked and the role of the teacher was that of a facilitator. The students had more freedom to create their own learning environment, which they did: emergent and self-organized order (the group work and the its outcomes) were both the medium and outcome of the activity.

Scenario 3

As part of the English program, the kindergarten teacher arranged a visit to a park/garden. A of class 37 students was accompanied by three teachers. The purpose of the visit was to

encourage the children's interests in the natural world, to develop vocabulary and introduce the children to the many fascinating forms of life. The teacher had pre-scheduled the tour around the park and what the children were to learn. Students were asked to line up in twos and walk in a straight line so that the teachers could control them and keep the group together. After a few minutes into the program, the children were no longer focusing on what was being taught by the teacher, but were more interested in other aspects of their surroundings. Students started to slowly move away from the group and started exploring on their own. They were fascinated by their surroundings and eager to grasp every opportunity to learn something new. But in order to keep the students focused on the pre-planned visit, every now and then, one of the teacher's would ask the children to come back and stand in line; the children did so with some initial reluctance.

Here is a straightforward case of a teacher restricting students' freedom and controlling the context in which they could learn so as to gain disciplinary order. This episode indicates how order is not always predetermined and fixed and how emergent order can occur through learning and recursion. Piaget suggested that the role of an adult was primarily to provide an environment that is stimulating and challenging, and in which children could learn. According to Piaget, young children can discover new and fascinating objects physically without any verbal intrusion of adults (cited in Smidt, 2002). The students were in an environment in which there were interesting things to explore; however, they were bound by traditional teaching (methodology that depends on one-way transfer of information directly from few instructors to many students with minimal or no student discussion), methods of having, and keeping control. According to Goffin and Wilson (2001) teachers should be encouraged to appreciate outdoor activities so as to benefit children's well-being and health, as well as notice further opportunities for children to have key experiences.

Scenario 2 is a good example of an emergent invisible pedagogy, where the learning environment encouraged the students to actively participate but in ways that did not conform to her original plan. The teacher subsequently sequenced her lesson in a way that involved students working together in groups, allowing the students to organize themselves (emerge) into self-chosen groups and then create their own learning environments; one can see how order appeared – emerged – spontaneously. This assumption provided students with an opportunity to interact with their social and physical environment without fixed or predetermined outcomes from the teacher, thereby displaying characteristics invisible pedagogy.

The scenarios reconsidered

Literacy is a cultural practice that influences a child's cognitive development and which emerges in playful interactions with other children. Taking scenario 1 for example, the students were first controlled by strong boundaries of hierarchy and there was one-way transfer of information directly from the teacher to many students with minimal discussion. But when the teacher stood back and allowed students to engage, the students continued to interact and arrive at their own conclusions. This is a good example of emergence – as new structures emerge, they also generate new environments. Looking back at scenario 1, the teacher in this example is highly visible because of the explicit hierarchical rules and where the power basis of the relationship between teacher and pupil is undisguised. The teacher was easily identified by the authority that was symbolically constructed at the front of the class. The teacher stood in front of

class, overlooking all the students, thereby reinforcing her symbolic and actual power. By contrast, if the hierarchical rules are implicit then the relationship is not clearly one of super-ordinate and sub-subordinate, and the teacher is not easily identified as the person in charge. This means that the power basis of teaching is hidden; it is invisible. The acquirers in this case, the children, had greater control of their own movements, activities and communication.

The kindergarten scenarios are examples of emergent order and the reworking of an invisible pedagogy that shows the limits of visible pedagogy. This means that teachers can create environments that stimulate students' learning through planned and unplanned lessons and which allow students to develop self-regulation techniques. Bringing to mind the example of the kindergarten teacher gaining control of the large classroom, we learn that imposed control, whilst they influences much kindergarten pedagogy in the examples here, encouraging traditional teaching methods, with the risk of little student engagement, are also frustrated by emergent, self-organized order. This is an important matter: the teacher should be looking for signs of emergent self-organized order and seeing how to capitalize on this in planning for pedagogy. As we follow the theoretical work of Bernstein (1975), he expands two forms of pedagogic practice – visible and invisible pedagogies. His writings include rules that define progressive and traditional forms of education (Sadovnik, 1991); visible pedagogy is aligned with more traditional methods, whilst invisible pedagogies are underlined by progressivist values.

Similarly, as Dewey (1934, cited in Eisner, 1985) reports that a truly scientific education can never develop if children are treated in the lump, i.e. only as a class; rather each child has a strong individuality and a school must take stock of all the facts in its material. Similar to Bernstein's implicit criteria, Dewey (*ibid*.) writes that if every student has a chance to express himself/herself and to show his or her qualities, the teacher will then have material on which to base her lesson plans. Emergent order of the kindergarten classroom displays the benefits of replacing conceptions of classroom control with those of self-organized discovery and learning, in which teacher intervention in student's learning is to guide their discoveries instead of simply informing and telling them. In this view, educators should be concerned with the child being a learner rather than the 'facts' to be learned; here the learner can be guided to create and learn his or her own knowledge. This view of education concerns the value of the child developing his/her understanding rather than simply acquiring knowledge by transmission (Blenkin and Kelly, 1987).

Kelly (1994) suggests that if educators conceptualize a classroom as an emergent complex system, then teachers and students can become co-participants in its structure and development. In this way, the classroom becomes an organic unit where control emerges from the bottom up, and the system, that is, the classroom can begin to self-organize so that it can meet the needs of those who are a part of it while it continues to grow.

Conclusion

Successful learning is not simply a matter of acquiring knowledge, but involves being able to access knowledge in a form that is appropriately framed and organized. Bernstein's visible and invisible pedagogies make it possible to differentiate the various ways in which a lesson can be organized to promote a learning environment. As the above examples and analysis have shown, complexity theory can have an impact upon education and learning. Classrooms processes can

be better planned in terms of emergent order rather than imposing rules that regulate students' behaviors. Teachers may not be used to the idea of a system (classroom) controlling itself. For many, control requires an individual with power and authority to take charge, whereas complexity theory has made it possible for teachers to believe that a system can possess its own control and order.

This paper has also shown the positive consequences of invisible pedagogy that facilitates active learning in which a child is given – or takes – power to question, probe and explore. The emergent order of kindergarten classroom, modeled on invisible pedagogies, shows that self-organization can rise through the dynamic, adaptive interactions, rather than as a result of external causes or a central controller (the teacher). This idea can enable educators to see how the classroom can be understood as a complex and emergent system.

On the other hand, the paper has also indicated the strong affinities between Bernstein's visible and invisible pedagogies and control and order respectively. Indeed complexity theory suggests, reinterpreting Bernstein, weak classification and framing. This raises an important question of the extent to which complexity theory is simply an updated restatement of Bernstein's views here, or whether it adds to his views. Is it, as Morrison (2005) suggests, perhaps new wine in old bottles, or, indeed, old wine in new bottles? What else does complexity theory add to the analysis of the scenarios, that Bernstein's analysis does not? Complexity theory here was seen to support group work, self-organization and invisible pedagogy and order rather than control. Is that all?

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